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KEYNOTE ADDRESS

A LIFE BEYOND THE GOLDEN ARCHES

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Abstract
Societal expectations of higher education have changed significantly in the past quarter century without equivalent increases in funding. These changes leave a shortfall between the outcomes higher education is expected to provide, the experiences it aspires to offer and those it can deliver. This shortfall has contributed to higher educations McDonaldization (Ritzer, 1996). Although flexible delivery (flexible delivery) and technology-enhanced learning (technology-enhanced learning) are common strategies to narrow this shortfall, I argue that they can actually increase its breadth. I apply Simons' model of *levers of organizational design* to show how higher education can effect cultural changes to help to transform this shortfall into an entrepreneurial gap, thus offering higher education a possible future beyond the golden arches.

"*Can you tell me what we're waiting for, Señor?*"
– Bob Dylan

Expectations of Higher Education and the Shortfall of Resources

In this era of knowledge economies and societies, many governments now recognize that "*universities are critical to the national innovation system*" (Australian Research Council, 2008, p. 2) and hence to prosperity within a highly competitive globalised market for intellectual capital and intellectual property (Organization for Economic Co-operation and Development, 2004; World Bank Group, 2002). Meanwhile, following widespread shifts toward neo-liberalism and "technological and economic reductionism" (Bullen, Robb, & Kenway, 2004, p. 7), many governments have shifted roles from providing and funding elitist higher education (higher education) towards regulating mass higher education (Gee, Hull, & Lankshear, 1996; Moreau & Leathwood, 2006). Expectations of higher education have therefore undergone significant changes (Boarini, Martins, Strauss, de la Maisonneuve, & Nicoletti, 2008). Characteristic of these changed expectations are increases in academic capitalism, accountability and compliance, massification, and McDonaldization.

Academic capitalism (Slaughter & Leslie, 1997) describes a shift in the aspirations of research. Humboldt's vision of universities searching for truth and knowledge (Nybom, 2007) has been replaced by universities searching for the production and commercial exploitation of intellectual property (World Bank Group, 2002), to enrich academics, subsidize universities (Bok, 2003), and fund economies (Australian Research Council, 2008). Quantitative assessment of research reduces higher education's freedom to self-define goals, policy or quality assurance for research (see Henderson, Shurville, & Fernstrom, 2009).

A new culture of *accountability* of both the quality of learning and teaching (Kis, 2005) and its fitness for the labour market (Boarini, Martins, Strauss, de la Maisonneuve, & Nicoletti, 2008) has mainstreamed androgogic and student-centred learning styles (see Browne & Shurville, 2007). While this shift may be overdue, its culture of regulatory compliance leaves higher education with less room to self-define policy, practice and quality assurance of learning and teaching.

Massification and McDonaldization of higher education refer to the unprecedented growth in *student numbers* and the oversight of their preparation for the workforce (Baker, 2007; Hall & Atkinson, 2006; Ritzer, 1996; Scott, 1998; Trow 2006). Some critiques of massification and McDonaldization have been profound:

> Ritzer's thesis is that western societies are being characterized by a desire for rationality, efficiency, predictability and control. McDonaldization is the process by which. . .fast food restaurant principles are applied to a wide range of production activities and service provision. Ritzer argues that higher education is no different from other service industries and consumers require the same standardization, reliability and predictability in terms of [higher education] provision as they do when purchasing a burger meal. (Lomas, 2001, p. 73).

In sum these changes mean that the purposes and regulation of the ivory towers can be hard to distinguish from those of the golden arches.

Unfortunately, policy makers have challenged higher education to meet these expectations without commensurate increases in funding (Herbst, 2007; Johnes & Johnes, 2008). This challenge creates a shortfall between available resources, societal expectations and higher education's own aspirations. Society requires higher education to narrow this shortfall via innovation and entrepreneurialism. However, in terms of double loop learning, regulation offers higher education the leeway to change its action strategies, to increase efficiency, rather than to shift its high level control variables, to enhance effectiveness (Argyris, 1992).

Flexible Delivery and Technology-Enhanced Learning in Compliance and Cost-Conscious Cultures

This shortfall has created compliance and cost conscious cultures where institutions are forced to undergo radical transformations in efficiency to either achieve or transcend societal expectations (Evaline, 2004). Arguably, despite this shortfall, much of higher education has set its sights beyond the golden arches to pursue a post-Fordist (Nunan, 1996) model of flexible, mass-personalisation where "the *winners* design *customize*d products and services *on time*, *on demand* faster and more perfectly than their global competition" (Gee & Lankshear, 1995, p. 6; Shurville, & Browne, 2006; Shurville, O'Grady, & Mayall, 2008).

Flexible delivery is key to meeting societal expectations (see Seddon & Angus, 2000). Canonically, flexible delivery provides "students with flexible access to learning experiences in terms of at least one of the following: time, place, pace, learning style, content, assessment and pathways" (Chen, 2003, p. 25). Flexible delivery facilitates mass-higher education which is integrated with work — which is itself increasingly flexible (Hall & Atkinson, 2006) — and shifts costs and responsibility from society to the individual (Gee & Lankshear, 1995; Moreau & Leathwood, 2006). So in economic terms, flexible delivery enables students to attend higher education and earn wages to pay their fees.

Flexible delivery also provides a framework for androgogic learning and teaching approaches that prepare learners for lifelong learning (Browne & Shurville, 2007; Luckin, Shurville, & Browne, 2006), and a means to implement the teaching-research nexus (Boyer Commission, 1999). It can also facilitate education for those with disabilities (Getzel, 2008). As Nunan observed, "while part of the framework for flexible delivery may be borrowed from economics, there are progressive interpretations of flexible learning which are structured around competing social and humanist values which have educational expression through concepts such as constructivism, open education, student-centred learning, life-long learning, deep learning, and accessible learning structures" (1996, online). So flexible delivery is an educational philosophy with which to move beyond McDonaldization and implement Nunan's ethical post-Fordist visions.

Flexible, post-Fordist delivery calls for a Copernician transition of the centre of power and convenience from academics to learners. In other words the learners become the star and the academic become the orbiting body. Unfortunately, this reversal often places substantial demands upon academics, professional staff and, ironically, the learners themselves (Chen, 2003). So although flexible delivery provides a way to increase access to higher education, a path to improved learning and teaching, and a philosophy for post-Fordist higher education, it can also tend to widen this shortfall between resources, expectation and visions.

Some believe that the shortfall can be reduced by systems for technology-enhanced learning that offer educational and institutional flexibility (Balacheff, Ludvigsen, de Jong, Lazonder, & Barnes, 2009; Conole & Oliver, 2006; Laurillard, Oliver, Wasson, & Hoppe, 2009; Shurville, O'Grady and Mayall, 2008). In Australia, for example, the application of ICT/technology-enhanced learning to academic and business process has recently been shown to produce cost improvements in the order of 3.3% across all Australian universities — with a range of 1.8% to 13.0% (Worthington & Lee, 2008). Moreover some argue that technology-enhanced learning can mediate new educational experiences:

> Our perspective. . .is not focused on efficiency in terms of using technology to accelerate learning processes by faster delivery and distribution of learning materials. It is rather oriented towards the role of technology to enable new types of learning experiences and to enrich existing learning scenarios." (Laurillard, Oliver, Wasson, & Hoppe, 2009, p. 289)

However, the price of technology-enhanced learning can — oft-times erroneously — be seen to be a driver for cost-conscious senior managers when the reality is more complex:

> Unlike conventional forms of course delivery which require physical plant of limited capacity, many Internet-based e-learning courses have theoretically unlimited capacities. If the substantial initial costs of course creation can be invested then there is the potential for significant return on investment. . .an attractive proposition to the senior managers of universities beset by the pressures discussed earlier (Williams, 2006, p. 515).

So, flexible delivery mediated by technology-enhanced learning has been widely and perhaps naively perceived as a means for higher education to enable reductions of the cost of provision of McDondaldsized education (Roberts, 1993) and, more tenuously, to enable flexible, post-Fordist mass-higher education (Laurillard, 2007), when it can actually be more expensive and labour intensive to implement than traditional approaches (Guri-Rosenblit, 2005).

Setting Institutional 'Levers' for Double Loop Learning

Robert Simons (2005) invented a model to (a) help organizations to design effective roles in terms of resource allocation, entrepreneurialism and double-loop learning; and (b) set appropriate cultural expectations for collaboration and cooperation. It contains four levers which can each be set independently from low to high:

- The *lever of resources* sets the number of resources for which an individual is given decision rights and held accountable for performance.

- The *lever of accountability* (which I refer to as the *lever of leeway*), sets the amount of trade-offs which an individual can make that affect the evaluation of their performance. With a high setting, an individual can, for example, refine their goals — in harmony with organizational strategy and policies — to increase the effectiveness of the targets they are changing. This refinement can make their work more effective and efficient. Having a high setting for this lever is like having the freedom to change the control variable in double-loop learning (Argyris, 1992).

- The *lever of influence* sets the size of the individual's social network and sphere of influence within the organization. A high setting increases the individual's ability to collect and disseminate information across the organization. It also offers the individual the opportunity to attempt to influence the priorities of others.

- The *lever of support* sets the amount of informal help and goodwill that anyone can expect to receive from others across the organisation either in the normal performance of their duties or when they innovate.

Simons argues that reining in the *lever of resources* while simultaneously loosening the *lever of freedom leeway* creates his entrepreneurial gap. This entrepreneurial gap encourages individuals to solve problems in resource-light ways by practicing innovation and double-loop learning. This disparate pair of settings for the *levers of resources* and *leeway* can be enabled by simultaneously setting the *levers of influence* and *support* to high values. These simultaneous high settings for the *levers of influence* and *support* mean that individuals and departments across the organization are expected to contribute knowledge and goodwill to innovative practice and join innovative initiatives. The positions for the *levers of influence* and *support* are set by example from the organization's leaders and by rewarding behaviors that match the desired settings. The cultural outcome of collegiality means that individuals and units who are narrowing the entrepreneurial gap do not have to fear undermining or other pathological behaviors, such as "tricks" and "black holes" (Scott, 2007, p. 17). Simons provides the example of Harvard Business School applying this matrix of settings to good effect (Simons, 2005).

Due to its cultural history as a collegiate environment (Becher & Trowler, 2001), higher education is in a good position to implement higher settings for the *levers of influence* and *support* than might be achieved in industry. My thesis is that if institutions can implement high settings for these levers, then some of the shortfall might be transformed into an entrepreneurial gap, with opportunities for innovation and entrepreneurship. This brings us to how stakeholders in flexible delivery and technology-enhanced learning can set the matrix of levers.

Adjusting the *lever of resources*: The setting for this lever largely externally imposed by public funding. However, academics and educational technologists can apply expert power to ensure that chosen human and technical resources are fit for purpose. Maximizing this constraint can entail engaging with change initiatives and winning over Information Technology Services (ITSs) to support innovative solutions. The most important considerations are a combination of educational and institutional flexibility in educational software (Shurville, O'Grady, & Mayall, 2008) and participation in development and deployment of services (Shurville & Williams, 2005). Senior educational technologists are starting to acquire new influence within ITSs and senior management so that they can affect human resources, purchasing, support strategies and technological choices (Shurville, Browne, & Whitaker, 2008; in press).

Adjusting the *lever of leeway*: The setting for this lever is largely externally imposed by regulation of higher education. Academics and senior educational technologists can lobby externally for changes to policies for managing learning and teaching and research. Managers and senior managers can contribute by applying the settings for the levers of influence and support to be discussed below to enable academics and educational technologists to work with colleagues from local, national and international communities of practice to lobby for evidenced change.

Adjusting the *levers of influence and support*: Academics and educational technologists can help to increase these settings by establishing and attending meetings of special interest groups across the campus and beyond. They can also establish and take part in local, national and international mentoring schemes and contribute learning designs to social networking sites, such as the LAMS repository (Shurville, O'Grady, & Mayall, 2008). Senior academics and senior educational technologists carry sufficient expert and legitimate power to influence local policy on such initiatives (Shurville & Browne, in press). It is a matter of choosing to prioritize being an agent for this particular change. As the *lever of support* is set by modeling and rewarding appropriate behaviors, it is essential that academics continue with the tradition of collegiate practice and that educational technologists, who have acquired new found strategic importance (Shurville, Browne, & Whitaker, 2008; Shurville, Browne, & Whitaker, in press), establish a code of conduct that prioritizes similar collegiality and transparent allegiance to theory (Shurville Greener, & Rospiglosi, in press).

Conclusion

Choosing to engage more deeply with a collegiate model of institutional culture in the face of mounting workloads is not easy. Nor is it a nice to have. If you accept the arguments made above, then fundamental changes have taken place concerning who sets the positions for two of the levers that govern our experience of higher education and, more importantly, the experience of up to 50% of our fellow citizens. It is important that academic and professional stakeholders in flexible delivery and technology-enhanced learning choose to wrest and retain control of the remaining levers and give them an occasional affirmative nudge. To do so, they need to model behaviors and engage in initiatives that *might* transform the shortfall between resources, expectations and vision into an entrepreneurial gap. In turn this transform*ation might* help higher education to offer everyone a life beyond the golden arches.

Acknowledgements

These acknowledgements might help to put the title into context. As a dyslexic, I was cast aside by the British secondary education system of the 1970s where “they hated you if you were clever and they despised a fool” (Lennon, 1970). So, I spent my youth in a succession of unskilled jobs — including McDonald’s Epsom branch, whose managers gave me a badly needed second chance. Dylan’s whose words “I’m ready when you are, Señor” (Dylan, 1979) turned my tide. James Fryer had sufficient faith to teach me Basic programming, which got me started. However, many other people made my journey from the golden arches to this keynote possible. Among them was Willie Taylor who encouraged me to enroll in an access course at Southwark College — without the requisite qualifications or fees — and *ensured* that I was accepted. Ironically, it got tough to pull yourself up by your bootstraps in Thatcher’s Britain; but Willie stood by us. He taught us and he marched with us — standing his ground when the police horses charged. He taught me that an education is a right worth fighting for. Professor Andy Clark, Dr Lyn Pemberton, and Professor Aaron Sloman took similar chances on me and offered heavenly support. As Lennon continues, “when they've tortured and scared you for twenty odd years, then they expect you to pick a career” (1970). Thanks to Willie et al., upon earning a PhD, I was able to trade the golden arches for a career in higher education; since then it has been, in Carver’s word, “*gravy*” (Carver, 1986). Today, I am proud to work for the University of South Australia, where equitable access — for Indigenous people, those from Adelaide’s northern suburbs, and those with disabilities — is a premise. My mother Shirley and my wife Marian have always modeled such values; I love them for it. I would also like to thank: Professors J. Fodor and S. Orlando; fellow original ICICTE Musketeer Prince Asher Rospigliosi; and Ken Fernstrom, Nicole Levinsky, Barry O’Grady and Nancy Pyrini of ICICTE, for helping to “make it”, in Crumley’s words, “worth the dyin” (1993).

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TECHNOLOGY-ENHANCED TEACHERS' PROFESSIONAL DEVELOPMENT: STUDY OF FOUR CASES IN CHINA

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Abstract

Technology-Enhanced Teachers' Professional Development (TETPD) is arousing increasing interest among practitioners and researchers both in China and other countries. Good practices of teachers' education, supported by information and communication technologies, are in line with the needs of society. This paper proposes a framework for designing a multiple-case study to analyze technology enhanced teacher professional development in four typical Chinese cases. It describes the differences and similarities among the cases and argues that an understanding of TETPD could be built from them. The paper concludes that TETPD needs not only the joint planning of the central government, but also full support from local governments and schools, and especially teachers' active participation.

Introduction

Success in using ICT in education depends largely on teachers and their level of skill in integrating ICT into their professional development and utilizing ICT to provide learner-centered, interactive education. All institutions of teacher education are faced with the challenge of preparing a new generation of teachers to effectively use the new learning resources in their life long learning and in their teaching practices. This is one of the reasons why technology enhanced teachers' professional development (TETPD) has aroused an increased interest from both practitioners and researchers, in China as well as in other countries (Carlson & Gadio, 2002; Schlager & Fusco, 2004; Zhang, 2007).

Today, there are more than 10 million teachers and 200 million students in China. In the past 20 years, teachers' education institutes in China have made great progress in TETPD (Gu, 2005). Many explorations and practices in China provided typical cases, lessons, experiences for the academic community in teacher education to draw upon when conducting research on TETPD (Jin & Xiong, 2006). Having proposed a theoretical framework on TPD which allows for the design of a multiple-case study (Yin, 1993), four typical cases are selected and presented. The paper then discusses how to analyze and successfully compare those cases in order to highlight similarities and differences among them and to contextualize the cases for comparative use in the multiple-case study design.

Theoretical Framework

In providing an understanding of TETPD, one need not only reflect the researchers' own recognition, but also anchor the work in the recent development and progress of research and practice. Therefore, a broader theoretical framework for the design, selection and analysis of a range of cases to study is needed. In order to do so, a tentative definition of TETPD is first proposed.

TETPD: A Tentative Definition

In recent years, teachers' professional development enhanced by information communication and technologies has been one of the trends and hot topics of teacher education development around the world (Villegas-Reimers, 2003; Zhao, 2007). The use of technology to support TPD draws a good deal of attention. But there is not any clear and generally accepted definition of TETPD, since the backgrounds and perspectives from researchers and policy- makers differ (Jiao, Wang, & Qin, 2009).

TETPD is a relatively new topic in China, but there is still some literature discussing the features and development of TETPD. Generally speaking, scholars, educators, practitioners and researchers use different terminologies and terms to refer to TETPD: such as TDP in the Environment of Information Technology (Gu, 2005), TDP towards Informationalization (Liang, Yu, & Wu, 2008), and Distance Teachers Education (Liang, 2004).

TDP in the Environment of Information Technology focus how technologies can be used and regarded as an environment in which TPD occur. Distance Teachers' Education put particular emphasis on how teachers' education can be deployed as distance education. Both can be regarded as a kind of strategies or approaches of TETPD. In the case of TDP towards Informationalization, prominence was given to the aims and missions of TPD.

All these concepts used by researchers in China are connected to TETPD. But since TETPD is a new issue, emerging from the interaction of TPD and the development of information communication and technologies, these concepts being conceptualized in a different area may be something different from TETPD. In a sense, they might intuitively be related to TETPD and act as guiding concepts. In TETPD, technology may be regarded not only as environment of TPD, but also as resources, tools, strategies, and approaches of TPD. Therefore, a tentative definition is needed.

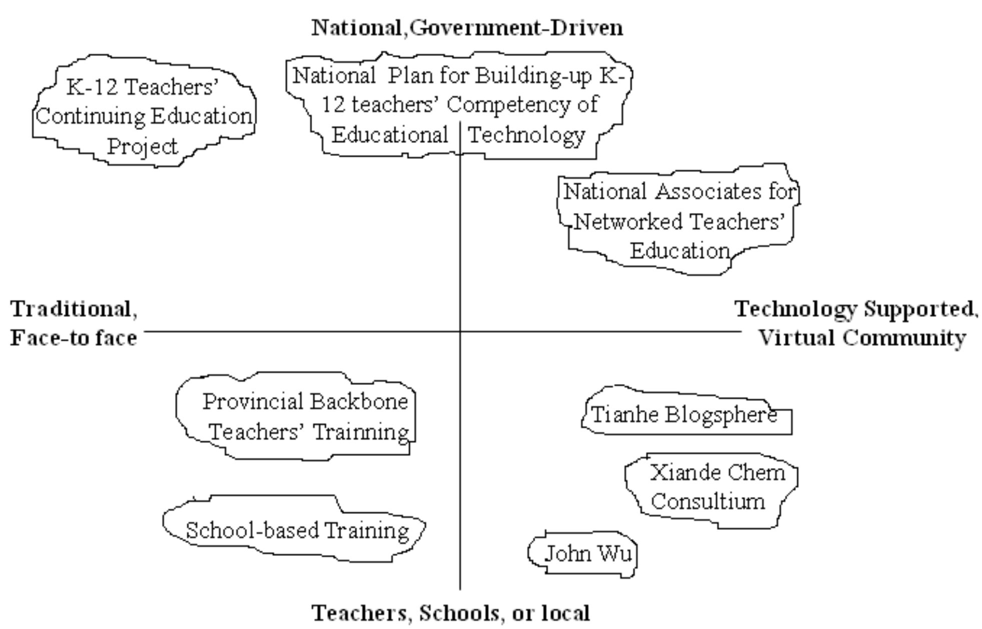
In this paper, TETPD is regarded as a systematic, dynamic and complex process which helps teacher to improve his or her professional knowledge, teaching strategies and skills, and attitude in technology enriched environment via technologies, especially information and communication technologies. Its aims and missions are to help teachers to adapt teaching and learning, and finally promote the quality of teaching and learning.

Theoretical Framework for the Design and Selection of Cases for a Multiple Case Study

There are a lot of research and practices, as well as successful cases on TPD and TETPD in China (Jiao, Wang, & Qin, 2009). An important question to address is how to select cases that would represent TETPD in China?

This paper presents a framework designed to select cases for a multiple case-study, and to analyze and compare the similarities and differences among some cases selected in China. The framework combines two dimensions: one is the stakeholders of TETPD such as government driven TETPD, individual teachers, schools, local departments; the other is the approaches, strategies and methodologies of TETPD used, such as traditional face to face dominated, technology supported, virtual communities etc. In accordance with to these two dimensions, four quadrants are formed. Within this framework, almost all TPD and TETPD may be designated to one of the four quadrants. The framework is shown in Figure 1.

Figure 1: The Framework for Cases Study



On the left side of the vertical axis, technologies such as computer technology, multimedia, Internet, etc., are considered as content and subject matter of TPD.

They are what teachers should learn. On the right side, technologies are used as approaches, methods, environments, and strategies to improve TPD. On this side, technology represents how teachers learn in an absolutely different way.

On the upper part of horizontal axis, TPD is initiated and driven by national or governmental initiatives, and on the lower part, TPD is spontaneous or controlled by individual teachers, specific schools, or local educational departments. This gives a framework to select cases representing as much variation and diversity within these dimensions as possible.

Case Selection and Methodological Consideration

In accordance with the tentative definition of TETPD given, and in relation to the framework discussed above, four cases of TETPD in China are selected. These are briefly presented and described in the following.

Brief Description of the Four Selected Cases

Case 1: National Plan for Building-up K–12 Teachers' Competence of Educational Technology (NPBKTCET)
In April of 2005, The Ministry of Education (MOE) issued *the Notice of Launch of National Plan for Building-up K–12 Teachers' Competence of Educational Technology*, with the purpose of applying ICT to teaching and learning in K–12 schools. Its aim is to markedly improve K–12 teachers' competences of educational technology, promote the effectively use of ICT in teaching, help teachers to change their pedagogy and teaching method, improve the quality of teaching and learning, and thereby develop basic education in China (MOE, 2005).

Case 2: National Associates for Networked Teachers' Education
In order to push forward the innovation of teachers' education and improve the quality of teachers and staff, the MOE launched the Plan of National Associates for Networked Teachers' Education (NANTE) in September of 2004. The NANTE is a joint enterprise of institutes of distance education, a confederation of 13 organizations and institutes which are involved in networked education for teacher education (MOE, 2003).

Case 3: Tianhe Blogosphere
Tianhe Blogosphere (www.thjy.edu.cn, in Chinese) is one of the top four regional platforms for teachers to communicate and share experiences concerning teaching in China. It has been known as one of the four teachers' blogospheres (the others being Zibo Blog for Teaching Research, Suzhou Educational Blogosphere, and Haiyan Teachers' Blogosphere), named as the Tianhe Blogosphere Phenomenon.

The blog was originally used by teachers in the Tianhe District of Guangzhou city. At present, it has attracted more than ten thousands of teachers from other areas in China.

Case 4: John (Bingjian Wu)
John is a former English teacher at Zhixin Primary School in Shaoguan city of Guangdong Province with a special website for teachers. (www.teacherweb.com/CH/Zhixin/JohnWu) He taught English to students from grades 4–6 for more than 10 years. In those years, John linked his class to classes from 26 different countries via different technologies, from Air Mail to E-mail, Website, etc. His students benefited from his exploration, while he progressed in his own professional development. Later, he was transferred to the teaching and research division under Shaoguan Department of Education. He is in charge of guiding English teachers at primary schools in Shaoguan city.

These four cases are not intended to be representatives of all case of TETPD or to present a comprehensive overview of all possible cases to select in China in this fast changing field. But within each case, both special and typical characteristics are included and they take full advantage of two dimensions mentioned above. The next section will provide additional information in each case in order to more thoroughly see the variation and diversity of each individual case.

Methodological Consideration on the Analysis of the Multiple-Case Study

The above theoretical framework helps us select four cases in China. The next question to address is how to analyze these four cases, and to make as much use of their similarities and differences in the multiple-case design. For each case to be better understood, each case is discussed from a more elaborated account of the framework in Figure 1.

In this paper, the following four facets and subsequent questions are discussed:

- Stakeholders: Who or what kind of organizations aid, finance, and organize the practices of TETPD?
- Features and Characteristics: What are the behavioral features and characteristics of teachers, educators and organizers involved in the TETPD?
- Primary Technologies: What kinds of technologies are used, and what roles and functions do technologies play in the TETPD?

- Effect and evaluation: What are the assessment and evaluation of the TETPD, in terms of comments from teachers who are involved, input-output analysis, etc.?

Discussion

The four facets above are used to differentiate and further describe the four cases. In this section, an analysis of each case from the four facets is provided, and then a comparison is made to illustrate similarities and differences among the cases and pointing towards the possible understanding of TETPD they could provide respectively.

Case 1: NPBKTCET

In July of 2005, the MOE launched a pilot project of new curriculum reform in nine provinces including Liaoning, Jiangsu, Henan, Guangxi, Hainan, Chongqing, Sichuan, Yunnan, and Ningxia. From July of 2006 on, new curriculum reform has been carried out in all-round in the whole nation.

NPBKTCET can be divided into two parts: training and examination. The examination of competence of educational technology (CETS) was organized and implemented by the National Test Center under the MOE. In August of 2006, The NPBKTCET's official website (www.teta.com.cn) was launched, and its office was established by MOE in September (MOE, 2005). Training activities were organized and the first national test was held in November. From then on, this kind of test is held twice a year.

The NPBKTCET is a top-down project. The stakeholders of NPBKTCET are the central government and local educational authorities. All K–12 teachers are required to participate in its training activities including face-to-face sessions and online sessions, and pass its national test. Its supporting websites both at the national level and the provincial level have been designed and developed. It is a one-size-fits-all model for teachers' professional development.

Case 2: NANTE

NANTE is a joint enterprise of institutes of distance education for teacher education, a confederation of 13 organizations and institutes. Included are 8 normal universities: Beijing Normal University, East China Normal University, North Eastern Normal University, Central China Normal University, Southwestern University, Shaanxi Normal University, Fujian Normal University and South China Normal University; A mega-university focused on distance education, Central Radio and TV University, An National Educational TV Station, China

Educational TV, and two publishing houses: Higher Education Press and Peoples' Education Press.

On the official website of NANTE (www.jswl.cn), there are different modules such as Teachers Training, Head teachers Training, Resources Centre, TPD, Rural Education, Educational News, Trends of K–12 Curriculum Reform, International Educational Review, Policies and Regulations, ICT Skills Training, etc. It has been a professional portal and hub for teachers' professional development.

NANTE is a loose organization associated with the Department of Teachers Education under the MOE (MOE, 2003). Its approach is a top-down way to help teachers' with professional development. Its effects and impacts on TPD are under observation in the future.

Case 3: Tianhe Blogosphere

The Tianhe Blogosphere is an important channel and approach for teachers' professional development. By April 7, 2009, there has been 14,026 K–12 teachers exchanged their professional experiences, affective interaction, ideas and thoughts, shown their own talents and competence on the Tianhe Blogosphere all over the country. A lot of bloggers tell their own stories and their life in schools, post their own lesson plans and syllabus to collect suggestions and advice from others online, accumulate successful cases and improve their own tacit knowledge and wisdom. The total posts' numbers in the blogosphere added up to 229,019 since it was built on February 2005. Today, more and more students in K–12 schools, undergraduates from teachers' colleges and normal universities, and in-service teachers from all over the country, are attracted to it.

As such, blogs are important part of the rapidly developing Web 2.0 phenomenon that revolutionizes the current World Wide Web. As a founder of Tianhe Blogosphere, Mr. Zhang Weichun said that Tianhe Blogosphere is not only a technological system, but also a communicative mechanism and management system, as well as a culture of TPD (Ruan, 2007). Not only teachers are active on the Tianhe Blogosphere, more and more students join in it, too.

Tianhe Blogosphere changed the model of TPD from a top-down, centralized model of TETPD to a bottom-up, autonomous and spontaneous model. It combined teaching and research, teacher resources development, teachers' practical reflection, school- based training as well as quality monitoring of teaching and learning in one system. It strengthens communications among teachers, students and parents. The blogosphere is unique in that it is a place where everyone can share his or her thoughts and spread his or her views. This personalized aspect seems very important for teachers.

Case 4: John (Bingjian Wu)

In the summer of 1994, Bingjian Wu (John), a 22-year-old English teacher at the Zhixin Primary School of Shaoguan, participated in an English Seminar sponsored by Shaoguan University. At the seminar, he met Rhonda Rolf, an elementary school teacher from Temple City. Both were enthusiastic about their work, and they had many experiences to share. Later, Wu and Rolf worked out a feasible pen pal program. John Wu put much extra effort into the program, because his students had difficulty in writing in English. In 1997, Rolf introduced John to her former teaching colleague, Mrs. Jackson. Jackson introduced a colleague of hers who worked at another school, Mrs. Fikac…… this process went on and more and more teachers from different countries and their classes were involved.

Mostly, the children's letters have been about their school life, birthday parties, pets, family members, hobbies, festivals, favorite pop stars, religion, and current events they had seen on news broadcasts. Sometimes with their letters, the children enclose small gifts such as photographs of themselves and their families, postcards, maps, paintings created by them, handicrafts, and reading materials that depict life in their countries (Xiang, 1999).

Through pen pal communication, John created a natural and real environment of English language learning for his classes, fulfilled language interactions and made his students experience a fancy English learning.

At that time, computers were really expensive for people there and the Internet access was not available. John and his students wrote air mails to their pen pals. Later, John bought a computer and developed websites to improve cross-cultural communication.

John is a self-regulated teacher with high achievement motivation. He continuously strives to develop professionally and to change his teaching and learning.

Comparison among Four Cases

These more elaborated descriptions can be used to highlight the four cases on each one of the four facets. Table 1 summarizes the similarities and differences among these four cases.

Table 1: Comparison among the Cases on Four Facets

	Case1: NPBKCET	Case2 NANTE	Case3 Tianhe Blogosphere	Case4 John Wu
Stakeholders	Central Gov.	Commonwealth of institutes and Central Gov.	Local education departments and teachers	A teacher
Features and Characteristics	Top-down compulsory	Semi-government	Teachers and schools are encouraged and attracted	Personal subjective
Primary Technologies	Face-to face training and websites	Online community, website with resources	Online community based blog workshops,	Air mail and e-mail, IM tools and website, etc.
Effect and evaluation	National, one size fits all	to be investigated	Neighbors help neighbors	Personal effective

In these four cases, case one, NPBKTCET can be regarded as a top-down, one-fits-all model of TPD. All K–12 teachers are required to accept training and pass the test. Face-to-face training is the dominant approach. Case 2, NANTE, is a mixture with real institutes and community of practice. It is funded and supported by government. A website with abundant resources, as a virtual community of teachers, has been created. Case 3, the Tianhe Blogosphere, is a model which satisfies the needs of teachers, schools and local educational authorities. More and more teachers have been involved in it. Case 4, John Wu, is a special case of a teacher who tried to find more room for his own development and sharing this experience through the internet.

Among these four cases, different technologies were used to improve TPD. But "Introducing new technology alone is never enough. The big spurts in productivity come when a new technology is combined with new ways of doing business" (Freidman, 2005, p. 119). That means, only when ICT and new ways of teaching, learning and professional developing are dynamically integrated, TETPD will truly promote the growth of teachers to enhance teaching quality and efficiency.

The cases provide the ground for claiming that there could not be one given model for TETPD. As it was expressed by Darling-Hammond: “In the recent past, many teacher education programs have been criticized for being overly theoretical, having little connection to practice, offering fragmented and incoherent courses, and lacking in a clear, shared conception of teaching among faculty” (2005, p. 391). The specific aspects of each case might provide a sound basis for adhering to Darling-Hammond’s point. Learning about practice could be done in practice, in technologies enriched settings, in professional communities of teachers, and learning by doing designed and effectively integrated in models of TETPD drawing on the four cases. Deng Xiaoping said that it doesn’t matter whether the cat is black or white, as long as it catches mice. For educators, the most important thing is to explore, compare and introduce approaches, strategies and models to improve teachers’ professional development, especially TPD that is enhanced by information communication and technologies.

Conclusion

Introducing technologies provides TPD new approaches, methods, strategies as well as environment. It has been an obvious trend to study new instructional technologies from teachers’ communities of practice and promote TPD in the technological settings. Teachers’ vision, motivation, enthusiasm and technological sensitivity are the foundation of technology enhanced teacher professional development. Therefore, TETPD needs not only the joint planning of the central government, but also the full support from local governments and schools, and especially teachers’ active participation.

These four cases illustrate the potential diversity of TETPD. Each case has its different features and characteristics; they reflect the four facets in different ways and form different approaches or models of TETPD. It is believed that TPD will reach educational ideals through combining multi-approaches and different methods, and in developing such models of TETPD multiple-case studies such as the one outlined here are needed.

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TECHNOLOGY-ENHANCED TEACHERS' PROFESSIONAL DEVELOPMENT: A LITERATURE REVIEW IN CHINA

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Abstract

In this paper, a review of the recent Chinese literature concerning background, policies, standards, evaluation, models as well as phases and processes of teacher professional development enhanced by technology is presented. The current situation in terms of status quo, issues and trends is described and considered in terms of technology- enhanced teachers' professional development. Finally, the paper highlights ten conclusions drawn from Chinese research and practices.

Introduction

The quality and performance of teachers have for a long time been considered as determining factors for the success of educational changes (Aluko & Aluko, 2008). Teachers' professional development (TPD) is a crucial component in nearly every modern proposal for educational improvement. Lately, technology-enhanced teachers' professional development (TETPD) has been one of the trends and hot topics of teacher education development in the world. In China, TPD is "mainly carried on by the way of pre-service education that is normal education in early years. It has gradually developed into in-service teachers' education till 1980s" (Wang, 2007). From the 1980s on, teachers' education has been advocated and related policies have been issued. Literature on practices and researches on how technology enhanced teachers' professional development has since increased.

Based upon a review of the past 20 years of Chinese literature on this issue, this paper intends to do four things. First it provides a background description on Chinese policies concerning TPD. Secondly it provides different standards and evaluation systems for TETPD. Thirdly, it provides a review of research on TPD and TETPD in terms of phases, processes, models and strategies for TPD and TETPD. Last and fourthly, the paper ends with ten conclusions concerning teachers professional development related to the use of technology in China.

A Tentative View of TETPD

In the past 20 years, Chinese research on TPD has progressed. The amount of literature on in-service teacher education outnumbered that on pre-service teacher education. And the perspectives, scopes, and outcomes of related researches became richer and richer (Yu, 2007). But at present, there is no clear and generally accepted definition of TETPD. The understandings, backgrounds and perspectives of researchers and policy- makers differ. To guide this paper, a tentative definition of TETPD could be to frame it as a systematic, dynamic and complex process which helps teacher to improve his or her professional knowledge, teaching strategies and skills, and attitude in technology-enriched environment via different technologies, especially information and communication technologies. The aims and missions of TETPD would be to help teachers to adapt teaching and learning in information age, and finally promote the quality of teaching and learning.

TETPD: Policies, Standards and Evaluation

With the recent development of teachers' education, and the transformation from in-service teacher education to a perspective of teachers' long-life education, TPD and TETPD have attracted many policy-makers of different departments of education in China.

A Short Historical Background on TPD and TETPD Policies

Looking backward will be helpful for looking forward. The three national conferences on education in the past twenty years opened the curtain of the TPD and TETPD in China.

The 1st National Conference on Education held on May 15–20, 1985 in Beijing is one of the most important conferences after China's implementation of the open-door policy and reform. At this conference, reform of educational system and its steps and strategies were discussed. Existing problems in Chinese educational system such as unreasonable structure, poor basic education, lack of schools, unsatisfied quality of schooling, and lack of qualified teachers and devices and equipments were also hot topics. *The Decision on the Reform of the Educational System by the Central Committee of the Communist Party of China* (CCCPC) was published by Xinhua News Agency on May 27. From then on, rights of basic education have been shifted to local governments in order to develop basic education. The nine-year compulsory education system has been put in to practice.

The 2nd National Conference on Education was held from June 14–17, 1994 in Beijing. Its mission was to execute the priority strategy giving to the development of education into effect, call on the whole society to put *The Outline for Reform and Development of Education in China* published in February 1993 into practice. In this government document, the CCCPC and the State Council expected to achieve the goal that nine-year compulsory education would be basically universalized and illiteracy would be eliminated, and the quality of education in all respects would be improved by the end of that century. In addition, the statement that revitalizing our nation depends upon education and invigorating education depends upon teachers firstly appeared in it. It became one of the common understandings in China to further boost teachers' training.

On December 24, 1998, The MOE released *The Action Plan for Invigorating Education toward 21st Century (MOE, 1998)*. This document was the blueprint of national educational reform and development in the trans-century period. In this document, a lot of effective measures, steps and strategies were made. For example, *Trans-century Project on Quality-oriented Education* to improve the overall quality of the whole nation, *Trans-century Teachers' Training Program* to enhance teachers' competence, *Project on High-level Creative Professional Manpower* to strengthen the scientific research work in Higher education, the *Project 211* (Chinese government's endeavor to strengthen about 100 institutions of higher education and key disciplinary areas as a national priority for the 21st century) to increase the creative competence of institutes, colleges and universities, and *Modern Distance Education Project* to shape open education networks and build up the long-life learning system.

The 3rd National Conference on Education was held from June 15–18, 1999 in Beijing. At this conference, *the Decision on Deepening Reform of Education and Conducting a Comprehensive Quality-oriented Education* was made by the CCCPC and the State Council. In September 1999, the MOE convened a national working conference on National K–12 Teachers' Continuing Education and Head Teachers' Training and the MOE Commissioned all parts of country to implement the *Project on K–12 Teachers' Continuing Education*.

The Chinese government tried to thoroughly train all K–12 teachers (more than ten million teachers) by *The Project on K–12 Teachers' Continuing Education*. Three types of teachers' training were mentioned in this project; new or novice teachers' training; in-service teachers' training; and backbone teachers' training. The MOE would organize the training of ten thousand Backbone Teachers at the national level; the local governments would organize training for ninety thousand backbone teachers at provincial level; and at the school level, a million backbone teachers would be trained. In addition, all K–12 teachers would accept computer skills training which would help them to use computer to aid their own teaching and learning. Diploma Education Project, aimed to improve teachers' diploma, and Trainers' Training Program was specially designed to promote different kinds of trainers' skill.

In order to carry out *The Decision on Deepening Reform of Education and Conducting a Comprehensive Quality-oriented Education*, the MOE decided to proceed with the reform of basic education, regulate the content and structure of the curriculum system, and build up a new curriculum system to meet the needs of quality-oriented education. In June 2001, the MOE released *the Outline for Reform of Curriculum System in Basic Education* (Pilot Edition, MOE, 2001) and published *the National Curriculum Standards for Compulsory Education* (Trial Edition, MOE, 2001). In the autumn of 2001, the new curriculum system was put into trial use.

In 2003, The State Council convened a national meeting on rural education and decided to launch modern distance education in rural primary and secondary schools to accelerate the educational resource share between urban and rural area and raise the quality and efficiency of rural education. On March 3, 2004, *the Action Plan for Invigorating Education from 2003 to 2007* was put into effect. In the plan, the Project on Modern Distance Education in Rural Primary and Secondary Schools, and the National Associates for Networked Teachers' Education came into effect. The project used three kinds of models: CD-ROMs distributing centers, Satellite Receiving Stations, and multi-computer labs.

The Standards of Educational Technology of China (SETC) (CAET, 2004) released by China Association for Educational Technology in November 2004 marked the start to mature of evaluation and assessment of teachers' technical capability and competence (Gu, 2008). A month later, on Dec. 25, 2004, the MOE issued *the China Educational Technology Standards* (CETS) (MOE, 2004) which was the first national competence standard for K–12 teachers and one of important landmarks of K–12 TPD in China. And then, the MOE launched *the National Plan of Build-up of K–12 Teachers' Competence of Educational Technology* (MOE, 2005).

On May 18th 2007, the State Council authorized *the Framework of Development of Education in the Eleventh National Five-year Plan* submitted by the MOE, in which strengthening teachers' education and training, improving the quality of teachers and staff were emphasized.

The following four points can be highlighted from the backgrounds and policies of TPD and TETPD since 1980s:

- Teachers' education in China was tremendously changed in the past 20 years and issues related to teachers such as TPD and TETPD were gradually highlighted.

- There has been three great transformations on teachers' education in China in the past 20 years: the first concerns a shift from only stressing normal education (Pre-service teachers' education) to the combination of normal education and in-service teachers' training; the second concerns a gradual shift from focusing on teachers' training and teachers' continuing education to TPD; the third concerns a shift from the over-emphasis on face to face teachers' training to a combination of face to face training and distance teachers education and other strategies and approaches.

- During the past 20 years, neither technologies nor technological factors were appreciated in TPD.
- And the amount of literature regarding TETPD has gradually increased.

Standards and Evaluations of TPD and TETPD

At present, a few standards and evaluation systems related to TPD and TETPD have been formulated and executed in practice in China. In some laws and regulations such as *Teacher's Law of the Peoples Republic of China* issued on Oct. 31, 1993 and *Regulation of Teacher's Qualification* released on Dec.12,1995 by the State Council, teachers' qualification and teachers' competence were concerned.

The SETC and CETS mentioned above are two documents related closely to standards and evaluation systems on TPD. The SETC covers basic requirements and competence of educational technology for almost all participants including students, teachers, educational administrators, and professionals of educational technology, it also covers its performance indicators, successful cases, design templates, evaluation tools and training syllabus required in the process of implementation.

The standards of competences of educational technology for teachers and staff, administrators and technicians in CETS cover the following four dimensions:

- Awareness and attitudes: recognition and understanding of the importance, consciousness of application, evaluation and reflection as well as life-long learning.
- Knowledge and skills: elementary knowledge and basic skills.
- Adoption and innovation: Instructional design and implementation, teaching support and administration, scientific research and development, cooperation, collaboration and communication.
- Social Responsibility: fair use, effective use, healthy use and code of conduct.

If the CETS and SETC are compared with National Educational Technology Standards for Teachers (NETS.T) issued by the International Society for Technology in Education (ISTE) in the USA, it is apparent that the CETS and SETC learnt a lot from NETS.T, but they have their own features and characteristics. The following comparison shows some of those issues.

Structural system of standards: CETS and SETC, SETC.T (SETC for teachers) in particular, are quite similar to NETS.T in the structures of competence and indicators. But NETS.T is more commonly used, understandable and operable than CETS and SETC. It can be used as an index system and rating scales to measure teachers' competence of educational technology, and help teachers in self-inspection and self-assessment.

Target audience: CETS is for all in-service teachers, but SETC and NETS.T for all teachers including pre-service teachers, newly inducted teachers as well as in-service teachers. All teachers' growth phases are covered in SETC.T including student teachers, pre-service teachers, new teachers and in-service teachers. For different kinds of teachers or teachers in different growth phases, different and specific requirements are specified.

Content of standards: The NETS.T has been revised and edited three times. It has been absorbed and integrated new research findings of educational technology and innovative technologies. Also, the content of NETS.T is in line with its sister standard, NETS.S, standard for students. At this point, SETC.T is quite similar to NETS.T and teachers' standards of educational technology are aligned with students' standards.

A difference, comparatively speaking, is that NETS.T is much more flexible and compatible than SETC.T and CETS because of the difference of national systems between the two countries. In the U.S.A, different states can localize and redefine the national standards to meet its own needs according to its own cases. In China, SETC.T is divided into two different parts, A and B. The former is used in schools in the developed area or in schools that have high standards. The latter is used in schools in developing areas or in schools that have lower standards. But the regional classification available is too simple and rough for China, being such a large country with such diversity. What is worse is that it is not considered an option to localize or regionalize in CETS.

Phases and Processes of TPD and TETPD

There is a lot of Chinese literature reporting on the processes and phases of TPD, but it seems that many build on foreign references and studies.

Baoxiang Shao and Jinbao Wang (1999) proposed 4 phases in the process of TPD of teachers: adaptation, growth, competent and mature. Caiguo Zheng (2007) claimed that the process of teacher professional development can be divided into 4: novice teachers, competent teachers, experienced teachers and expert teachers. Lan Ye and Yimin Bai (2001) believed that a teacher career cycle of TPD covers 5 phases: focus on nothing, focus virtually, focus on existence, focus on task, and focus on self-updating. Qin Luo and Shiyan Liao (2002) indicated 4 phases: adaptation, development, mature, and continuing development. Table 1 shows the different researchers and phases.

Table 1: Phases of Teachers' Careers of TPD

Researchers	Phases of TPD
Baoxiang Shao and Jinbao Wang (1999)	adaptation, growth, competent and mature
Lan Ye & Yimin Bai (2001)	focus on nothing, focus virtually, focus on existence, focus on task, and focus on self-updating
Qin Luo and Shiyan Liao (2002)	adaptation, development, mature, and continuing development
Caiguo Zheng (2007)	novice teachers, competent teachers, experienced teachers and expert teachers respectively

The researches above are researches on phases of TPD, not phases and processes of TETPD. There are only a few Chinese reports on phases and processes of TETPD, but there are some researches on phases of TPD in rich technology settings or informationalized environments. For example, Xiaoqing Gu (2004) referred the course of TPD as 4 phases: understanding, application, integration and innovation. Lu Wang divided TPD into 3 distinct phases: learning from experience, reflection from practice, and innovation from research (Wei, 2005). Shengquan Yu (2006) indicated that a teacher would experience 5 phases: learning from imitation, try and use, suspicion and puzzledom, evolvement and integration, as well as innovation and development. Wenxin Liang (2008) extended Shengquan Yu's 5-phases theory from ecological perspectives. He classified the course of TPD into 3 phases: ecological mutation phase, ecological evolution phase, ecological equilibrium phase. In the ecological mutation phase, teachers begin to know ICT and try to understand it; in the ecological evolution phase, teachers integrate ICT into their own teaching and learning; in the ecological equilibrium phase, teachers fulfill the application of technologies and can effectively integrate ICT into their teaching and learning. Table 2 summarizes the research on phases of TPD in technology rich settings.

Table 2: Phases of Teachers' Careers of TETPD

Researchers	Phases of TPD
Xiaoqing Gu (2004)	understanding, application, integration and innovation
Lu Wang (2005)	learning from experience, reflection from practice, and innovation from research
Shengquan Yu (2006)	learning from imitation, try and use, suspicion and puzzle dom, evolvement and integration, as well as innovation and development
Wenxin Liang (2008)	ecological mutation phase, ecological evolution phase, ecological equilibrium phase

Actually, one might note that the phases proposed above are quite similar to the ideas about barriers for ICT use proposed by Patricia L. Rogers (2000). Either TPD enhanced by technologies or general TPD, teachers' growth seems to follow its trajectory. It may not exceed its own path of TPD. But, with the introduction of technologies into TPD, the phases and processes of TPD may be changed. A way of understanding this change from the research above is:

- Content of teachers' learning is changed, basic skills and applications of technologies such as ICT turn into what teachers should learn during the course of TPD, especially at the beginning of TPD.

- Features and characteristics of each phase may be changed such as learning focus, learning styles etc (Fu, 2003; Gu, 2004).

- The duration of each phase of TPD may be changed. It may be shortened if technology is properly used.

- Levels of competence and degree of development of TPD may be improved and promoted.

It is all these changes that TETPD and research on TETPD are focused and emphasized. It is not hard to see that the development of technologies and its introduction to school setting affected teachers' professional development, and phases or growth periods of TPD in a sense followed the development and evolution of ICT. Many researches on phases of TPD in China were based on foreign researches. These suggested phases are quite similar to those revealed by foreign researchers.

TETPD: Different Models

Dennis Sparks and Susan Loucks-Horsley (1989) described five models of teachers' professional development: the individually guided model, the observation and feedback model, the curriculum development/improvement model, the training model, and the inquiry model.

Having analyzed the effects of networked environment on TPD from a perspectives of teachers professional qualities and roles of teachers, Xiufeng Ma and Xiaofei Li (2006) elaborated four models of TPD: autonomous development; cooperation development based on learning organization; practical reflection; and network associates. Meanwhile, in the same paper, they regarded the effective strategies of TPD supported by networked technologies as autonomous development, cooperation development based on learning organization, practical reflection, and network associates.

There are few reports on models of TETPD. What Dennis Sparks and Susan Loucks-Horsley (1989), Xiufeng Ma and Xiaofei Li (2006) described are more strategies, methods or approaches rather than models of TPD.

TETPD: Conclusions from Research and Practices in China

This paper reviews the researches and practices on TPD and TETPD in China. Having reviewed the Chinese literature, it can be concluded:

- TPD was highlighted for special attention, and researches and practices on TETPD in China are at its preliminary stage. TPD and TETPD have increasingly attracted policy makers of departments of education in China.

- Training is one of significant approaches and strategies of TPD and TETPD in China. Some other approaches, strategies and methods of TETPD have appeared recently and are being adopted slowly.

- Practices on TPD and TETPD have gone ahead of research. There are few studies on TETPD reported in Chinese literature, but practices on TETPD are booming recently.

- Teachers' training practices in china have been dominated by top-down organization and face to face trainings are the overwhelming majority of teachers training activities in China. In recent years, other practices on TETPD begin to come to prominence in China.

- Much research and practice on TPD and TETPD in China seems to be anchored in approaches from abroad. Most of them focused on phases of TPD. There are few reports on phases, processes and models of TETPD. It seems that there is a long way for Chinese researchers to go before having developed an approach of their own.

- There is a lack of research on teachers' learning and learning through the use of technologies in China. The difference between knowledge learning and technology learning has been neglected by designer and practitioners in the practices of teachers' training.

- Training techniques and methods should be improved and new strategies and approaches should be introduced. Some training lack proper instructional design. Complex and advanced technologies used to be selected as content of teachers' training. But these technologies seem seldom to be brought into play in teaching and learning of teachers who accepted this kind of training. Therefore, new strategies and approaches such as participatory training, task-driven training, action research, cases study, problem based training, could be adopted in teachers' training.

- Traditional pedagogical skills have not been given proper importance and technologies and teachers professional skills in networked environments are highly thought of by training designers and teacher-trainers. For example, oral expression, classroom management, questioning, homework design and mark, peer coaching and mentoring, skills of lesson plan, were overlooked in training.

- The enthusiasm of teachers of TPD should be encouraged; especially the desire of teachers' autonomous development should be stirred up.

Training, based on a model of one size fits all, can not meet the individual teacher's needs. Teachers, being as busy as a bee with great pressure for raising the rate of their students enrolled into colleges and universities, has not enough time to update their own knowledge and pedagogy.

- The links between Normal universities or Teachers' training institutes and K–12 schools should be strengthened. Researchers who work in normal universities or teachers' training institutes should be encouraged to do their own research in classrooms or K–12 school settings.

TPD is not a business made at a stroke. Effective continuous TPD demands cooperation and collaboration through technologies among educational departments, K–12 teachers, educational researchers, and educational resources suppliers.

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TECHNOLOGY ENHANCED TEACHER PROFESSIONAL DEVELOPMENT — FOUR CASES IN SWEDEN FOR TEACHERS' PROFESSIONAL DEVELOPMENT AND THE USE OF ICT

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Abstract

In this paper, the theoretical framework and design of the Swedish part of an international comparative study of Technology Enhanced Teacher Professional Development (TETPD) are presented. The aim of the paper is to provide a framework for a Swedish multiple-case study. Through the use of the framework, four different cases that are described as programs in which ICT is used in and for TPD are selected. The four cases are presented and compared on four characteristic features. The significance and prospect of the programs in terms of enhancing the use of ICT for teaching and learning are then discussed.

Introduction

Constant change in the working conditions of teachers and increased impact of information and communication technologies both lead to a need for teachers to engage in professional development activities. Teachers' professional development (TPD) is therefore a dynamic area of constant change, and teachers' knowledge and skills are in a constant need of improvement, teachers are in need of TPD. According to Diaz-Maggioli (2004) TPD is often constricted by numbers of barriers. Among others he talks about TPD as often being a question of top-down decision making, characterised by a lack of ownership of the professional development process that has a inaccessibility of professional development opportunities and providing little or no support in transferring professional development ideas to the classroom. Others have identified further barriers such as TPD arranged and carried out in single or short sessions in which the teachers is attending in person (McRae et al., 2001).

In Sweden TPD seems often to be initiated on a central, governmental level with directives concerning financing and organisation of content and implementation (see i.e. ordinance 1982:608; ordinance 2007:223). Governmentally initiated TPD have been studied and analysed both in Sweden as well as internationally. For instance, Strömberg (1994) and Englund (1992) hold that state controlled TPD is a means for the state to secure that teachers are loyal to the curriculum rather than to the traditions of the profession. Diaz-Maggioli (2004) holds that the steering limits the ownership over the TPD and Husby (2005) argues that it could lead to teachers' learning not being as meaningful. Similar ideas could be found in Hargreaves (2006) and Goodson and Hargreaves (2003) who hold that teachers search for continuous learning should be encouraged, instead of teachers giving in to demands for change from above. Blase (2005) holds that teachers often find themselves in a political, economical and social dilemma regarding their TPD.

Theoretical Framework for TPD

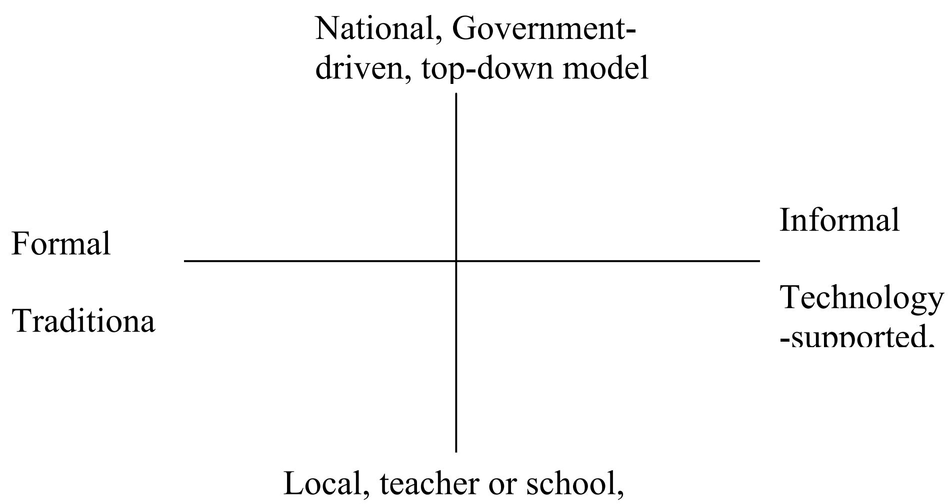
Turning the focus for a moment to the content and characteristics of Teacher Professional Development, there are several different positions to be noted. In her literature review, Villegas-Reimers (2003) gives broad background descriptions of different views on TPD. Starting in professional development, which is referred to as the development of a person in his or her professional role, Villegas-Reimers goes on to clarify TPD as the professional growth of a teacher as a result of gaining increased experience after examining his/her teaching systematically (building on Glatthorn, 1995). Professional development includes formal (such as attending workshops, mentoring, etc.) and informal (such as reading publications, watching documentaries, etc.) experiences (building on Ganser, 2000). Fraser, Kennedy, Reid and McKinney (2007) suggest a joint framework of three different models when discussing a possible framework to examine TPD. Several dimensions of TPD are included in the models. First, there are three interrelated aspects of professional learning, as they are suggested by Bell and Gilbert (1996): personal, social and occupational. Second, the analytical framework by Kennedy (2005) is used in which the purpose of TPD could be located along a continuum of being transmissive, transitional or transformative. Third, Reid's quadrant of teacher learning (McKinney et al., 2005) is presented, which is comprised of two dimensions: formal-informal and planned-incidental. Through this joint framework, complex relations affecting TPD are possible to identify.

All in all, it seems that some characteristics of TPD might be possible to include as a framework for a comparison of different models of TPD.

Selection of Cases

From these different distinctions, this paper aims at presenting four different cases of teacher professional development, all of them, in one way or another, are related to the use of technology. The cases mirror two dimensions of teacher professional development (see Figure 1).

Figure 1: Two Dimensions of TPD Used for Selecting Cases



First the distinction between top-down models and programs and bottom-up models and programs. Secondly, the issue of formal-informal models or programs. By relating the cases back to the theoretical framework recognized above, the paper will end in a discussion of the possibilities for Technology Enhanced Teacher Professional Development within each of these four different cases. The cases will be described in the following.

Case 1: ITiS (National programme for ICT in schools)

The National Programme for ICT in School, ITis, was initiated in 1999 by the government and the programme ran from 1999 to 2002 (Jedeskog, 2005). The programme was building on prior programmes of TPD using ICT, and people involved in the programme were recruited as facilitators in the ITiS-programme from prior programmes. Actually, all Swedish schools were involved in the ITiS-programme. The programme consisted of seven components to improve teachers' ICT literacy: in-service training; a multimedia computer for each participant; state grants to improve internet accessibility for the schools; state grant to ensure all teachers and pupils e-mail having addresses; support for developing the Swedish Schoolnet and the European Schoolnet; special measures for pupils with special needs; and awards for excellent pedagogical contributions.

Teachers and school managers were offered an ICT course to acquaint them with the potential use of ICT as an educational tool. All 289 Swedish municipalities choose to participate. Training was to be arranged flexible, in form of intensive courses, study circles or seminars. Training was to be held regionally, adapted to regional conditions. A management group, representing teacher training institutions, regional educational development centers, and local municipalities, coordinated a regional network. Training was offered for facilitators, principals, administrative heads and politicians. Facilitators were to gain insights in how to chair seminars and to support teams of teachers in developing their learning. Training for principals was intended to give them insights into their role in implementation of development work in schools. The training consisted of both theoretical and practical parts. Practical parts were development projects carried out in teacher teams and with pupils. Theoretical parts were centered in three areas: ICT in the world; ICT and learning; ICT in practice. The in-service training was aligned with the pedagogical approaches set out in the national curriculum, such as a shift from teaching to learning, giving pupils more responsibility, interdisciplinary approaches to teaching in teams and a problems-based pupils-oriented pedagogy. Every teacher team summarized their work in a final report, in order to reflect personal learning and development during the in-service training. Focus on the team and not the individual teacher. Finding good models for in-service training was time consuming. Benefits from the ITiS-model were time for reflection and cooperation with colleagues in seminars. The basic requirements were team work, problem based learning and lifelong learning.

Case 2: The National Teacher Professional Development Program "Lifting the Teachers" (Lärarlyftet)

In 2007 the government took the initiative to form The National Teacher Professional Development Program "Lifting the Teachers" (Department of Education, 2007). The programme is set to run between 2007–2010 and include teachers working in almost all aspects of the Swedish K–12 school system Improving schools is one of the major motives for the programme. In the national evaluations conducted by the Swedish National Agency for Education, the outcome of the students' performance in several subject areas has decreased in 2003 compared to the result from 1995 and 1992 evaluations. Research, it is claimed by the government, has shown that the competence of the teacher is one most important factor for the performance of the students. Therefore the teachers are in need of TPD. The focus of the programme should be on the teachers' subject knowledge and their didactical competence, as well as other relevant TPD that might benefit the students' performance. The TPD will be held by the universities appointed the task by the Swedish National Agency for Education. The TPD-courses, which are to be held, are not all given at all universities, the Agency will select those universities and colleges who have the best conditions. This means that the courses to be held must be given in an open and flexible mode, allowing participants from many different regions of the country who are in need of specific courses. Many courses will be given as distance courses using ICT as educational support. Teachers apply for the courses at the universities, but they need approval from their principals and municipalities before entering the programme. This also means that there is a rather large individual influence from the teachers to search themselves for appropriate courses, but at the same time the municipality will have the final words before they could start their TPD.

Case 3: The online learning community Lektion.se

Lektion.se is, according to the website (www.lektion.se), a web-based teaching material produced for teachers by teachers. It is a database of lessons and materials free for use where teachers are voluntarily sharing among themselves. Lektion.se is the largest online community for teachers, teacher trainees and other stakeholders in Sweden, sharing an interest in the practice of schools. Its history dates back to 2003 and originally this community was built in order to make possible for teachers to publish, search and download lesson plans. Activities that are provided free of charge, are member driven, and are flexible in time and space. There are different resources provided for the members. Lektion.se contains an online forum where teachers communicate with other teachers active on the site in a community, as well as providing publishing houses and other producers of educational materials as a way to reach a large group of teachers. The community also includes a database of work opportunities. The forum contains almost 20 smaller sub-forums where discussions have been available for the members for several years. The discussions in the forums are built up by threads, and every one has the possibilities to get a notice each time a new message is written in the forums one chooses to follow. Additionally, there is the possibility to create ones own page and to construct private networks or groups. Lektion.se is with its idea and target group a unique OLC in Sweden. Many groups of stakeholders of the Swedish schools are active in different discussions. Among others, one can find teachers working in pre-school, compulsory school, upper secondary school and different kinds of adult education. In addition, school leaders and school politicians are participating in the discussions.

Case 4: PIM (Practical ICT and Media Skills, a service from The Swedish National Agency for Education)

The Swedish National Agency for Education provides an Internet-based tool for the Swedish schools in order to give them increased access to new tools in schools such as digital cameras, projectors and other teaching resources on the Internet. The PIM brochure (www.skolverket.se) states that PIM offers the opportunity to enhance and broaden skills in the field of ICT use, both on ones own and together with others. PIM consists of ten guides in which teachers with experience of working in schools describe how IT and media can be used. The guides cover different topics, from mailings for a meeting with parents, search techniques and source criticism on the Internet, to compiling images and music to create slideshows. The guides provide step-by-step support, showing how to work with computers. For all sections there are exercises, which can be done alone or together with colleagues. As an Internet resource, studying the content in PIM can be done whenever it is suitable. PIM also contains a study map, which shows different routes that can be taken through the courses, depending on what level of competence that is strived for. If a municipality wishes to implement more wide ranging skills for its staff, PIM can be used to give teachers the opportunity for examination in practical IT and media skills. Examinations take place under the auspices of the municipality, and are attainable at five different levels: individual level, working group level, teaching in the modern classroom, resources for individual schools, and resources in the municipality. These examinations are based on both practical skills and theoretical knowledge. The Swedish National Agency for Education creates the examination environment for the municipality on the Internet and trains the future examinees.

Comparing the Four Cases on Some Characteristics

In an attempt to provide a further understanding of these four cases, this paper is attending to relate the cases to the some characteristics of TPD. Important issues to highlight are the primary stakeholders of the TPD, the features of the TPD in terms of compulsory or voluntarily chosen models, the primary technologies used and the possible effect and evaluation of the TPD. In Table 1 those aspects are summarized for each case.

As can be seen from Table 1, the cases mirror different aspects of TPD, different stakeholders as well as top-down or bottom-up models. The cases also reflect different ways of working with the content of the TPD, and the cases can be seen as using different technologies for managing the TPD. The possible effect and evaluation content of each case could differ, and the main effects are still needed to be investigated in cases 2–4.

Table 1: Comparison of the Four Cases

	Case 1	Case 2	Case 3	Case 4
	ITiS	Lifting the teachers	Lektion.se	PIM
Stakeholders	Government but Voluntarily participation of municipalities	Government, but voluntarily participation of teachers	Personal	Local, Voluntarily participation from municipalities and teachers
Features and Characteristics	Top-down model, but support for local adjustments	Top-down model	Bottom-up approach	Top-down model, with support for bottom-up use
Primary technologies	Face-to-face training	Face to face training combined with distance education technologies	Online community	Online tool
Effect and evaluation	National, municipality and teachers	National, teachers.	Not yet investigated	Local municipality and teachers

Concluding Remarks

So, what could be the implications of these fours cases and their potential for programmes or models of TPD aiming at enhance the practice of teaching and learning? Could there be cases where the use of ICT might affect teaching and learning positively?

The case of ITiS seems to be such a model, where a government initiative provides a framework for the integration of ICT in teaching and learning leading to professional development at teacher level. The long-term effects of ITiS are yet to be investigated. The case of lektion.se has also several features that have a potential to be a powerful model of TETPD. What is yet to be investigated in the case of lektion.se is the effects that the teachers' participation based on their school practice, i.e. their own teaching and learning. The case of PIM also seems to have a potential to be a model which could provide technology enhanced TPD for teachers. The case, which seems to be most traditional and furthest from a TPD that might use technology to enhance the teaching and learning, is the latest initiative lifting the teachers. In this case, there are several features of the model that reminds of the identified barriers of effective TPD.

TPD that is anchored in participation, collaborative activities and dialogue intertwine possibilities for a professional development that offers a way to bridge theory and practice and to enhance teaching and learning. Productive arenas for this purpose need to be identified, as well as arenas for integrating the possibilities that the technology of today affords. In this paper, several cases of such TPD has been discussed, enterprises in which technology as innovation will have a crucial place both as leverage and catalyst of change, and as a pedagogical tool in itself. In such enterprises, technology enhanced teacher professional development may be realised.

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IMPLEMENTING ICT IN EDUCATION — MORE THAN BUILDING THE INFRASTRUCTURE?

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Abstract

Since 1994 Sweden has carried out a number of initiatives for integrating ICT into education that are funded by the Government and other actors. Huge amounts of money have been invested in developing infrastructure. However, it seems that there is still a gap between the claims for ICT use in education and the current practice of using ICT in classroom. The intention of this paper is to present and analyze potential "barriers" that have brought about the ineffective use of ICT in classroom and to provide some backgrounds for suggesting models of Technology Enhanced Teacher Professional Development.

Introduction

IT is one of the most important political issues for the Swedish Government. In the statement of the Government Bill (Proposition 2004/05:175), the new goal for IT politics is that Sweden will be one of the outstanding countries of information society for all. Sweden will strive to be an outstanding IT nation with high use and great benefits of IT in all areas of the society and for all social groups. It is argued that the regulation system, education and infrastructure should give priority to increase confidence in IT, competence to use IT, as well as access to the services of information society in the aim of create a information society for all.

In the area of education, the European policies of ICT in education have had great influence on the Swedish policies of ICT in education system. One of the first policies in European context concerning ICT in education was issued by the Lisbon Council (European Council, 2000). Since then Sweden has been one of the countries in Europe at the leading position of the rapid transition towards the information society, in which to invest and develop integration of ICT into education systems has been the most important national strategy. Following the Lisbon Council policy of EU, Sweden has carried out a number of projects funded by the Government and other foundations such as the Knowledge Foundation (http://www.kks.se/). Most of these programs were nationwide. Huge amounts of money have been invested in developing infrastructure such as Internet access, e-mail use, hard- and software installation in classrooms, as well as in improving teachers´ competence of using ICT in teaching and learning through cooperation among municipalities, universities/institutions and schools. Sweden ranks one of the best among the 27 countries in Europe in dealing with ICT infrastructure in schools (European Commission Information Society and Media, 2006).

A recent commission staff working document (Commission of the European Communities, 2008) reports on how the use of e-learning has developed since the Lisbon Council. In the document it is stated that the impact on education and training has not yet been as great as expected, that embedding ICT in education requires further changes. Although ICT has the potential to support lifelong learning, this has not yet been realized. In the conclusions of the report, it is called for a renewed approach towards ICT for teaching and training. In this approach, one aspect is upgrading the digital competence and to shift from access to quality of use of ICT for learning. Some recent investigations also indicate that a majority of Swedish teachers actually do not use computers in classroom as much as they are expected to do. Knowledge about the use of ICT in teacher education is reported as being not good enough, and almost half of the students are not satisfied with the knowledge they got about IT use in their future teaching (European Commission Information Society and Media, 2006; Knowledge Foundation, 2005, 2006). In brief, in spite of political commitment and financial investment at national level, it seems that there is still a rhetoric-reality gap between the claims for ICT use in education and the current practice that reflects the complicated process of implementation.

This paper emphases on the issues of implementation of ICT in education in Swedish context with a special focus on demands on teachers and their professional development in relation to ICT practice in schools. Integration of ICT into education is actually more than a question of merely innovation of technology and its adoption in practice — it is dealing with all other aspects concerning teaching and learning. What are the conditions, at school and teacher level, that are necessary for a successful implementation of ICT in schools, and what can these be connected to the concern of effective models for teacher professional development aiming at promoting integration of ICT in education?

Background

Integration of ICT in education has been extensively studied in various sub-areas and in different perspectives during the last fifteen years. Some studies have focused on the important role of national policies (macro level) concerning ICT in education (Jones, 2003; Kozma, 2003). It is realized that strategic policies can serve functions such as providing rationales, goals, and visions for integrating ICT in education aiming at motivating change and coordinating disparate efforts so as to improve the nation's overall educational goals. Companion operational policies provide possibility to carry out programs and provide resources to enable these changes. Some studies have emphasized on measuring the impact of variables at individual level (micro level) such as using ICT in classroom, teachers' and pupils' computer attitudes and experiences, as well as gender and ethic issues (Albirini, 2006; van Braak et al., 2004; Volman et al., 2005). Focus on the local conditions for ICT use in education and those school-related factors (meso level) such as variability between schools in organizational culture, policies/action plan, and innovation and performance capacity and contextual characteristics of schools are also presented (E-learning Nordic, 2006; Tondeur et al., 2008).

Increased access to ICT and its potential advantages in teaching and learning have been realized and discussed in many countries around the world. Research has found that ICT is under-used in many schools and the potential of ICT is not being realized (Abrami, 2001; Conlon & Simpsons, 2003; E-learning Nordic 2006; European Commission Information Society and Media, 2006). The potential barriers to a successful and effective integration of ICT in schools are identified by previous research, in which both environmental variables and individual characteristics of teachers are regarded as the critical factors. Environmental barriers concern equipment and resources issues such as limited access, technical problems, lack of time and support; while barriers at individual teacher level deal with issues such as individual differences in beliefs, attitudes, perceptions, knowledge and skills of integration of ICT in education among teachers (Ertmer, 2005; European Schoolnet, 2006; Mishra & Koehler, 2006; Mueller et al., 2008; Wood et al., 2005).

Giving importance to the environmental and organizational conditions in facilitating implementation of technology innovations in education, Ely (1999) also lays stress on factors and conditions at teacher level. According to him, dissatisfaction with the status quo could be an innate feeling or an induced state that calls for change. Existence of knowledge and skills is another important factor that influences the direction and process of implementation in the area of technology innovations, but new knowledge and skills are also needed to make implementation of technology innovation possible and individuals who involve in innovations need thus time and opportunity to renew their knowledge and get new skills. Active participation through shared decision-making and good communication among all parties is also seen as of being crucial. Briefly, these conditions reflect the characteristics of teacher profession in the new technology age and thus claim a new perspective on teacher professional development (TPD), as well as new systems and models of TPD (Villegas-Reimers, 2003). Teachers' ICT training connected to school subject specific practices and immediately and continuous support is regarded as an important influence on how well ICT is embraced in the classroom (Baylor & Ritchie, 2002).

National ICT Policies and Initiatives

In spring 1994, the Government appointed a Commission to promote widespread use of information technology in Sweden. The Commission had a great influence in society during its first years. One of its mayor initiations was the project of National Action Program for ICT in Schools (ITiS) launched by the Swedish Government (Regeringens skrivelse 1997/98:176).

ITiS was an ICT-project as well as a school development project. It included all educational actors in pre-school, compulsory school, special school, sami school, upper secondary school and municipal adult education. All Swedish municipalities chose to participate in all parts of the program. Four guiding principles underpinned the planning of the program and informed the implementation in the municipalities. Equal standards between schools and quality for pupils, as well as the dimension of school development were stressed. A Delegation was formed to take the responsibility of distributing state grants to the municipalities to improve the Internet access of schools, creating opportunities for all pupils and teachers to have e-mail addresses, offering in-service training activities for about 75.000 teachers in teams (about 60% of the total number of teachers in Sweden), making computers available for home use by the teachers who have obtained an ICT certificate, supporting the development of the Swedish Schoolnet and the European School-net, and making special arrangement for functionally disabled students.

Swedish Schoolnet was another initiative carried out to develop ICT access and use in Swedish schools (from 2008 ICT for teachers). It was an online framework for teachers, educators and students with the overall goal to stimulate and support active and collaborative learning by using IT in schools. In the beginning (since 1994) it was provided by the Swedish National Agency for Education (since 2003 by the National Agency for School Improvement) and financed by the government. The Schoolnet had the objective to provide a platform for the development of new educational approaches opened up by the Internet and new multimedia technologies. One of the important functions for Schoolnet was also to give information and to support the decision makers at regional and municipal levels in developing suitable products for use in schools. It functioned also as an information centre, a library and a news agency. Schoolnet was supposed to be a useful forum for communication and activities of teachers and students to set up a network of contacts and initiate discussions with each other all over the world (www.skolverket.se).

From 2008 the National Agency for School Improvement no longer exists, and the content and responsibility for ICT in education was again transferred to the Swedish National Agency for Education. In the Agency’s support for improvement, IT in schools is one area. The Agency now provides a new website, ICT for teachers, for teachers with common interest in using ICT as a tool for education. Through the new website teachers have access to several resources, among which the professional development tool PIM (Practical IT and Media skills) with a purpose of enhancing teacher skills in using Information Technology in schools is worth noticing. PIM is an online platform for teachers with common interest in using ICT as a tool for teaching and learning. Through the website, teachers have access to several resources. PIM is a combination of supervisions on Internet, study circle and daily support. The project is a part of a mission of the Swedish National Agency for Education given by the government. It consists of ten guides in a range of fields covering all kinds of topics. Materials can be used for both individual teachers and teacher teams. The supervisions can even be used in daily work, for instance, when teachers and students need direct help and support in using some programs. All materials are of free use for all educators in Sweden. In autumn 2007 PIM engaged somewhat 30,000 teachers. In addition, teachers are guided to the eTwinning partnership through the website, with a purpose to collaborate through the Internet with partner schools in 27 European countries (http://pim.skolverket.se/).

In 2005, The Swedish Knowledge Foundation started the greatest investment in Sweden on IT in schools and education since the ITiS project. About a hundred million Swedish crowns should be invested in a program to strengthen IT in teacher education during a ten-year period. One reason for this program is the results from the 2005 investigation of the attitudes, access and use of IT of student teachers where it was reported that ICT was not integrated good enough into teacher education and that teachers were not prepared with sufficient knowledge and skills concerning ICT that was needed in their classroom practice (Knowledge Foundation, 2005). The first step in the Knowledge Foundation program has been to initiate three projects (LIKA: Learning, Information, Communication and Administration; KompLIT: Competence development in Teacher Education through IT; Ung Kommunikation: Young Communication), intended to run between 2006 and 2010, to highlight certain areas of teacher education. These projects are to be carried out in cooperation with the municipalities concerning in-service teacher training, as well as with other actors such as industries and institutions. The next step already in progress is to build a network among all teacher educations in Sweden that intends to support experimentation and development of joint projects aimed at increasing the use of ICT in teacher education at large.

ICT Infrastructure in School and Use of ICT in Teaching

One major outcome of these national policies and initiatives in the area of ICT in education is the greater extension of access to IT equipment in Swedish schools. By 2006, all teachers have access to computer in which 45% have own computers in schools. 96% teachers and school leaders have access to Internet and e-mail (Knowledge Foundation, 2006). According to a survey in mission of European Commission (European Commission Information Society of and Media, 2006), all Swedish schools use computers for teaching, and have Internet access by the year 2006. 89% of schools use the Internet via a broadband connection. In fact, in the aspect of infrastructure of ICT in school, Sweden ranks at the top of the 27 countries in Europe according to the survey.

In using of ICT in schools, it is reported that more than 90% Swedish schools have integrated ICT into teaching subjects in one or another way (European Commission Information Society and Media, 2006). However, ICT use by teachers in classroom in Sweden is not the most frequent and intensive in Europe, if comparing to Finland for instance. 54% of teachers use computers in less than 10% of all lessons. The majority of Swedish teachers are satisfied with the technical access means at their schools, but they also state the problems to find adequate learning materials (62%) and argue that the existing materials are of poor quality (54%). In this respect, no other countries in European Union have reached such high figures, which need to have further studies to identify the underlying reasons for this phenomenon (European Commission Information Society and Media, 2006).

E-learning Nordic 2006, which involved four Nordic countries (Finland, Sweden, Norway and Denmark) is the first inter-Nordic study concentrated on the impact of ICT on education. The aim of the study is to discover and document the perceived impact of ICT on education by teachers, pupils, headmasters and parents within three key areas such as performance of the pupils, teaching and learning processes and knowledge-sharing, communication and home-school cooperation. It is assessed by pupils, teachers and parents that ICT generally has a positive impact on teaching and learning, but it was also expected that ICT could and should have more revolutionary impact on teaching and learning processes in schools. The study indicates that the potential of ICT is not being fully realized at all schools and the use of ICT as a tool for pedagogical development is not in focus. ICT has been used in improving knowledge-sharing, communication and home-school cooperation in many schools, but it is not moderate and it is believed that it could and should be a more powerful tool in these areas (E-learning Nordic 2006).

The Knowledge Foundation has, for more than 10 years, supported and developed the use of ICT in schools. During this period the Foundation has continually investigated pupils', teachers' and school leaders' attitudes on ICT use in schools. The latest investigation was conducted in 2006, in which 1200 teachers, 600 headmasters and 1200 upper secondary school pupils participated in the survey. The major results show that a great majority of pupils and many teachers assess the pedagogic usefulness by using ICT in school assignments. However, almost one fifth of the teachers state that they do not use computers in the lessons at all. Teachers who have taken part in ITiS use computers in higher extension than other teachers, and elder teachers use computers in their lessons more than younger teachers do. The result also shows that the IT supported communication has greatly increased. Seven of ten teachers communicate with pupils via e-mail. Six of ten teachers communicate with the parents via e-mail. Generally, using computers in communication, administration and information searching in school context by teachers are more frequently than directly using in teaching (Knowledge Foundation, 2006).

Swedish teachers have positive attitude towards using IT in teaching (83%), but comparing to headmasters (94%) and pupils (89%), this percentage is lower. More than half of teachers realize the usefulness and advantages of integrating IT in teaching as pedagogical tool, i.e. in facilitating information searching, computer practice, and learning, increasing pupils' motivation and stimulating the process of writing and critical thinking, and making easier for communication between teachers and pupils. But on the other hand, more teachers than school leaders and upper secondary pupils realize the difficulties or barriers for using ICT in teaching (Knowledge Foundation, 2006). Major barriers concerned by the teachers were poor equipment (60%) such as too little computers (69%) and too slow computers (51%), as well as teachers' lower competence of using IT (61%). Development of technology is too fast that the teachers (42%) feel that they are not able to keep up with updating their knowledge is another reason given by the teachers. About a half stated that they have had too little time for using IT in teaching. Moreover, concern of wrong use of Internet by pupils and wrong or false information on Internet has also been the reason that teachers do not give priority to integrating ICT in teaching.

In 2005, the Knowledge Foundation conducted a large study on student teachers. The results show that the access to computers and Internet among the students is high, but their use is more frequent at home than at the university. They report having enough knowledge about emailing, information seeking, and word processing, areas in which they use IT in teacher education as well, but their knowledge on using software for presentations is not enough. Only three of ten students report that teacher education has dealt with new skills in the use of IT, and a majority believes that the teacher educators' ability to use IT was not enough. Knowledge about the use of IT in teacher education is not good enough, and almost half of the students report that they are not satisfied with the knowledge they got about IT use in their future teaching (Knowledge Foundation, 2005).

Discussion

In over ten years, the Swedish Government has had sustainable commitment and substantial investment in promoting ICT in schools and encouraging teachers to use ICT. Both strategic and operational policies are provided at the national level. The strategic policies provide common visions of significant expenditures requited for employing ICT in education; while operational policies, which usually frame as action plans, programs or projects, offer the opportunities to enable theses visions to be reached (Kozma, 2003). Some positive outcomes of this national effort have been the development of ICT infrastructure in Swedish schools, cooperation between schools, municipalities, industry and teacher education, and providing teacher training, especially in-service training that emphasizes on teachers' knowledge and skills needed in using ICT in classroom. In this respect, the effectiveness of a degree of top-down initiatives and companions in putting ICT-related change into the large context of educational innovation and school reforms, especially at the beginning, have been proved.

However, central policies and reforms do not automatically lead to practical changes in classroom. The top-down initiatives should follow a grater attention to local conditions to ensure a successful implementation of policies. Furthermore, implementation involves far more than a mechanical application/translation from goals and initiatives into routine procedures and actions. School and individual efforts, initiatives, interpretations and attitudes play en important roll in this process. It is argued that school factors such as school policies, resources, leadership, and collaborative teacher team seem to be positively related to improvement of ICT in schools (Baylor & Ritchie, 2002; E-Learning, 2006; Ely, 1999; Tondeur et al., 2008). In the Swedish case, the reasons teachers give to explain the lower level of use of ICT in their teaching are mostly those concern conditions at organizational/school level such as poor quality of ICT equipment and limited resources of time and money etc. The majority of teachers now have access to and use IT on a regular basis, but the issue could be that at school level, there is absence of long-term plans for continual and sustainable investment and development in improving ICT environment in schools. Innovation of technology goes rapidly and it is needed to renew both equipment and knowledge to keep up in line with the advance of technology (Ely, 1999; European Schoolnet, 2006; Wood et al., 2005).

In the area of classroom innovation related to ICT, it is teachers who are the key determinants of implementation. In using ICT, teachers cannot deny the existence of technology in schools, but how often the technology is used and in what way the technology is used is heavily dependent upon individual teachers. Poor attitude toward technology or fear of using technology could cause teachers to avoid using IT in lessons, which have been evidenced by many studies (e.g., Ertmer, 2005; Mishra & Koehler, 2006; Mueller et al., 2008). The investigation indicates that the majority of Swedish teachers have positive attitudes towards ICT impact in teaching and learning, but they are not satisfied with their competence and capacity in using ICT in teaching. Today's teachers are more familiar with computer and Internet in general, but to integrate ICT in teaching is something more than only the issue of being able to use technology. Having no confidence in using ICT in classroom might depend on lack of ability and the skills of integrating computer technology in their instruction in classroom practice. Furthermore, there is no doubt that teachers' perceptions, experiences, pedagogical beliefs and philosophy have significant effects on their way of teaching. Teachers' acknowledgement of using ICT as a learning/cognitive tool in knowledge construction and the beliefs of own capability of implementing technology successfully in classroom are important prerequisites for ICT practice (Abrami, 2001; Wozney et al., 2006).

In Sweden, it seems that ICT has shifted the focus from policies and programs on providing infrastructure and promoting use of ICT to effectively use by teachers in classroom in order to enhance their teaching and thereby the learning of their pupils, which puts new demands on teacher education and teacher professional development. It is stated in Government Directive (2007:103) by the Committee for a renewed teacher education in Sweden that the new teacher education should ensure teachers the skills needed in concerning and choosing ICT and media for learning. In 2008, the government issued an additional directive (Government Directive 2008:43) relating teacher education to the eight key competencies for lifelong learning stated by the European Union (European Union, 2006), and giving especially importance to the responsibility of teacher education, teachers and schools for developing a digital competence for the future Europe. In autumn 2008, the Committee had presented its inquiry for a new teacher education program (SOU 2008:109), in which it is stated that ICT should be involved in all teacher education programs and ICT should be used as en educational resource.

The lesson Sweden has learnt is that a successful and effective integration of ICT into education needs not only commitment and intervention of the central government, but also full support and initiative participation of the locals and individuals, in which teachers knowledge and skills on ICT and their attitudes, beliefs, as well as ability of ICT use in teaching and learning play a crucial roll. ICT competence should be a central part of the teacher's profession. ICT should not only be a content of TPD that teachers should learn as their knowledge and skill basis, but also a means of promoting an effective TPD. The power of a bottom-up, long-term, reflective, differential, contextualized, collaborative, and pedagogical approach related models of teacher professional development has been stressed recently (Hargreaves, 2006; Villegas-Reimers, 2003), in which a technology enhanced teacher professional development (TETPD) model could be one of them.

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UTILIZING A LEARNING MANAGEMENT SYSTEM IN A BLENDED LEARNING DESIGN TO ENHANCE SELF-REGULATED LEARNING STRATEGIES IN A BACCALAUREATE NURSING FUNDAMENTALS COURSE

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Abstract

Learning management systems which facilitate online learning have transformed higher education. Blended learning, the combination of traditional face-to-face and web-based delivery has proliferated across institutions of higher education at all levels (Newby et al., 2006). These technologies present new opportunities to extend traditional course evaluation to include the efficacy of technology integration as a dimension of instructional quality. Results using the LESSON questionnaire suggest discrepancy between actual capabilities and learners' perceptions of the capabilities of such systems to support self-regulated learning strategies. Recommendations for engaging learners in more self-regulatory behaviours are presented.

Introduction

This descriptive case study is part of a larger research project involving the development and validation of the LESSON, a multidimensional questionnaire designed to assess pedagogical utility in learning management systems (LMSs) and similar e-learning technologies (Bratt, 2007; Bratt & McCracken, 2008). Learning management systems (LMSs), the enterprise systems which support online learning have emerged as core technologies crucial to the successful delivery of online learning environments (Syllabus, 2004). The LESSON is a recently developed questionnaire designed to measure the capability of LMSs to support self-regulatory behaviours from the learner's perspective. Its use in course evaluations could provide instructors, course designers, and LMS administrators with insights as to whether students are using the pedagogical affordances of these systems to support their learning goals.

This paper presents the results of a study assessing the use of Blackboard to support selected learning strategies within a blended learning environment in a first year undergraduate nursing practice foundations course in a Canadian baccalaureate nursing program. Two primary research questions guided this study:

- What types of learning strategies do learners perceive are supported by their course LMS?
- Is there a discrepancy between learner's perceived support and the actual capabilities of the LMS?

The most common delivery mode for Foundational nursing courses is face to face. The course under investigation extends this mode by integrating Blackboard with face-to-face strategies used in the classroom, nursing laboratories and clinical practice. The traditional course evaluation criteria were extended to include the role of the learning management system as a factor in course efficacy. Traditional evaluation criteria include communication skills, organizational skills, etc. However, course instructors were interested in evaluating students' perceptions using non-traditional criteria. As such, a questionnaire designed to evaluate the perceived capability of a LMS to support self-regulated learning (SRL) strategies from the learner's perspective was used to evaluate the course. The following section identifies and describes the learning strategies considered in the evaluation.

Literature Review

A course evaluation can provide feedback to teachers as part of a critical evaluative process to improve the quality of teaching and learning. The evaluation is usually in the form of a questionnaire and may consider factors such: communication skills, organizational skills, enthusiasm, flexibility, attitude toward the student, teacher — student interaction, encouragement of the student, knowledge of the subject, clarity of presentation, course difficulty, fairness of grading and exams, and global student rating (Kim & Hodge, 2000). This present study considers two factors: (a) learners' perceptions of the course learning management system capability to support their learning strategies; and (b) indirectly, if the LMS supports self-regulated learning strategies. Results from the questionnaire will inform revisions to the use of LMS to support the course design.

Learning Strategies: Definitions and Categories

Learning strategies are described as mental activities and behaviours that are engaged by the learner to facilitate encoding during knowledge acquisition which, according to cognitive theory, is central to the learning process (Ertmer & Newby, 1993). Learning strategies are believed to influence the acquisition, organization and integration and later recall of new knowledge (Weinstein & Mayer, 1986). There has been some debate over whether the definition of strategy must include intentionality as a criterion or if strategy selection may reach a level of automaticity as much less conscious attention and reflection is required by the learner. This present research adopts the definition of strategy proposed by

Pressley et al.: “A strategy is composed of cognitive operations over and above the processes that are natural consequences of carrying out the task, ranging from one such operation to a sequence of interdependent operations. Strategies achieve cognitive purposes (e.g., comprehending, memorizing) and are potentially conscious and controllable activities” (1985, p. 4). More simply put, they are specific, goal-oriented methods of attaining a performance standard. An example of a strategy might be rehearsal (repeating items from a list) in order to memorize information. Educational research associated with self-regulated learning typically distinguishes between the three major types: cognitive, metacognitive, and affective (Winne, 1996) which are further subdivided into: (1) rehearsal (2) elaboration (3) organizational (4) comprehension and (5) affective strategies (Weinstein & Mayer, 1986). As this current research is founded on Zimmerman’s (1986) framework, it will exclusively examine cognitive and metacognitive learning. The fourteen SRL strategies contained within the framework are explained in the following section and summarized in Table 1.

Method

Descriptive case study research is used to obtain information concerning the current status of the phenomena to describe “what exists” with respect to variables or conditions in a situation. This case study assessed student’s perceptions of the ability of Blackboard to support specific learning strategies within a Nursing Practice Foundations course.

Nursing Practice Foundations: Description of Course and Structure

The course is described as a blended learning course design in which foundational nursing practice knowledge and skills are attained and integrated within classroom, laboratory, simulation, and practice settings. The course is a complex orchestration of three core course components that include face-to-face instructor led lectures, face-to-face instructor led lab and simulation activities and instructor supervised clinical practice. Since this was a first year undergraduate nursing course, content was pre-structured and required a guided instructor environment. Instructional learning strategies used in the classroom included direct teaching, lecture, lecture with discussion, brainstorming, concept mapping, case studies, worksheets, and guest speakers.

Participants

Participants were drawn from a Baccalaureate Nursing program in western Canada where access to a convenience sample of students enrolled in a first year Nursing Practice Fundamentals course which used Blackboard to support the delivery of the course using blended learning. The sample was selected based on sample size, homogeneity of the sample, consistency of the course web site design and instructional design and complexity of user-system interactions. Three hundred and twenty-seven participated in the survey over 3 academic terms. Mean results show that 1.93 had post secondary education and the majority of students had experience with learning management systems.

Ethical approval was obtained and confidentiality of names and information was maintained. Participants were instructed that they may withdraw at any time and may register a complaint to the Director of the Office of Research Ethics without penalty. Any uniquely identifiable data would not be included in the aggregate data. Participant's data was maintained in a secure location on a password protected computer system.

Data Collection and Instrumentation

This present research describes the role of a course learning management system in supporting the pedagogical goals of students in a first year Nursing Practice Foundations course. The study was introduced to the Nursing Practice Foundations students in their classroom one week prior to the data collection sessions. Participation in the study was voluntary. Class time was provided for participants to assemble in a computer lab in order to complete the web-based questionnaire. Data was collected over 3 semesters using 3 different cohorts.

The data collection in this study had been extended from a prior study to include log data and qualitative data. Log data is a type of archival record of user generated interactions with a computer system. This study used Blackboard's students tracking utility to analyze their interactions with the system. A content analysis of these records enabled us to characterize their activities in the form of strategies (such as seeking information, seeking help, etc.). Data was also collected using the Learning Strategies Support Online (LESSON) questionnaire (Bratt & McCracken, 2008). The LESSON is a 101-item Likert-type rating scale using a 5 point response format with anchor points of *strongly disagree* and *strongly agree*. The questionnaire was developed by one of the researchers as part of a larger study to assess the capability of LMS (and similar e-Learning systems) to support the pedagogical goals of end-users. The instrument had previously undergone an expert review, pre-pilot and pilot testing as part of the validation process. The dimensions measured by the LESSON are derived from the literature on learning strategies — in particular those identified by Zimmerman and Martinez-Pons (1988) as associated with self-regulated learning. Participants were also invited to provide comments about their interactions with Blackboard in a comment box at the end of the questionnaire. Data from all three sources were reviewed and analyzed together to provide a triangulation of results based on both quantitative and qualitative data.

Analysis and Results

Two methods of analysis were used in this study based on the type of data collected: basic descriptive statistics (questionnaire items and log data), and content analysis (qualitative data). Descriptive statistics were used to calculate the mean scores for each of the factors. Results showed that perceptions of learning strategy support were generally positive but varied across factors. Some strategies, such as *Environmental Structuring* and *Self-evaluation* were perceived as strongly supported, while others, such as *Elaboration* and *Transforming*, were viewed as less supported. Mean scores ranged from 3.18 to 4.33 suggesting neutral to strong perceptions of support for learning strategies. Mean scores above 3.7 were identified as significant. Scores < 3.0 indicated neutrality and not indicative of learning strategy support. Mean scores ≥ 3.7 or higher were considered indicative of perceptions of learning strategies support. Table 1 shows the mean scores for each learning strategy.

Table 1: Mean Scores for Each Learning Strategy Factor

Categories of Learning Strategies	$\bar{X}$
Environmental structuring	4.30
Self-evaluation	4.28
Reviewing records	3.96
Seeking information	3.89
Goal-setting	3.82
Seeking help from others	3.80
Monitoring comprehension	3.78
Planning	3.78
Organizing	3.54
Keeping records	3.52
Rehearsing and memorizing	3.47
Collaborating	3.38
Self-consequencing	3.28
Elaboration	3.26
Transforming	3.15

Results

Environmental Structuring

Results indicate that students perceived that Blackboard provided them with the flexibility to access the course resources and information at their convenience. This evidence is corroborated with both Blackboard log data which show that students accessed nursing skill videos on multiple occasions and participants' comments that the ease and utility of Blackboard enabled them to use the site's resources at their convenience enabling them to customize their learning environment to suit their learning preferences.

In a traditional classroom environment access to course materials such as instructional videos would only be available on campus. This restriction limits students' flexibility to review course material at a time and location of their choice. Blackboard tracking statistics recorded 98,887 sessions across three academic terms.

Self-evaluation

Results showed that students believed Blackboard provided them with the ability to judge their learning outcomes. For example, five quizzes provided feedback enabling students to judge their understanding of course content prior to midterm and final exams and potentially adjust their behaviours in order to optimize their learning outcomes. Evidence of self-evaluative behaviours is suggested through Blackboard tracking statistics which show access to My Grades, quizzes and clinical reflective practice journal across all three semesters. Further evidence of Blackboard's capability to support self-evaluation is demonstrated in participants' comments that having access to their grades helped them to evaluate and monitor their progress.

Reviewing Records

Results showed that students believed Blackboard supported their own efforts to review quizzes and videos in order to prepare for labs, class and tests.

Seeking Information

Students felt that Blackboard enabled them to seek for assignments and/or course related work. Blackboard log data show significant use of video, e-mail access, frequently asked questions and rubrics across all terms.

Goal Setting

Mean scores confirm that students knew they had the ability to use Blackboard features to facilitate setting learning goals. Tools such as assignment rubrics provide learners with clear evaluation criteria and performance indicators.

Seeking Help from Others

Mean scores showed that students felt that Blackboard afforded them the ability to interact with each other and their instructors. Tools such as a discussion board and e-mail enable learners to ask for assistance from others. Blackboard tracking statistics show substantial use of the discussion board and e-mail program across three academic terms.

Monitoring Comprehension

Mean scores showed that students knew that Blackboard allowed them to monitor their understanding of course content. Tools such as weekly quizzes enable learners to observe their performance. Blackboard tracking statistics show that students completed 6091 across all three academic terms.

Planning

Results suggest that students believed that Blackboard allowed them to plan the sequencing and timing for completion of educational activities. Tools such as the Course Calendar, Announcements, and Assignment Reminders assist with planning and time management skills. Blackboard tracking statistics confirmed that within a fourth month semester term results show that students accessed the calendar 943 times across three academic terms.

Analysis of the log files was based on frequency of user-generated activity such as accessing the Discussion Board or viewing video files, as shown in Table 2.

Table 2: Blackboard Data Log for Nursing 175

	Frequency			Total Frequency	
Activity	Winter 2008 (*n* = 143)	Fall 2008 (*n* = 157)	Winter 2009 (*n* = 185)		Total Enrollment
Announcements	2781	4015	3096	9892	485
Assessments	2522	5015	3809	11346	
Calendar	353	332	258	943	
Discussions	4028	7363	3905	15296	
Mail	1534	2415	1903	5852	
My Grades	5615	6191	2650	14456	
Files	20054	11537	9511	41102	
Videos	508	783	718	2009	
Quizzes	2941	1611	1539	6091	
FAQs	2086	1279	1904	5269	

Participant comments indicated generally favourable learner interactions with Blackboard. However there were issues regarding instructors' skill level with the system and with navigation and the organization of the course content. Some comments include:

> *"These online resources work great when the instructors understand how to use them. I believe proper training is essential if the tool is to be used for the benefit of the students/instructors"*

> *"Black board is a tool, and much of the issues with it are due to the use of this tool by the users . . . Education needs to be to instructors as well, not just students."*

This feedback suggests issues with how the system is being used — not with the system itself. Additional themes which arise from the qualitative data include a) I can study anywhere, anytime; b) I can monitor progress; c) Everything I need to know is on Blackboard; and d) Blackboard is great for communication.

Discussion

Results suggest that learners perceived that Blackboard is capable of supporting *some* of the learning strategies identified in the Zimmerman and Martinez-Pons model. These strategies are: environmental structuring, self-evaluation, and reviewing records. These results suggest minor discrepancies between learner's perception of system capabilities and the actual capabilities of the system. For example, a mean score of 3.96 for Seeking Information indicates students do not use the abundant course resources available in Blackboard to support this strategy. Similarly, a mean score of 3.80 for the factor Seeking Help from Others suggest that students are not aware of the communication tools that enable them to seek assistance. More significant discrepancies appear with Goal setting, Monitoring Comprehension, Planning and Collaboration. The discrepancy may be attributed to three causes: a) students do not engage in self-regulatory behaviours in an online environment; b) students are unaware of many of Blackboard's features; or c) the course design does not require students to use these strategies. The latter reason may explain low ratings for *Collaboration*. Blackboard was not expected to support collaboration as a learning strategy in this course. The importance of understanding and learning about collaboration in registered nursing is vitally important. Collaboration, in this course, was learned during face-to-face lectures, case studies, labs and in clinical practice.

Further investigation into the relationship between learners' self-regulatory behaviour both on and offline may be informative. Insufficient training with LMSs may also be associated with low ratings for strategy support. Many higher education institutions provide information literacy workshops, writing skills and study skills programs to develop these core skills associated with academic success. One participant commented, "*Didn't know black board had all these applications . . . I wish I would have had an orientation*". Research on the effects of similar learning management systems training on strategy use is recommended.

Low ratings on factors such as *Organizing* and *Transforming*, *Elaboration*, and *Self-consequencing* reflect that fact the Blackboard currently lacks to capability to support these strategies. The system does not provide authoring tools which allow learners to create, customize, and organize notes to suit their learning preferences. Nor does the system enable learners to change the appearance of course content or link to related content presented elsewhere in the course.

The blended learning design of this course created the opportunity for students to adjust their environmental conditions for learning to take place. Whether students are in class, lab or in clinical practice, they can access, review or monitor their outcomes or make changes to their learning goals. More importantly, course content accessed and studied online provided for richer face-to-face interaction with instructors. This flexibility and self-reflection afforded by LMSs such as Blackboard is more difficult in traditional face-to-face classroom interaction.

Limitations of the Study

Two factors present limitations to the study. The first is the single case study methodology which inherently limits generalizability to the local issue. The second factor relates to the validation of the LESSON. While the questionnaire has undergone expert review, construct validation and content validation, pre-pilot, and pilot studies, it is important to note that the questionnaire is still in the validation process. The results of this study will determine the factor structure in order to further validate the dimensions that it measures.

Future Recommendations

The extension of traditional course evaluation criteria to include the efficacy of technology integration as a dimension of instructional quality has proved informative. Log data analysis and participant comments indicate significant and generally favourable learner interactions with Blackboard. However, it is clear from participants' comments that instructors need to be trained on how to use Blackboard effectively — both from a technical and an information design perspective. It is recommended that all instructors involved in the course complete a training session provided by the institution because instructors require face-to-face, hands on instruction, not just the self-help Blackboard provides. Results using the LESSON questionnaire suggest discrepancy between actual capabilities and learners' perceptions of the capabilities of such systems to support self-regulated learning strategies. Recommendations include a training session for students and transforming the instructional design of the course to explicitly require students to engage in self-regulatory behaviours such as organizing and transforming their notes, linking new content to prior knowledge (elaboration), setting learning goals, and collaborating with others.

Finally, the results of the study suggest that a more learner-centered design of the system is required in order to support the self-regulatory behaviours which are associated with academic success. Software applications such as graphical organizers, academic planners, annotation tools and knowledge management tools could be integrated into LMSs. The ability to customize course content; create one's own content and organize information to suit the learner's preference are strongly recommended in future designs of this system and similar e-learning systems.

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PHEROMONE THERAPY: DESIGN FOR LEARNING ONLINE

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Abstract
Learning online presents challenges for tutors and students alike and retention is poor. The Pheromone Therapy online course was designed to include opportunities for induction, interaction and social communication. The social aspects of learning online are often seen as prime motivators in building effective learning experiences. Interviews with students, primarily mature workers in veterinary surgeries, while revealing support for induction and interactivity, suggested that learning experiences which were situated in practice, with opportunities for shared participation, created the greatest cohesion and sense of community.

Introduction

The last 10 years has seen the introduction of pheromone-related products for the management of a range of behavioural problems in small and companion animals but with no formal or independent qualification for those seeking a wider knowledge of such treatments. In response to the increasing interest among veterinary professionals, the author was invited to design a course, Pheromone Therapy, to fill this gap. This paper will look at the theoretical and the practical elements considered essential for effective online learning design and report on findings from the author's investigation into the experience of the first cohort of students on the course.

Distance Delivery

Early distinctions between "digital natives" and "digital immigrants" have evolved into debates about levels of digital literacy. The digital divide is now less about access to technology but more about the ways in which it is used (Prenksy, 2001; CIBER, 2008). Distance online delivery involves a dual learning curve. When the prime delivery mechanism is a virtual learning environment it should be expected that the student cohort is likely to present a mix of prior digital experience.

Innovation theory (Rogers, 1995) recognises that identified need is a prime motivator for change in practice; for students this motivation may be a return to academic study. The majority of distance delivery involves at least some, if not all, online components, so students selecting flexible models of education may face a technical as well as a pedagogic challenge and designers of online courses need to recognise the dual nature of this challenge. Students uncomfortable with virtual environments are less likely to become successful online learners than those familiar with engaging with a range of digital content. Ensuring time and opportunities are built in for students to find their digital feet, as well as their academic ones, may be a key to online learning design.

Pheromone Therapy was delivered via a ‘conventional’ virtual learning environment (VLE). The decision to use an institutionally hosted resource, and not to incorporate ‘new’ Internet social networking tools, was underpinned by the philosophy that the technology should enable learning and not direct it. This is not to say that new Internet technologies, such as participant-led blog and wiki software, do not have educational validity, but it was felt important to ensure a digital baseline. This could be achieved by using the VLE already familiar to staff, thus reducing their digital learning curve, as well as maintaining existing technical support including the ICT Help Desk. The primary focus was to create an effective learning experience using resources that enabled social and pedagogical interaction. With appropriate content, it was felt that a typical virtual learning system could provide the balanced mix required.

Underpinning Theory

The technical processes of online delivery must reflect, and be informed by, appropriate pedagogical approaches. Accounts of online learning experiences have been criticised for failing to draw upon theoretical positions and following commonsense rather than theoretically informed design (Conole et al., 2004). Underpinning practice with theory is essential if desired outcomes are to be effectively mapped against the most appropriate tools and activities.

Design for effective online learning requires a creative approach to rational issues such as curriculum alignment and assessment. When designing the Pheromone Therapy course it was felt important to move away from a content driven style that replicated the transmission model of face-to-face delivery. Rather than text-based resources, a more interactive environment was sought — one which supported a constructivist approach where students could engage in meaningful learning experiences. Application of the principles of curriculum alignment to virtual learning environments emphasises a need to develop appropriate activities which are relevant to the learning outcomes, but which also give the student opportunity to test their knowledge acquisition in a formative and engaging manner.

The affordance of the Internet for collaboration, and the nature of resource-based, independent learning assume the student is both self-directed and motivated. Yet these qualities are often outcomes of higher education and not necessarily present from the start. Students new to learning online may need encouragement and support with the processes of engaging with virtual communication. Appropriate scaffolding can provide support when required and be withdrawn as the student gains in confidence. Such scaffolding exploits the Zone of Proximal Development (ZPD) defined by Vygotsky (1978) as the distance between the learner's current and potential cognitive development. Support from staff or peers, who already have the prerequisite skills, alongside opportunities to practise new skills, create a framework of peer, social and task 'presences' identified as essential components of effective online practice (Garrison & Anderson, 2003).

Translating face-to-face support and social interaction into a virtual environment can take time and models for establishing an online community suggest phased activities that encourage sharing of information (Salmon, 2000). A process of assimilation into a new online environment may be necessary to reduce feelings of isolation. Students who experience initial difficulty with text communication have an opportunity to practise while also building relationships and getting to know their colleagues socially. Research on Computer Mediated Conferencing (CMC) suggests that giving students time to establish relationships with colleagues helps build the foundations for future confidence in online contributions (Preece, 2000). Once the teaching elements of the course have begun, social interaction should then be directed towards areas with a specific societal focus.

Pheromone Therapy was underpinned by a network of opportunities for social interaction. Activities designed to establish social presence included a 'café' discussion forum and a gallery for student photographs. The weekly lectures were supported with individual online tutorials. These offered opportunities to apply learning to practice and enabled meaningful engagement with content. The process of collaborative learning through shared activity was seen as encouraging student learning to be situated within their lived experiences and help develop a network of social, peer and task relationships described by Wenger (1998) as a Community of Practice.

Design for Online Learning

Distance delivery can pose a significant paradigm shift from traditional transmission modes. Didactic pedagogies, where students are passive recipients of knowledge, become less appropriate. Emphasis shifts from delivery to support; from the lecturer being the 'fount of knowledge' to the facilitator of the student learning experience. Effective learning experiences require more than digitised lecture notes and handouts and if maximum advantage is to be gained from online communication opportunities, synchronous and asynchronous discussion needs to be planned, monitored and moderated. Rather than having a single person in a lecture theatre, design for online learning requires a multi-team approach.

Lecturers retain their importance but the team involves learning developers and learning technologists with the appropriate academic subject librarians and administrative support staff. It can be a complex undertaking and the time required to set up an online course is often seriously underestimated. Unlike face-to-face delivery, virtual learning areas offer valuable opportunities for pre-course testing therefore involving additional roles of critical friends and colleagues.

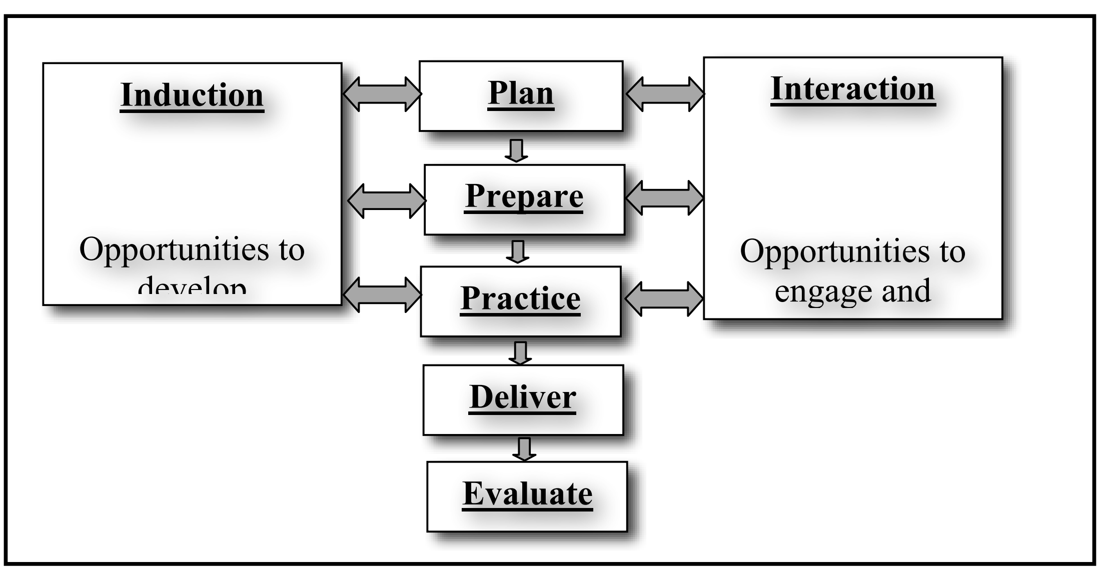
The practice of creating a digital course, within an appropriate theoretical framework, can be best enabled through a model of instructional design where the essential processes are identified and given structure. Part of this process involves creating a framework of learning outcomes, appropriate activities and assessments, and then breaking these down into discrete, manageable chunks. This way, effective learning experiences can be constructed — ones that rely heavily on active user engagement with pedagogically informed content.

Instructional design identifies the key learning experiences, and staff allocation to tasks and responsibilities, within an overall time frame. The process offers a creative approach to rational issues such as curriculum alignment, and achievement of learning outcomes, but includes built in capacity for flexibility should the need arise.

Instructional Design

Traditional instructional design taxonomy has roots in the rudiments of face-to-face delivery and can be successfully applied to design for online learning. Traditional models (Fardouly, 1998) encompassed the key stages required but failed to acknowledge the disproportionate investment of time and resources the learning design entails. The author adapted existing models to create one which more accurately reflected the process and is shown in Figure 1.

Figure 1: The 3PD Design Model Used in the Pheromone Therapy Course



The core of the model consists of the **Plan**, **Prepare** and **Practice** stages followed by **Delivery** and **Evaluation**. Two key processes of **Induction** and **Interaction** were then incorporated into the first three stages. Induction included activities focused on preparation for learning and the establishing of 'social' presence and communications. Interaction involved the design and construction of activities designed to enable the 'cognitive' and 'teaching' presences identified by Garrison and Anderson (2003) as prerequisites for optimum online learning conditions.

Induction. As already referred to, learning online poses a dual technical and pedagogical challenge, especially if the student's existing experience is limited to a traditional transmission model. Pheromone Therapy used the Induction phase to create a pre-course space for dealing with technical problems without them impacting on progress in the early weeks of the course. This was also seen as the time to begin to build the social connections which were seen as integral to an effective online community.

The process of building online social links began with a request for students to introduce themselves and establish common links and points of interest. Further exchange of social information took place through an online photo gallery which was also an opportunity to check skills with uploading and attaching files. Extending this early collaboration, students were asked to engage with Net-etiquette and work together to construct their own preferred guidelines for communicating online. At the end of the Induction phase, students were asked to compare themselves with how they felt at the beginning thereby introducing the concepts of reflective practice that underpin the learning experience.

Induction began the process of building a social community at an early stage in the educational journey, before teaching started. Opportunities for social exchange were seen as important for building confidence and establishing the skills necessary to operate successfully within a virtual learning environment. Ensuring a 'social' presence, and giving the cohort a sense of itself as a cohesive social group, was seen as an essential component in building and maintaining a learning community. Most importantly, recognising the poor retention rates with distance delivery (Ormond, 2003), induction is a process that can make students feel valued and welcomed; a good experience at the start of the course may improve the chances of completion.

Interaction. Discursive interaction is key to the construction of meaning and knowledge in virtual learning environments. To maximise this potential, each Pheromone Therapy tutorial had an associated discussion area with pertinent questions and a weekly synchronous tutor-led session. Interaction in forums can produce powerful learning experiences, but resource materials that support and enable interaction are also recognised as having valuable learning potential.

Repurposing existing face-to-face content into small activity-based learning objects and chunks including active involvement with content offered rich stimulation. The challenge for the author was to minimise the technical knowledge required to construct these activities so that the focus was on pedagogic content. Following the principle that interaction encourages engagement, pheromone lectures were recreated as audio-visual tutorials that included narration, animation and video set in a user controlled environment. Each tutorial was supported by supplementary activities with formative and summative assessment opportunities. Supporting individual recall and revision, these check points for learning were produced using design templates which could be customized in terms of appearance and content with options for individual question feedback.

Principles of inclusive design were adhered to throughout construction of the learning area and all multimedia content was accompanied by appropriate transcript materials. Inter-activities were provided in a variety of formats including a textual alternative and an extensive pre-course evaluation 'tested' the interactive content with a variety of users and assistive technologies.

Research

The decision to research the student experience of the first delivery of Pheromone Therapy was seen as an opportunity to investigate what JISC (2007) described as being the 'under researched world' of the learner in a digital age. It allowed the author to assess in more detail the effectiveness of the learning design and draw attention to identified course strengths and weaknesses. The author conducted an initial evaluation via an online survey. A researcher was then employed to contact the students, all professional workers within veterinary practice, and identify those willing to participate in the research study.

Methodology

The study is based on a transcendental phenomenological approach to social research, first developed by Husserl (1963) and further advanced by Schutz (1962), which allows an examination of how respondents construct intentional conscious structures and attach and share the meaning of phenomenon (ibid). The rationale for this approach is to examine the students' constructs of intentional structures from interaction with the VLE and with each other. Although this approach does not provide 'hard data' with regards to identifying correlations between particular variables (in fact, it implicitly contests both the validly and reliability of the more objectivistic epistemological approaches to social research (Schutz, 1962)), it does allow the research to examine the student experience of online learning, which at times presents contrasting and competing constructions of this experience. Although the findings are based on the experience of a small sample, which of course raises the issue of generalisability, Guba and Lincoln (1994) state that research of this nature is valid in its own right and that the findings are transferable to similar situations. Thus, the research is able to suggest conclusions and recommendations which can be made in terms of developing VLEs and providing an online learning experience that is inclusive and pedagogically effective.

The research was administered using asynchronous email interviews with the 2007/08 student cohort. The rationale for this approach was grounded in the phenomenological approach, the impracticality of interviewing students in person due to the geographical dispersion of the respondents, which is quite common with online learning cohorts, as well as the difficulties of arranging telephone interviews with respondents who were all fully engaged with demanding full time careers. Due to these constraints it was decided the most practical approach to data collection would be asynchronous email interviews. Although this method of data collection allowed the research to get access to respondents that would have otherwise declined to participate in the research, there were a number of disadvantages, which are aptly highlighted by Bryman (2004). These included the difficulty of establishing a rapport between the researchers and respondents and the length of time it took to complete the data collection stage (3 months). In addition, a small number of respondents did not fully complete all aspects of the interview, which led to minor gaps in the data. Despite these drawbacks, the method of data collection allowed access to data that would have otherwise been unreachable.

The data was analysed using discourse analysis which allows an in-depth examination of how different and competing conscious constructs are created and represented through language. While there a number of approaches to discourse analysis, the one adopted by the research is based on the work of Potter (1997), which is both anti-realist and constructionist in its ontological and epistemological approach, and thus is an entirely logical form of analysis for a phenomenological methodological approach based on the conscious constructs of respondents. This analytical approach is significant in the fact that it allowed the research to explore the constructs of the students' experiences of the VLE and online learning in general. Moreover, the approach also is advantageous over other forms of language data analysis such as content analysis in that it can be applied to other forms of communication such as the written word (Bryman, 2004), and thus is appropriate for an online platform that is heavily, if not solely, reliant on the electronically written communication.

Research Findings

The induction phase of Pheromone Therapy, designed to ensure students had the necessary technical skills to be effective online learners, lasted for two weeks.

This was thought to be adequate at the planning stage but students reported that they would have liked a longer period of time. Examination of technical support help desk records suggest that there were initial difficulties with logging on and unfamiliarity with the digital environment did take some students time to become accustomed to.

> *"I would have appreciated receiving the induction materials earlier than I did."*

> *"I recommend that you get the materials out at least a month before the start so all kinds of glitches can be sorted."*

The initial programme evaluation showed that the number of students who rated their computer skills as "not confident" at the start of the course (41.2%) had significantly fallen (6.3%) by the end of the course.

When asked to comment on their increased confidence with using the technology, students typically reported positive benefits from participating on the course:

> *"[I now feel] more confident with future online learning programmes since participating in this one"*

These comments emphasised the importance of not underestimating the value of pre-course preparation and also not taking for granted that students automatically have the appropriate digital competences.

Overall, the students were unanimous that the course had been a beneficial learning experience; they valued the specialist nature of the content but found the pace too fast, with many suggesting fortnightly rather than weekly tutorials. There may need to be a greater spread of the workload in future courses, or this could have been a reflection on the students' pre-existing level of digital skills which meant they took longer to access, absorb and respond to the new knowledge. The question will be more carefully phrased in subsequent investigations.

Students were unanimous in highly rating the Pheromone Therapy lectures. In particular the user controls enabling replay and revision, and the provision of transcripts to all students were seen as excellent tools for enhancing learning.

The interactive assessments designed to engage students with content and assess levels of knowledge throughout the course were rated by all students as "Very Useful." Comments on the Interactive assessments included:

> *"Well designed to build up knowledge."*

"Very helpful and many more could be included in the future."

"I enjoyed the multiple choice questions on this week's activity."

"They were a quick and entertaining way of learning."

"Useful and clarified my understanding."

The discussion forums attached to each tutorial were also highly valued. One interesting outcome was the extent to which the tutorial discussion forums were the main focus of learning experiences while the social café forums were largely ignored.

This paper has already suggested that the processes of shared activity encourages student learning to be situated within lived experience. This combination of social, peer and task relationships, creates opportunities for effective learning derived from sharing practice-based knowledge. Lave and Wenger (1991) suggest a series of activities to stimulate the development of a community of practice. Table 1 shows how discourse analysis of the discussion forums identified examples of this process.

Table 1: Evidence for Development of a Community of Practice

Activities suggested by Lave and Wenger (1991) as integral to communities of practice.	**Discourse analysis from discussion forums**
Problem solving	"I was wondering what advice would you give to an owner who has adult cats and wants to introduce a dog to the household."
Requests for information	"I've been reading the 'Truth about Dogs' by Stephen Budiansky…does this suggest that some associated stress behaviours cannot be avoided?"
Seeking experience	"I know this wasn't one of the discussion group questions but I would like to ask how many people do home visit behavioural consultations rather than the client coming to the clinic."
Reusing assets	"I listened last night to a lecture on the hospitalised cat – evaluating the stress. I will put some of the point on another thread."
Coordination and synergy	"I have some of these lectures on cd rom and will try to circulate them; hope to get something organised next week."

Discussing developments	"Does anyone use any other assessments that I can't think of here?"
Documentation projects	"Here's the link. I hope it will work. If it doesn't I can send anyone who is interested the pdf file."
Mapping knowledge and identifying gaps	"I've never done kitten socialisation classes but would be intrigued to see one. It would be interesting to find out if people think kitten parties would help."

While students were avid contributors to the Tutorial based discussion forums, they were less interested in opportunities for social communication. The Café type forums were only partially visited initially and eventually fell into disuse.

When asked about how students saw the importance of getting to know the others in their cohort the typical response was

> *"I don't feel it was necessary"*

Reasons given for not contributing to the Gallery were in a similar vein.

> *"It was nice to see but I don't really feel it was that beneficial."*

> *"It didn't make much difference to me personally."*

Students were also asked if they missed an opportunity to meet up for an induction day; the majority of other distance delivery courses at the university encourage a face-to-face induction session but this was not seen as detrimental.

> *"Maybe if it was a longer course but not sure it would make a huge difference."*

> *"It was the fact that I didn't need to do campus inductions and getting to know other students that this course appealed to me"*

With this cohort of students, the identified needs for an induction period, interaction with content and the provision of opportunities for the social side of learning were only borne out in the first two instances. Both induction and interaction were appreciated but with regard to societal contact, the student focus was clearly on practice-based communication.

Conclusion

Pheromone Therapy presented the author with a unique opportunity to design and develop an online learning course. Innovative practice included pre-course Induction activities designed to give students the skills required for virtual learning and extensive use of multimedia and inter-active resources. Opportunities for socialisation were seen as key to building an effective online community but the research into the student experience indicated that societal attention was focused exclusively on situated learning. Encouragement to build social relationships was largely ignored and online communication was notably restricted to the application of new knowledge to practice and the sharing of that experience. There are clear implications for future course design, in particular in terms of providing an online experience that is inclusive and pedagogically effective: firstly, the expected confirmation that students need time to find their digital confidence prior to starting their course and secondly the student appreciation of high levels of interaction and formative assessment. This cohort of students expressed little interest in getting to know each other socially. It needs to be established if this was a finding unique to this group or an identifiable feature of all similar practice-based learning and attention will be paid to this in evaluation of future cohorts.

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USING E-LEARNING TO IMPROVE PRESCRIBING PRACTICE IN EMERGING PRESCRIBERS

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Abstract

This paper reports on The National Prescribing Curriculum (NPC), a series of online, case-based modules designed to improve prescribing performance and confidence in emerging Australian prescribers. The modules mirror the decision-making process outlined in the WHO Guide to Good Prescribing (de Vries et al., 1994) and were developed as an initiative to combat emerging data that, increasingly, medical graduates demonstrate shortfalls in basic pharmacological knowledge and prescribing skills (Hilmer et al., 2009). The modules are situated in real life situations and include complex, authentic tasks. As most learners access the modules in a self-paced mode, sophisticated levels of expert and peer feedback have been integrated into the modules.

Introduction

Prescribing errors and adverse drug reactions are largely preventable but remain the most common cause of injury to hospitalised patients (Bobb et al., 2004; Nichols et al., 2008; Roughhead & Semple, 2008). In one study, 9.2% of inpatient medication orders contained at least one prescribing error, of which 4% were serious enough to report as medication incidents (Dean Franklin et al., 2007). This percentage of error appears to be increasing and has significant consequences for patient safety (Heaton et al., 2008; Maxwell et al., 2006). Prescribing errors may be caused by a combination of factors involving the environment, team, individual, patient and task. Therefore the idea that a single intervention will prevent prescribing errors is simplistic. As part of a multi-layered solution Coombes et al. (2008) note that “Safe-prescribing skills and awareness of medication errors is required by all members of the health care team, and should be a core component of undergraduate and post-graduate training programs” (p. 93)

Increasingly data is emerging internationally that medical graduates demonstrate shortfalls in basic pharmacological knowledge and prescribing skills and that graduates feel they have had inadequate training in this area (Coombes et al., 2008; Heaton et al., 2008; Hilmer et al., 2008). Results from an Australian study involving 191 interns, indicated that “Interns about to commence supervised clinical practice in NSW teaching hospitals demonstrated severe deficits in prescribing of regular medications, initiation of new therapies, prescribing of discharge medications and particularly prescribing of Schedule 8 medications” (Hilmer et al., 2009, p. 8) The authors note that most of these graduates recognize they are inadequately prepared and would have like more pharmacological training as undergraduates. Similarly, 74% of 2413 UK medical students (who participated in a web-based survey) felt that the amount of clinical pharmacology teaching was “too little” or “far too little” (Heaton et al., 2008).

PBL and Changes in Medical Education

Problem Based Learning (PBL) has now been adopted as the major teaching methodology by most universities in Australia (and many around the world). One consequence of this change has been that some scientific disciplines have now been “synthesized in a horizontal integration of the scientific curriculum around studying the major body systems” (Woodman et al., 2004, p. 1195). This has resulted in a minority of graduates receiving distinct courses and assessments in basic and clinical pharmacology, an area that was previously taught as a specific discipline (Heaton et al., 2008; Maxwell et al., 2007). Given that we know that safe and effective use of medicines requires an understanding of clinical pharmacology, it’s not surprising that a British Government report reviewing the causes of medication errors, recommended enhanced pharmacology and therapeutics training for medical students and junior doctors (Coombes et al., 2007). The challenge in this context is providing students with more exposure to the principles of clinical pharmacology in a manner that is congruent with a PBL curriculum.

Additionally in Australia, many undergraduate medical courses have dropped from a 6-year to a 5-year degree and graduate medical degrees can be completed in 4 years. The second challenge is in finding innovative ways to help medical students absorb large amounts of knowledge in shorter time periods. Dalziel (2007) also notes that in the continuing education of doctors, there is an onus on medical practitioners as adult learners gaining medical knowledge offsite and after hours and that the most common way for doctors to access scientific information is through online journals, articles and research databases. Education of undergraduate students therefore needs to prepare them for a self-directed adult learning style, while being flexible enough to fit around other commitments.

The National Prescribing Curriculum

In meeting the above mentioned challenges, an e-learning solution seemed ideal. The National Prescribing Curriculum (NPC) is a series of case-based modules which mirror the decision-making process outlined in the World Health Organization (WHO) Guide to Good Prescribing (de Vries et al., 1994). The modules are offered free of charge and are currently used by all Australian medical schools and a number of Pharmacy, Dental and Nurse Practitioner schools. The emphasis in the NPC is on learners building their own personal formulary of preferred drugs for specific conditions enabling them to prescribe confidently and rationally.

The WHO Guide to Good Prescribing

The WHO Guide to Good Prescribing provides a set of structured stages that include: setting therapeutic goals for a particular patient; deciding on a therapeutic approach (including considering non-drug options); if a drug is needed; choosing and checking the effectiveness, safety and appropriateness of the preferred agent for that individual patient; writing a prescription; monitoring treatment of the patient; and providing the patient with information, instructions and warnings (de Vries et al., 1994; Shakib, 2003; Woodman et al., 2004).

Developing a Personal Formulary

The WHO guidelines (de Vries et al., 1994) focus on the process of prescribing and at its centre is the development of a personal formulary. The rationale is that emerging prescribers will develop a limited set of drugs which they will use rationally for specific indications (de Vries et al., 1995; Heaton et al., 2008; Maxwell et al., 2006; Shakib & George, 2003). “In view of the impossibility of teaching students all basic knowledge on the thousands of drugs available, the approach seems to be an efficient way of teaching rational prescribing” (de Vries et al., 1995, p. 1454).

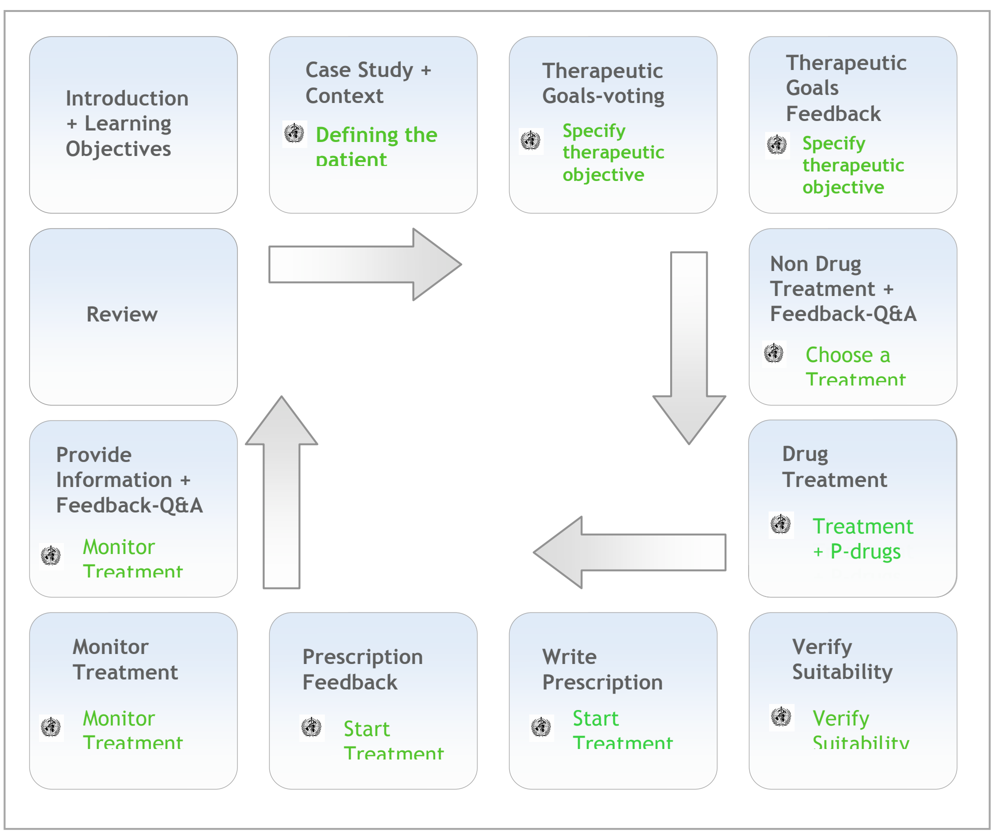
In selecting drugs to be added to their personal formulary, the WHO method forces emerging prescribers to make important decisions. Taking into consideration, pharmacological, clinical and epidemiological principles, prescribers narrow down the process from choosing drug classes to specific preferred (P)-drugs to add to their own formulary. By having to consider alternative therapies prescribers are better equipped to choose alternative drugs for specific patients, based on rational, evidence-based decisions. The framework for decision-making will also assist prescribers make decisions more critically throughout their career when appraising new drugs on the market (de Vries et al., 2008).

Learning Design — A Template for Self-paced Delivery

There are three central ideas behind learning design: that learning should be active, that activities are orchestrated (using workflow) and that learning designs can be recorded, modified, shared and re-used (Britain, 2004). Currently the most common mode of delivery for the modules within universities is self-paced and therefore our basic template is for a self-paced delivery model. The template is, however, flexible enough to be easily modified to suit different delivery methods (a blended environment in a tutorial for example) and to incorporate different activities when needed.

We have developed our modules using LAMS (Learning Activity Management System) software. Each module takes learners approximately one hour to complete. Learners access the modules through a self sign in process, organized with their universities. The following figure represents each stage of the WHO Guide to Good Prescribing (de Vries et al., 1994) mapped to a LAMS activity and sequenced together to form one module.

Figure 1: Stages of the WHO Guide to
Good Prescribing Mapped to LAMS Activities



Description of a Typical Module

The content of each LAMS activity in a typical module is described below. The information includes the activity title, the LAMS tool used, the stage mapped to the WHO Guide for Good Prescribing (de Vries et al., 1994) and a description of the activity.

1. Title: Introduction. **Tool:** Flash object inside a LAMS Noticeboard.
Learners are introduced to the topic, given the learning objectives and links to the Australian Medical Handbook (AMH), WHO and National Prescribing Service (NPS) Guides to Good Prescribing.

2. Title: Case Study and context. **Tool:** Flash object inside a LAMS Noticeboard. **WHO**: Defining the patient problem.
Learners are given the context where the prescriber is working and to whom they report. Students are also given a provisional diagnosis for the patient along with other necessary patient results.

3. Title: Therapeutic Goals. **Tool:** Voting tool LAMS. **WHO**: Specify the therapeutic objective.
A list of short-term therapeutic goals (including red herrings) is given. Learners may nominate as many as they wish. They then see their peers' answers represented in graphical format.

4. Title: Therapeutic Goals Feedback. **Tool:** Flash object inside a LAMS Noticeboard. **WHO**: Specify the therapeutic objective.
Expert feedback on the previous exercise is given. Literally the expert is an industry specialist who wrote a particular module. The concept of the expert is represented through an image.

5. Title: Non Drug Treatment + feedback. **Tool:** Question and Answer tool LAMS. **WHO**:'Choose a treatment.
The next four steps are the most critical in the prescribing process. Drug options are not always the most appropriate form of treatment - non drug options must also be considered. The Q&A tool was chosen so that learners can see peer answers and have a sense of their peers' presence online. Peer feedback is followed by expert feedback.

6. Title: Drug Treatment. **Tool:** Drug Tool +My Formulary LAMS. **WHO**: Choose a treatment + P-drug.'
Drug treatment should be based on: efficacy, safety, suitability and cost. This tool consists of three pages that narrow down the process from choosing drug classes to specific P-drugs to add to their own formulary. All drugs in this tool are linked

with the most current information from The AMH and Therapeutic Guidelines in line with requirements for evidence-based, rational resources.

7. Title: Verify Suitability. **Tool:** Flash Object inside a LAMS Noticeboard.
WHO: Verify suitability.
The prescriber now needs to check that the P-drug is suitable for their individual patient. They are given more specific patient information (medical history, allergies, test results and so on) to narrow down their choices before writing a prescription.

8. Title: Write a prescription. **Tool:** Prescription tool LAMS. **WHO**: Start treatment — e.g., write an accurate prescription.
Learners follow a process where they search for drugs in their formulary, select drugs for the prescription, enter doctor, patient and drug details into the prescription, preview and print the prescription and get feedback from an expert on the correct prescription. This process mirrors real-life prescribing.

9. Title: Expert Feedback. **Tool:** Flash Object inside a LAMS Noticeboard.
WHO: Start treatment.
Feedback from the previous section shows correct prescribing. This section allows feedback on incorrect answers, common mistakes, adverse reactions and allergies.

10. Title: Monitor Treatment. **Tool:** Flash Object inside a LAMS Noticeboard.
WHO: Monitor treatment.
The process of prescribing doesn't stop after writing a prescription. This activity (and the following two activities) requires learners to think about what is needed to monitor a patient's progress. Learners choose between a list of possible options, get feedback on each individual choice, and then get more detailed feedback from the expert.

11. Title: Provide Information + feedback. **Tool:** Question and Answer tool LAMS. **WHO**: Give information and instructions.
Learners are asked to list information, advice and warnings that they need to provide to the patient, carers and other health professionals. They then see their peers' answers and expert feedback.

12. Title: Review. **Tool:** Flash Object inside a LAMS Noticeboard.
This MCQ activity provides a quick review of the module. Learners can do the quiz as many times as they like and are provided with feedback.

Design Values

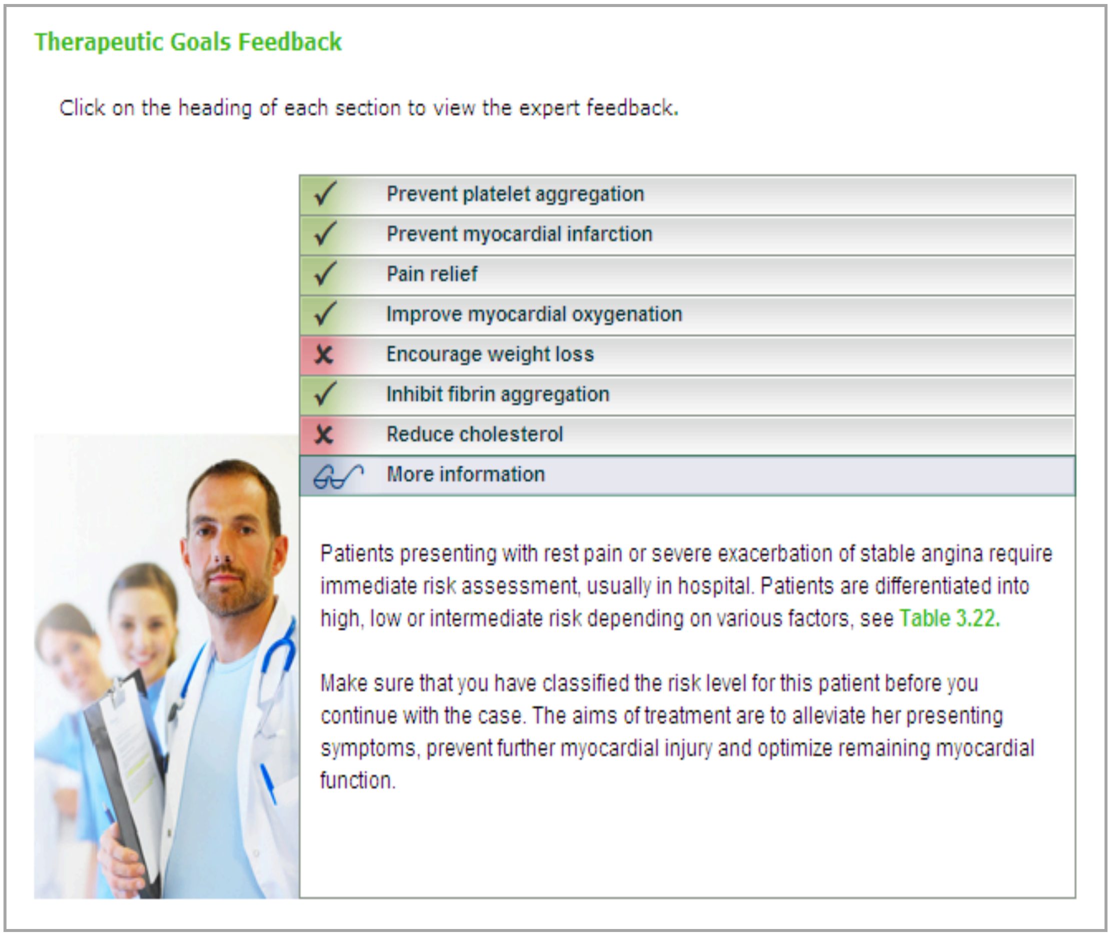
Design values are always an integral part of the instructional design process. Goodyear states that learning designs should represent "educational values and vision" (Goodyear, 2005, p. 82). Reigeluth concurs: "And we have seen that values play an important role in an instructional–design theory in that they underlie both the goals it pursues and the methods it offers to obtain those goals" (1999, p. 14). The following are some of the design values that impacted on our learning design for the National Prescribing Curriculum.

Greater Levels of Feedback for Learners

One of the central components of constructivist learning theory is that students should be given complex and authentic tasks that reflect the types of problems they need to solve in real life (Herrington et al., 2000; Reigeluth, 1999). In addition learners are increasingly being given more responsibility for their own learning, and asked to act as self-directed learners and identify and bridge gaps in their own knowledge (Waters & Johnstone, 2004). As noted earlier, medical students are time poor and have many competing curricular interests. In requiring students to be increasingly autonomous in their learning, it is also vital to provide them with adequate support and scaffolding: "Learner autonomy means increased responsibility for the student which, if it is to succeed, requires a strong framework of support and guidance for the students from the outset" (Herrington et al., 2000, p. 403).

Expert feedback. Given that we know that the majority of our students use our modules in a self-paced mode with little input from tutors, built in mechanisms for feedback were vital in the development of our curriculum. At various points throughout a module, students receive expert feedback. There are visual clues to indicate that the model answer is expert feedback (see Figure 2 below). In order to provide more appropriate and extensive feedback to learners, we have engaged in a process of consultation with key industry experts to write content. Additionally learners have access to a series of four interactive tutorials on how to use the curriculum.

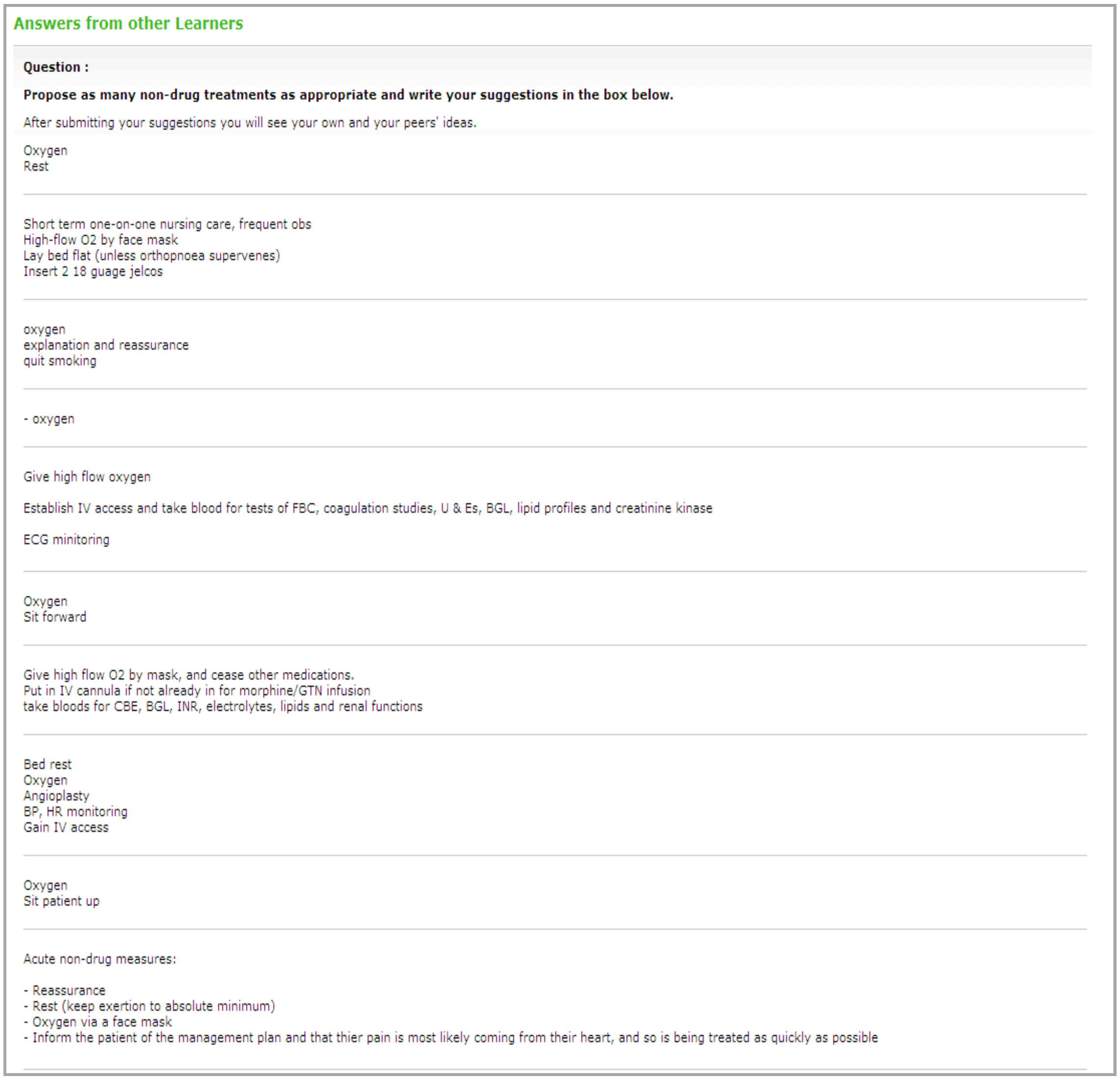
Figure 2: Expert Feedback — Learners Equate this Image with ‘The Expert’



Peer feedback. Increasing student autonomy means a shift in role for the instructor as the main agent of learning to that of a facilitator of learning — a “guide on the side” versus a “sage on the stage” (Reigeluth, 1999, p. 19). Reigeluth notes that with this shift opportunities arise for other ‘agents’ in leaning, one of which is other learners. Moore (1996) has also noted three levels of interaction that are important to consider when designing online curriculum: learner to content, learner to instructor and learner to learner.

With this in mind, we have tried to provide a learning environment that fosters learner-to-learner interaction. In a number of points in a module we used the question and answer tool in LAMS. Students are asked a question, which they type into a space provided. On the following screen they can then see all their peers’ responses (see Figure 3 below) before going on to receive expert feedback. This provides students not only with the opportunity to learn from their peers but also to reflect on and assess how their responses compare to others.

Figure 3: Peer Feedback


Answers from other Learners

Question :

Propose as many non-drug treatments as appropriate and write your suggestions in the box below.

After submitting your suggestions you will see your own and your peers' ideas.

Oxygen
Rest

Short term one-on-one nursing care, frequent obs
High-flow O2 by face mask
Lay bed flat (unless orthopnoea supervenes)
Insert 2 18 guage jelcos

oxygen
explanation and reassurance
quit smoking

- oxygen

Give high flow oxygen

Establish IV access and take blood for tests of FBC, coagulation studies, U & Es, BGL, lipid profiles and creatinine kinase

ECG minitoring

Oxygen
Sit forward

Give high flow O2 by mask, and cease other medications.
Put in IV cannula if not already in for morphine/GTN infusion
take bloods for CBE, BGL, INR, electrolytes, lipids and renal functions

Bed rest
Oxygen
Angioplasty
BP, HR monitoring
Gain IV access

Oxygen
Sit patient up

Acute non-drug measures:

- Reassurance
- Rest (keep exertion to absolute minimum)
- Oxygen via a face mask
- Inform the patient of the management plan and that thier pain is most likely coming from their heart, and so is being treated as quickly as possible

Active and Authentic Tasks

Giving students real world problems and authentic tasks to complete, aims to provide learning experiences in which students are actively involved, giving direct experience of new concepts (Waters & Johnstone, 2004). The rationale is that students are better able to transfer knowledge to new situations when they are able to make meaningful connections between what they are learning and how they can apply it: "This is because a learning environment that mirrors the real world and provides students with concrete experiences is likely to promote the application of knowledge and, therefore, a deeper understanding" (Waters & Johnstone, 2004, p. 415).

The "write prescription" activity is one example of authentic task design. Learners follow a process where they search for drugs in their formulary, select drugs for the prescription, enter doctor, patient and drug details into the prescription, preview and print the prescription and get feedback from an expert on the correct prescription. The five prescription types have the same fields and look very similar to real life prescriptions used in Australian public hospitals and general practice.

But writing the prescription is only a small part of the prescribing process. By using a case-based, patient-centred curriculum, aligned to the stages outline in the WHO Guide to Good Prescribing (de Vries, 1994), our curriculum emphasizes prescribing as a process and not as a single activity. We have been able to delve into other related aspects of each case such as engaging in clear and effective communication with the client, their carers and other health professional colleagues and offering non-drug and lifestyle measures as management options (National Prescribing Service, 2006)

Conclusion

> These modules are the anchor for this unit of study and an invaluable resource for the student nurse practitioner. The use of clinical cases allows the students to integrate the process of safe and efficacious prescribing within the context of real life situations and is a major strength of the prescribing modules. Students overwhelmingly appreciate the resources provided within the modules.
>
> — Dr Tom Buckley (Course co-ordinator, University of Technology Sydney).

Thus far we have had very positive feedback from both learners and educators on the National Prescribing Curriculum. Later in 2009 we look forward to formally evaluating the modules to provide us with more concrete data on whether we are achieving our aims to improve prescribing performance and confidence (in emerging prescribers). We are also committed to a process of continuous improvement and are therefore also very interested in learner and instructor experiences and perceptions in using our curriculum. This process will involve collecting process data through survey and outcome data through Objective Structured Clinical Examinations (OSCE).

Note

The National Prescribing Service is an independent, non-profit organization who provide accurate, balanced, evidence-based information and services to help people choose if, when and how to use medicines to improve their health and wellbeing.

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INTEGRATING COMPUTER SIMULATION TRAINING INTO MEDICAL CURRICULUM — A QUICK AND BASIC APPROACH

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Abstract

This paper reports on the integration of a radiological computer simulation into a clinical practice course for undergraduate nurse students and on the evaluation of this integration. The primary objective is to investigate whether a quick and basic approach to integration is sufficient in order to promote learning. We evaluate the integration as a product from a student perspective by inquiring, through interviews, into their experiences of learning with this simulation training and into their estimates of key integration design choices. Our overall conclusion is that a quick and basic approach to integration such as ours can be sufficient in promoting learning.

Introduction

This paper will report an attempt to integrate a computer simulation into a university course for nurses. Simulations have been used for training purposes in medical education for some time and are now widespread, they are however not thoroughly researched (Bradley, 2006). One important function they serve is to prepare trainees for a practice in which there is little or no space for trial and error, and achieving this in a milieu that is safe and ethically defensible. In medical education, undergraduate training on actual patients is sometimes impossible because it is not safe or not ethically defensible. (For further introductions see for instance Issenberg et al., 2005 and Gaba, 2004). One example of this is learning to perform radiographic examinations. Correct positioning of the patient, X-ray tube and film, as well as interpretation of X-ray images, is essential in preventing diagnostic errors that can lead to excessive radiation exposure and/or poor patient outcomes. The risks associated with radiation prohibit pure training on peers and patients.

This motivated the Learning Radiology in Simulated Environments project, within which educational, medical and technical expertise has cooperated in developing and evaluating training with a radiological simulator. This has been done in primarily *experimental* settings and results implied for instance that simulation training improve proficiency development in comparison to conventional training even though the activity in the latter seemed more in line with theoretical ideals (Söderström et al., 2008). However, the links between experiments and educational practice are not absolute, and integration and evaluation of computer simulation training in practice is thus a necessary supplement.

Other researchers, such as Davies (2002) and Rystedt and Lindström (2001), have argued that not only the simulator but the learning environment as a whole and the integration of simulation into curriculum is crucial in order to promote learning. Rystedt and Lindström, one of the few examples of Swedish educational researchers in this field, argue that "both the integration of the simulation and the design of the simulation itself are decisive for the consequences for learning" (2001, p. 139). This suggests that integration is not to be taken lightly. However, as a teacher you may not have the time or motivation to engage in a potentially complex and time-consuming processes of integration but still want to introduce the technology to the students.

With this paper we therefore want to investigate whether quick and basic integration is sufficient in promoting learning. This is done by integrating simulation training into a university course for nurses and evaluating it as a product from a student learning perspective.

Design

This section will describe the university course studied, the cervical spine simulator, the integration of simulation into the course and the evaluation.

A University Course for Nurses

Nursing Procedures in Conventional Radiological Procedures is a 30 credits clinical practice course for students attending the second year on the Diagnostic Radiology Nursing Programme at Umeå University. This course considers care, method and technology in computer tomography and ultrasound procedures as well as conventional radiological procedures. It is divided in two parts, one part given on the third semester and one given on the fourth. It is into the latter that the simulation has been integrated. It is a ten-week course with eight weeks dedicated to clinical practice training at local and regional hospitals. The first week is dedicated to theoretical, methodical and practical preparations, the following eight weeks to training and the last week to exams and closure.

The reasons for choosing this course were that the simulation matched its content and because that it was given at a time and place that suited our project.

The Cervical Spine Simulator

The simulator is a standard PC equipped with simulation software. It has two monitors: one representing a three-dimensional anatomical model, X-ray tube and film; the other representing two-dimensional X-ray images. The control peripherals used for interaction include a standard keyboard and mouse as well as a special mouse-like device.

Using the simulator the students can perform real time radiographic examinations of patients' cervical spine, which is one of the examinations studied and practiced in this course. It allows the user to position the three-dimensional model of the patient, X-ray tube and the film. X-ray images can then be 'exposed' at will by students, immediately presented by the simulator as geometrically correct radiographs rendered from the positions of the models. Exercises have been developed for the simulator including replication of standard views, replication of incorrect views. It is also possible to view the two-dimensional X-ray image change in real-time as the model is manipulated and experiment in an improvised manner. Training is thus performed in a safe environment without the use of ionizing radiation. For further technical specifications and description of validity see Nilsson (2007).

Quick and Basic Integration — Key Features

The integration was a compromise between three factors: practical conditions framing the course, experiences from our previous experiments and an aspiration to keep things simple. It was done in collaboration with course teachers and included demonstration of the simulator and a meeting focused on practical conditions of the course and experiences from our previous research. In the end all decisions were made by the teachers.

It was decided that the simulation training should be added to existing activities instead of replacing anything and that it should primarily consist of one mandatory training session performed during the first course week. The course schedule allowed for it and it required less effort than replacements would have. Students were also enabled to reserve the simulator for additional independent training throughout the course. Other researchers have indicated that students would use simulators in their spare time if available (Bloom et al., 2003). Also, we assumed that this kind of self-regulated training could promote learning without requiring further investments. Student introductions to the simulator were given in connection to a regular lesson instead of at every group training session. This was complemented by a hand-out with basic instructions to keep the sessions going. Training groups were created in connection to these introductions and training sessions were scheduled. Two hours was reserved for each group, and the students themselves decided how much of this to use. Other key settings for the mandatory training session were as follows.

The number of students in each training group was two. There were three reasons for this. One was that experiences from previous experiments suggested that three students might be too many for this type of training. The second was that the total time needed for the sessions was cut in half in comparison to solo groups. The third was that these nurses, in clinical practice, often will work in groups of two.

The training groups were created by the students themselves, i.e. they choose whom to work with. There were two reasons for this. One was that experiences from previous experiments indicate that the students have opinions about who makes a good partner. The second was that the teachers do not have to put extra effort into the creation of groups.

There was no teacher present, overlooking, the training sessions. There were two reasons for this. First, our belief that this simulation training could be performed without one, that the simulation and hand out instructions in themselves would be sufficient in, to use Grahams (2002) concept, structuring the learning activity. Second, that teacher presence would have required a more intrusive reshuffling of teacher resources.

Evaluation of Simulation Integration

We have chosen to evaluate the simulation training integration as product from a student learning perspective. After all, it is students in the process of learning that this training is supposed to assist. This makes student appreciation of the training an important aim as well as a valuable indicator of integration success. The basic assumption is that a failed integration would produce student rejection and that a successful integration would produce student appreciation. So we wanted to describe students' experiences of actually learning with the simulation training under the given circumstances. We have thus performed interviews, inquiring about students' estimates of the simulation training contribution to learning, to fulfilling course aims and to preparing for future clinical work. We complemented this by inquiring about their estimates of key design choices such as group size, group creation, teacher presence, and the possibility of additional independent simulation training during clinical practice.

Subjects were all undergraduate students taking the Nursing Procedures in Conventional Radiological Procedures course described above. Course population was 12 students. While participation in simulation training was mandatory, participation in this study was of course voluntary. One of the students chose not to participate due to matters of private nature, giving a total of 11 interviews.

The interviews were semi-structured and performed at the end of the course during a period of one week. Each had a time limit of 60 minutes and was conducted in a classroom familiar to the respondents. All interviews were recorded on tape and later transcribed.

Results

This section is divided in two sections: first, student appreciation of simulation training contribution to learning, to fulfilling course aims, and to preparation for future clinical work; second, student appreciation of key design choices for the integration, i.e. group size, group creation, teacher non-presence and the possibility of independent simulation training during clinical practice.

Contribution to Learning, Course Aims and Future Clinical Work

Contribution to learning. All participating students claim that the simulation training contributes learning within the course. Some students focus on the development during the training session, while others focus on its value in preparing for the clinical training. One woman says:

> *I understand the basics now, for radiology in general as well, how the image changes when the tube is turned.*

This coming to understand the relationship between the 'camera angle', the 3D-model and the 2D X-ray image is a recurring theme in the interviews. This particular respondent claims that this is of general value, not only in relation to this specific examination/body part. Another, male respondent focus on the preparatory aspect of the training when saying:

> *I wasn't unfamiliar with the examination then [in clinical practice], I could identify the anatomy, know how to correct bad images.*

Contribution to fulfilling course aims. All participants claim that the simulation training contributes to the fulfilling of course aims. Several respondents note, in some way or another, that the cervical spine modelled in the simulation was only one part in a larger course. In response to the direct question a male student says:

> *To some extent. It fulfilled its function well, but the cervical spine is only a minor part of the course. I helped me understand better, to see in different ways.*

Contribution to preparation for future clinical work. All students claim that the simulation training helps prepare them for future clinical work. This is related the previous questions about learning and course aim. A male student commented:

> *Especially as an introduction to it [the future clinical practice]. It is significantly better trying and failing with a simulator or dummy than with a real patient. From a radiation point of view. Absolutely.*

Group Creation, Group Size, Teacher Presence and Independent Training

Group size. All students appreciate working in groups of two. It is preferred before individual training as well as training in groups of three. The benefits stated for working in groups focus on discussion, where different perceptions and perspectives contribute to problem solving and learning, reducing the risk of getting stuck and pressuring students to make their ideas explicit. In the words of a female respondent:

> *It is always beneficial to have two approaches, to be able to discuss and find a way that works for both. So that both understands and can remember later on.*

The benefits stated for working in groups of two instead of working in groups of three or more include more time for each individual to manipulate the simulator, less risk of 'chaos' due to too many opinions, less risk for polarization and someone being excluded, and when sitting in front of a PC simulation three is a crowd.

Group creation. Most students (9/11) explicitly claim that creating groups themselves is beneficial for learning, the other two are ambivalent. The responses reveal that students, as might be suspected, given the chance will pick a friend over someone less familiar to them. The stated benefits of this is that it makes collaboration easier by lowering the threshold for asking questions, lessening the fear of embarrassment, encouraging discussion and participation. Some add that this is more important in larger student classes. However, two of the students raise an interesting question about whether or not learning to collaborate with just about anyone should be an aim since:

> *When you work out [in practice] you don't know who you will end up with.*

Teacher presence. Most students (7/11) claim they see benefits in working without teacher present, as they did during the mandatory simulation training. The reasons for this include that having a teacher present encourage asking for correct solutions instead of actually trying and making valuable mistakes. As one of the male respondents put it:

> *. . . you learn more from making mistakes and correcting them yourself than by having someone showing you what to do.*

Not having someone looking over your shoulder reduces the fear of embarrassment and gives you more time to think things through. However, having a teacher present can be beneficial when working with the simulator for the first time so as to quickly overcome potential technical issues.

Simulation training during clinical training. All students claim that the possibility of simulation training during the clinical training period was not frequently realized. In fact, out of 11 respondents only 3 used the simulation a on their own and in those cases only one time each. The primary reason for not training was that students felt they were choosing between simulation training and clinical training and valued the latter higher. And since clinical training was so intense students felt there was no time so spare for simulation training. A female respondent explains:

> *The lab I was working in treated patients all the time so I had no possibility of leaving. I thought, there will be some slow day I can spend on training. But there weren't many slow days. So I chose to focus on real patients.*

Lack of availability is also stated as a reason for not training, primarily when students were in a clinic out of town.

Discussion

We have evaluated simulation training integration as a product from a student learning perspective. Results indicate that our quick and basic approach has been sufficient in promoting learning. There is no doubt that the students have appreciated the simulation training. They believe that it has contributed to learning, to fulfilling course aims and to preparing them for future clinical work. Several respondents noted that the cervical spine examination is only one among others to be studied within the course. However, the simulators central function of illustrating how the two-dimensional X-ray image transform as the three-dimensional model is manipulated received special notice in the interviews as something principal valuable. This indicates that the training has contributed with a lesson of general value.

Our aspiration to keep the integration simple led us to exclude the teacher from the simulation training, enable additional independent training throughout the course and leave work group creation to the students. It is interesting to note that not only do students accept the responsibility of creating groups themselves and training without teacher present, they see benefits in it. It seems to promote student initiative and engagement during the training, suggesting that hand-outs and simulator are sufficient in structuring the learning activity (Graham, 2002). Additional independent training was not frequently performed due to students choosing clinical practice with real patients over simulation training, and due to students periodically being in clinics out of town which limit actual availability to the simulator. This illustrates one limitation of the 'always available' argument for using simulators applied by for instance Engum et al. (2003). Promoting actual availability further might increase usage, but in our case only at the cost of purchasing more simulators and distributing them to the hospitals where students perform their clinical practice.

We also note that working in groups of two is appreciated by students. It seems to allow for the benefits of working in collaboration without producing the drawbacks of social complexity associated with larger groups, supporting the *smaller is better* rule of thumb (Graham, 2002).

Like Rystedt and Lindström (2001) we believe that simulation integration can be vital in order to promote learning. What we have shown with this study however is that a quick and basic approach to integration can be sufficient.

Limitations

There are limitations associated with using student appreciation as a measurement of the simulation integration. It excludes, for instance, impact on students' clinical performance. This is, however, a limitation that is not easily transcended when evaluating actual educational practice. Students have equal rights to the best available education making it hard to defend experiments where students are given different training. Also it is not necessarily obvious how to delimit clinical performance. If both training and practice is collaborative, should we still evaluate individual procedural proficiency?

We also have the issue of how general these results are. Are they valid for other simulations for example? It seems natural that evaluations like ours to some extent will be dependent on the simulation itself. A less intuitive simulation, for instance, may depend on there being a teacher present to help students overcome usability issues. Then again, if the simulation is too complex we have to ask ourselves if it is worth the investment in the first place. There is a wide range of simulations used in medical education differing in a number of ways (see for instance Meller, 1997; Lane et al., 2001), which makes the specifics of the result shifty. The generality of the overall conclusion however need not be dependent on these specifics. Further research on other simulations in other contexts could help us shed light on this issue.

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EVALUATION OF MOBILE AUTHORING AND TUTORING IN MEDICAL ISSUES

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Abstract

Mobile computing facilities may provide many assets to the educational process. Mobile technology provides software access from anywhere and at any time, as well as computer equipment independence. The need for time and place independence is even greater for medical instructors and medical students. Medical instructors are usually doctors that have to treat patients on top of their tutoring duties. Mobile features are complementary to web-based features for desktop computers in a high extend in asynchronous e-learning environments. Time and place independence is also a considerable potential for medical students with overloaded educational duties. In this paper we examine the degree of usefulness of mobile facilities for medical instructors who wish to author and manage their courses using a mobile authoring tool. Furthermore, we investigate how acceptable and useful the mobile features of an e-learning system have been to medical students that have used the system, in comparison with the use of the system through a desktop computer. In addition we investigate usability issues.

Introduction

In the last decade, there has been a growing interest in mobile technology and mobile networks. As a result, a great number of services are offered to the users of mobile phones including education. In the fast pace of modern life, students and instructors would appreciate using constructively some spare time that would otherwise be wasted. For example, when they are traveling or even when they are waiting in queue. Moreover, medical students and their instructors may have to work on lessons at any place, even when away from offices, classrooms and medical labs where computers are usually located. Assets of mobile interaction include device independence as well as more independence with respect to time and place in comparison with web-based education using standard PCs.

Mobile education may be quite impersonal since the presence of a human instructor and human co-students may not be available. A remedy to this kind of problem may be given by providing affective interaction based on the user's emotional state. The recognition of emotions can lead to affective user interfaces that take into account the users' feelings and can adapt their behavior according to these feelings. Regardless of the various emotional paradigms, neurologists/ psychologists have made progress in demonstrating that emotions play an important role in the process of decision making and action deciding [1].

Moreover, the way people feel may play an important role in their cognitive processes [2]. Recently, significant research effort has been put in the recognition of emotions of users while they interact with software applications. Picard points out that one of the major challenges in affective computing is to try to improve the accuracy of recognizing people's emotions [3]. Improving the accuracy of emotion recognition may imply the combination of many modalities in user interfaces. Indeed, human emotions are usually expressed in several ways. Human faces, people's voices, or people's actions may all reveal emotions.

Ideally, evidence from many modes of interaction should be combined by a computer system so that it can generate as valid hypotheses as possible about users' emotions [4]. It is hoped that a multimodal approach may provide not only better performance, but also more robustness [5]. As it is stated in [6], although the benefit of fusion (i.e., audio-visual fusion, linguistic and paralinguistic fusion, multi-visual-cue fusion from face, head and body gestures) for affect recognition is expected from engineering and psychological perspectives, our knowledge of how humans achieve this fusion is extremely limited.

In previous work, the authors of this paper have implemented and evaluated with quite satisfactory results emotion recognition systems, incorporated in educational applications ([7], [8]). As a next step we have extended our affective educational system by providing mobile interaction between users and a mobile tutoring system. In many situations this means that learning may take place at home or some other site, supervised remotely and asynchronously by a human instructor but away from the settings of a real class.

The main characteristic of the proposed mobile medical tutoring system is that it combines evidence from two modes, namely the mobile device's microphone and keyboard, in order to identify users' emotions. The emotion recognition assumptions from the two modes are combined through a multi-criteria decision making method. More specifically, the system uses Simple Additive Weighting (SAW) [9] for evaluating different emotions, taking into account the input of the two different modes and selecting the one that seems more likely to have been felt by the user. In this respect, emotion recognition is based on several criteria that a human tutor would have used in order to perform emotion recognition of his/her students during the teaching course.

After a thorough investigation in the related scientific literature we found that there is a shortage of educational systems that incorporate multi-modal emotion recognition, not to mention affective medical educational systems. Even less are the existing affective educational systems with mobile facilities. In [10] a mobile context-aware intelligent affective guide is described, that guides visitors touring an outdoor attraction. The authors of this system aim mainly at constructing a mobile guide that generates emotions. On the contrary, our proposed educational system for medicine aims at recognizing users' emotions through their interaction with a mobile device rather than generating emotions.

As a second related approach we found that Yoon et al. [11] propose a speech emotion recognition agent for mobile communication service. This system tries to recognize five emotional states, namely neutral emotional state, happiness, sadness, anger, and annoyance from the speech captured by a cellular phone in real time and then it calculates the degree of affection such as love, truthfulness, weariness, trick, and friendship. In their approach only data from the mobile device's microphone are taken into consideration, while in our research we investigate a mobile bi-modal emotion recognition approach. Moreover, our proposed system is incorporated in a medical educational application and data pass through linguistic and also paralinguistic level of analysis. This derives from the fact that in an educational application we should take into consideration 'how' users speak, using a microphone, or type, using the keyboard (such as low or high voice, slow or quick typing speed), as well as 'what' users say or type (such as correct answers or mistakes).

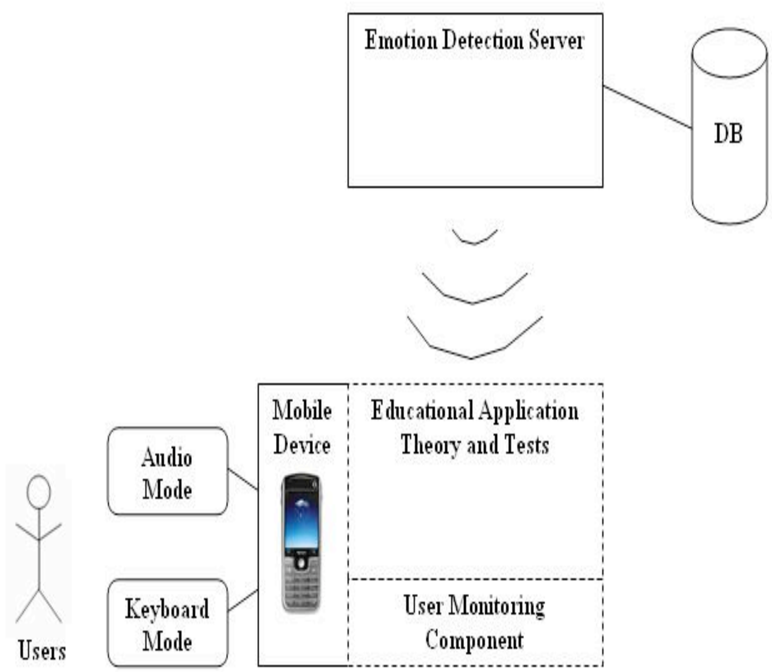
In view of the above, in this paper we describe a novel mobile tutoring system for medicine that incorporates bi-modal emotion recognition through a multi-criteria theory. We examine the degree of usefulness of mobile facilities for medical instructors who wish to author and manage their courses using a mobile authoring tool. Furthermore, we investigate how acceptable and useful the mobile features of an e-learning system have been to medical students that have used the system, in comparison with the use of the system through a desktop computer. In addition we investigate usability issues. The approach that we have taken for this investigation is through a study that involves medical instructors and students who were asked to use both the mobile and standard desktop facilities of the medical educational system, so that we could compare usability issues among the two modes. As a result, most medical instructors and students found mobile facilities useful and easy to use. However, users who had previous computing experience would prefer to combine mobile facilities with standard desktop computing rather than depend on them exclusively. On the other hand, users with no computing experience were happy to use their mobile phones.

Overview of the Mobile Medical Tutoring System

The main architecture of the mobile bi-modal emotion recognition system is illustrated in Figure 1. Medical students are able to use their mobile device and interact with a pre-installed medical tutoring application. Their interaction can be accomplished orally (through the mobile device's microphone) or by using the mobile devices keyboard and of course by combining these two modes of interaction. All data are captured during the interaction of users with the mobile device through the two modes of interaction and then transmitted wirelessly to the main server. This means that the actual emotion recognition process takes place on a main server and not on mobile devices, which have limited capabilities in data processing and storing. When an emotional state is detected the emotion detection server transmits this information wirelessly back to the mobile device that has initiated this process. Correspondingly, input actions are used as trigger conditions for emotion recognition by the emotion detection server. Finally the resulting data sets that are comprised of all the detected input actions as well as possible recognized emotional states are stored in the emotion detection server's database.

The discrimination between the medical students and their instructors is done by the application that uses the main server's data base and for each user a personal profile is created and stored in the data base. In order to accomplish that, user name and password is always required to gain access to the medical tutoring system.

Figure 1: Architecture of the Mobile Emotion Detection system



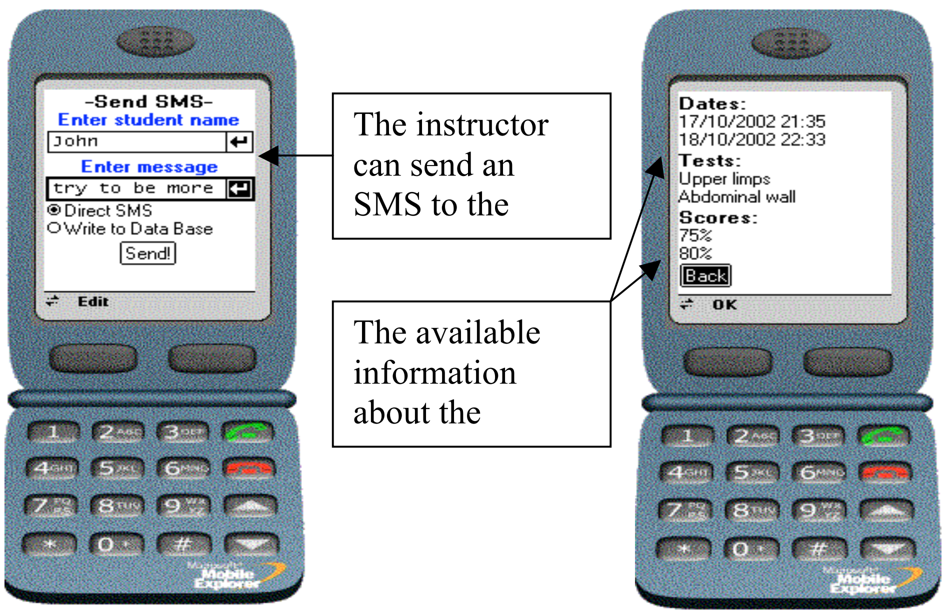
A snapshot of a mobile emulator operated by a medical student is illustrated in Figure 2. Medical students may write their answers through the mobile device's keyboard, or alternatively give their answers orally, using their mobile device's microphone. In both cases, the data from the two possible modes of interaction are stored in the main system's database (emotion detection server), in order to be processed for emotion recognition purposes. During the short examinations, the system also tries to perform error diagnosis in cases where the answers have been incorrect. Error diagnosis aims at giving an explanation about a mistake taking into account the history record of each user and the particular circumstances where the error has occurred.

Medical instructors can also use the mobile medical tutoring system through the educational process. Medical instructors and their students are not only able to have easy access to the databases of the application, but they can also "communicate" with each other. The communication between them can be realized in many ways. By using a mobile phone (and thereby connecting to the application's mobile pages) medical instructors can send short messages via the Short Message Service (SMS), either directly to their students (if they also have mobile phones) or by e-mail. Alternatively medical instructors can store a message to the application's database. In this case, they have to declare the name of the receiver and the tutoring system will use its audio-visual interface to inform her/him as soon as s/he opens the application.

Figure 2: A medical student is answering a question of a test either using the keyboard or orally through the mobile device's microphone

An example of an instructor monitoring the progress of a student through a mobile phone and sending an SMS to him is illustrated in Figure 3. Both teachers and students are able to send short messages (SMSs) containing remarks and additional information. The body of the SMS is entered in the "enter message" field and the name of the receiver is written in the "enter student name" field.

Figure 3: A medical instructor monitors the progress of a student and sends SMS



Multi-criteria for Emotion Recognition

The proposed mobile medical tutoring system incorporates a highly sophisticated emotion recognition module. As a first step in specifying the criteria that would lead to emotion recognition, we specified basic input actions through the mobile device's keyboard and microphone that take place during the interaction of users with the medical tutoring system. These input actions provide information for the emotional states that may occur while a user interacts with an educational system. The overall functionality of this approach also incorporates user stereotypes and (recognition of emotions through audio-lingual data and keyboard evidence) is explicitly described in [12, 13] for the case of interaction through a personal computer. However, analysing the empirical studies that lead to the specification of the weights for each input action requires more comprehensive writing and is beyond the scopes of this paper.

Input actions are considered as criteria for evaluating all different emotions and selecting the one that seems more confident. There are six emotional states for the system to recognize, namely happiness, anger, sadness, disgust, surprise, as well as the neutral emotional state. More specifically, each emotion is evaluated first using only the criteria (input actions) from the keyboard and then only the criteria (input actions) from the microphone. According to the proposed approach, in cases where both modalities (keyboard and microphone) recognize the same emotion, the probability that this emotion has occurred is increased significantly. Otherwise, the mean of the values for each emotion is calculated and the one with the higher mean is selected.

Considering the mobile device's keyboard we have the following categories of user actions: a) user types normally b) user types quickly (speed higher than the usual speed of the particular user) c) user types slowly (speed lower than the usual speed of the particular user) d) user uses the "delete" key of his/her mobile device often e) user presses unrelated keys on the keyboard f) user does not use the keyboard. These actions are considered as criteria for the evaluation of emotion with respect to the user's actions through the keyboard.

Considering the users' basic input actions through the mobile device's microphone we have seven cases: a) user speaks using strong language; b) users uses exclamations; c) user speaks with a high voice volume (higher than the average recorded level); d) user speaks with a low voice volume (low than the average recorded level); e) user speaks in a normal voice volume ;f) user speaks words from a specific list of words showing an emotion; and g) user does not say anything. These seven actions are considered as criteria for the evaluation of emotion with respect to what users say.

For the evaluation of each alternative emotion the system uses the Simple Additive Weighting method, SAW. However, the overall functionality of this approach exceeds the scopes of this paper, since our main aim is to focus on the evaluation of the resulting system. For a thorough examination of the incorporation of an emotion recognition module into a sophisticated mobile system we may refer to past work of the authors [14, 15].

Evaluation

Software that is meant to help the educational process can be considered successful if it is approved by human instructors and is educationally beneficial to students. Otherwise it may not even be included in the educational process and may not be accepted by its targeted users. Thus, evaluation of this kind of software is an important phase that has to follow development at all times.

For the evaluation of the resulting mobile educational system 10 medical instructors, as well as 100 medical students participated. All of the instructors who participated in the experiment were familiar with the use of computers. In addition, they had been trained for the use of the mobile medical system before the experiment.

When interviewed, all of the instructors confirmed that the resulting system had a user-friendly interface and that the mobile facilities were either useful or very useful. More specifically, 9 of them stated that they found the mobile facilities either useful or very useful both for the creation and the maintenance of their courses whereas only 1 of them said that s/he had not used the mobile features at all during the creation of the course but they found them useful during the maintenance of the course. The exact answers of instructors to questions about the mobile features of the authoring tool are illustrated in Figures 4 and 5. As expected, all of the 9 instructors who found useful the mobile features of the application for both phases, made clear that they had used the mobile facilities in a complementary way with a desktop computer, since the authoring process involves inserting a lot of data. Thus it would have been difficult for anyone to develop the whole course using a mobile phone.

Figure 4: Instructors' opinions about the usefulness of mobile creation of courses

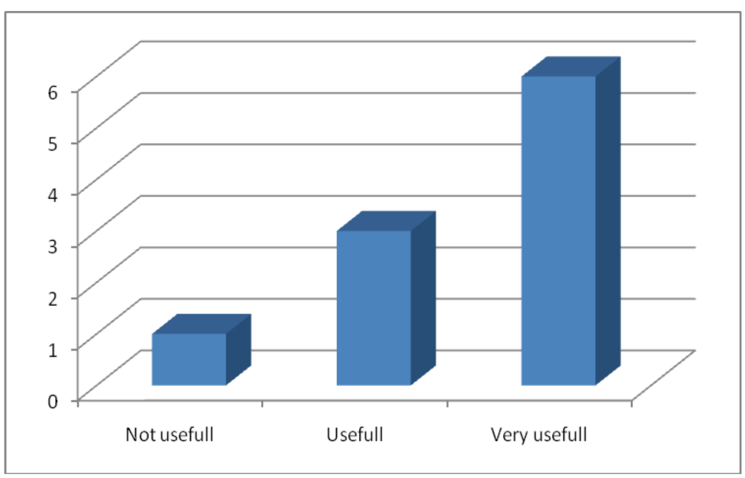
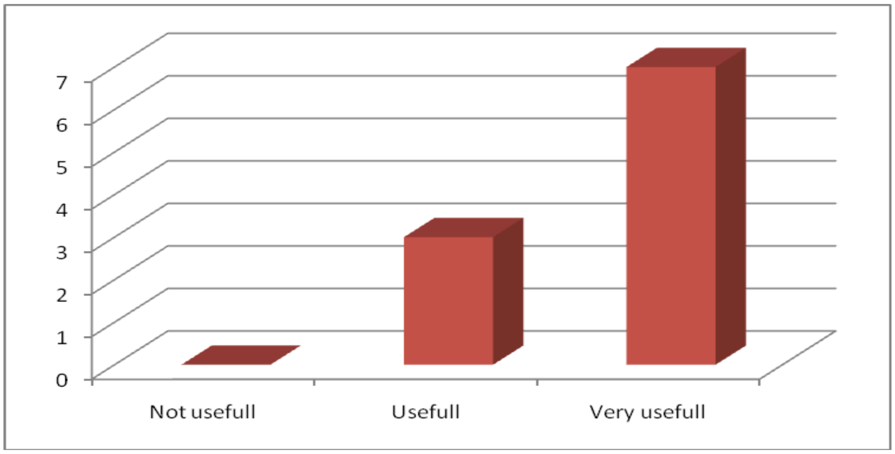
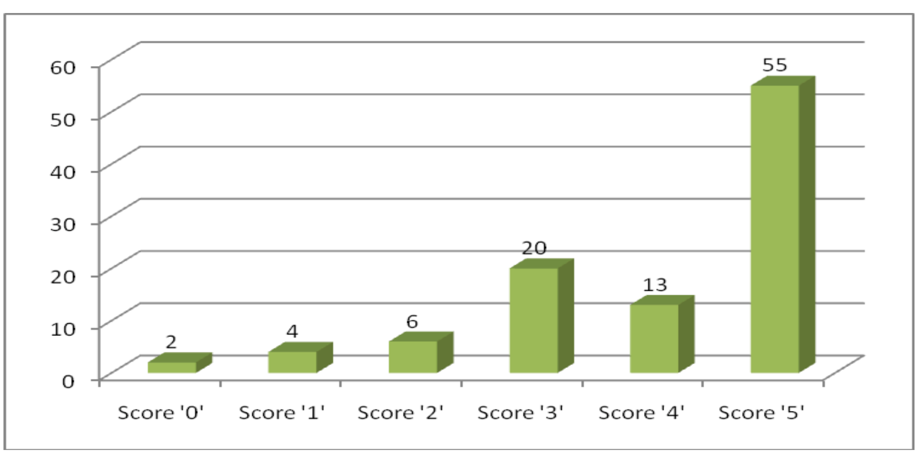


Figure 5: Instructors' opinions about the usefulness of mobile maintenance of courses



Additionally, the 100 medical student participants were asked to score the degree of usefulness of the resulting system after having used it. As a result of this evaluation study, medical students have appreciated both the desktop and mobile features of the e-learning system for different reasons. The affective desktop facilities were considered very user-friendly by students who had previous computing experience. However, one very important finding came up from students who were not familiar with computers. Mobile facilities were preferred by these students. Most of the students, who do not have much experience in using computers, own a mobile phone and therefore know how to use it. These reasons make the mobile interaction "more attractive" and "accepted" by the majority of medical students. Figure 6 illustrates the medical student's scores, taking their values from 0 indicating that the resulting system was not useful at all, up to 5 indicating that the resulting system was found to be very useful to them.

Figure 6: Medical students' scores for the degree of usefulness of the mobile tutoring system



Conclusions

This paper has described a mobile medical tutoring system that incorporates mobile technology in order to help students and instructors with many learning and training obligations. The system has been designed to provide the relatively new mobile facilities, while retaining high quality of the educational application with respect to high interactivity, personalization and user-friendliness. This work also shows how mobile devices may be used constructively in medical education by combining existing technologies of educational software with mobile features.

The research conducted, has resulted in the development of a sophisticated mobile medical tutoring system that has been evaluated among medical instructors and their students. The evaluation results were very encouraging and showed that the contribution of mobile software features to education can be appreciated by both instructors and students.

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QUALITY ASSURANCE OF TRANSNATIONAL VIRTUAL HIGHER EDUCATION: LESSONS LEARNED FROM A BUSINESS STUDIES PROGRAM DELIVERED IN SUB-SAHARAN AFRICA

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Abstract

Increased competition, diversification and advances in educational technologies have been accompanied by the rapid expansion of online transnational higher education. Alongside these developments there has also been an increased focus on quality audit and assurance of transnational programs. In this context, Curtin University of Technology in Western Australia in partnership with the African Virtual University (AVU) in Nairobi, Kenya, delivered accredited business studies programs to students in four AVU partner institutions between 2004 and 2008. This paper describes the challenges involved in delivering ICT-based courses in developing countries and the quality assurance strategies employed in program design and delivery.

Background and Context

International higher education (HE) has undergone a transformation over the past 20 years with increased competition and diversification across the sector and exponential growth in the use of information and communication technologies (ICTs) making borderless education a reality (Coleman, 2003). In Australia, a number of universities have extensive records of international provision, with some having been involved in the export of educational programs since as early as 1985. In 2003, it was estimated that Australian institutions were offering nearly 1600 programs across 42 countries (Garrett & Verbik, 2003) with the majority of these programs being offered in Asia. Coleman (2003, p.355) outlines the trends in internationalization in Australia as follows:

> The radical developments in international higher education systems in the 20 years since 1980 were especially pronounced in Australia . . . Australia's relationship with international students shifted from one of aid to trade, with educational services growing to a $4.2 billion (AUD) industry and the nation's ninth largest export earner.

These developments in Australia were coupled with a period of declining Federal Government funding for higher education, providing the impetus for a rapid expansion of the tertiary education export market in order for universities to diversify and grow revenue. The impact of these policy drivers on the Australian

HE sector is evidenced by the fact that education is now Australia's third largest export industry, increasing from $12.2 billion in 2007 to $15.5 billion in 2008. Much of this growth has depended on the provision of programs to students in developing countries. Although e-learning programs have formed part of the increased transnational offerings the growth in online provision has been more modest. In this regard, an OECD report states:

> E-learning is becoming increasingly prominent in tertiary education. All available evidence points to growing enrolments and provision, although from a low starting point. However, after the hype of the new economy, growing disenchantment with e-learning has replaced over-enthusiasm. Failures of e-learning operations have, at least temporarily, overshadowed the prospects of widened and flexible access to tertiary education, pedagogic innovation, decreased cost, etc., that e-learning once embodied. (2005, p. 11)

As noted in the OECD report, the initial promise of online course delivery for increasing access to tertiary studies across national borders has not been met and has since led to a more considered approach to the development of e-learning programs. In addition to the high costs incurred in the development and maintenance of online programs, there are numerous challenges involved in the delivery of these programs across national borders, particularly when the provider institution is in a developed country and the students are in developing countries as is increasingly the case: "The irony is that while online learning might be of most benefit to developing nations, the developing world has generally poor telecommunications infrastructure and insufficient funds to invest in expensive new technologies" (Garrett, 2002, p. 3).

It is well documented that HE systems in developing countries are under considerable strain with escalating demand and chronic under funding impacting on the quality of both academic staff and curricula (The Task Force on Higher Education and Society 2000). Furthermore, the relationship between tertiary education as a driver of economic growth and the problems associated with unmet demand for post-secondary studies in developing countries has been noted:

> Given that increased access to post-secondary appears to be one of the drivers of economic growth in knowledge economies, cross-border post-secondary education can increase access in receiving countries. The benefits of access mainly concern developing countries, as most developed countries do not face a large-scale problem of unmet demand. (OECD, 2004, p. 239)

This changing scenario in HE raised questions about the quality of educational offerings from the perspective of both provider and host institutions and countries and the growing number of students enrolled in transnational programs, forecast to be in excess of 7.2 million by 2025 (Hyam, 2003). Moreover, with the rapid expansion in the diversity and scale of transnational programs it has been argued that many institutions headed into uncharted waters with program provision and that this in some cases preceded the establishment of appropriate quality assurance arrangements (Baird, 2006). In this regard, the sharing of experiences, outcomes and lessons learned from transnational DE provision in different contexts can be useful to inform improvements in the design, development and delivery of further transnational programs (Baird, 2006; Machado dos Santos, 2002)

It was against this background that in 2002 Curtin University of Technology successfully tendered for the AusAID funded African Virtual University (AVU) project. The project was part of the Virtual Colombo Plan, an Australian Aid initiative which aimed to bridge the digital divide in higher education. The project's goal was to increase access to higher education across Africa. A further purpose was to strengthen the capacity of the AVU and its' partner institutions (PIs) to facilitate the development and delivery of online higher education programs. The original scope of the project included the following objectives:

- To strengthen the capacity for AVU partner institutions' learning centres to develop and deliver ICT-enhanced courses and to provide support to academic staff responsible for AVU courses.
- To strengthen AVU policy frameworks, management and technical systems.
- To increase AVU formal course offerings through the supply of ICT-based business studies programs contextualised for the African context.

The project's main focus then, was on capacity building within the AVU and its partner institutions as well as the provision of contextualised course materials and licenses for the business studies programs to the AVU and its Lead Partner University (LPU). The intention was for the AVU to on-sell the programs to its partner institutions and for the LPU to accredit the programs in Africa. However, before the project's inception the AVU requested that the programs be accredited by Curtin on the basis that there maybe less demand from African fee-paying students for programs accredited by an African university. The subsequent negotiations delayed the project's start-up and impacted on the project objectives resulting in a significant reduction in the capacity building components for the AVU. The change in focus also had implications for Curtin with regard to the contextualisation of the course materials and quality assurance of program delivery as detailed below.

Overview of the Curtin African Virtual University (AVU) Project

Curtin University of Technology is Western Australia's largest university and the third largest provider of transnational education of the Australian universities. Curtin is a large multi-campus institution, operating out of 16 locations including campuses in Sydney, Malaysia and Singapore. It has over 41,000 students with international students representing 41.5% of student enrolments (approximately 17,000) and approximately half of the international cohort study offshore, mainly in SE Asia. Curtin was one of the first Australian universities to offer programs offshore, commencing a collaborative partnership with the Marketing Institute of Singapore in 1986.

The African Virtual University (AVU) is an inter-governmental organisation based in Nairobi Kenya. It was established as a World Bank initiative in 1997 to use the potential of emerging information and communication technologies to increase access to tertiary programs for African students. The AVU has a network of more than 50 Learning Centres located in universities across 27 African countries. The AVU Learning Centres offer various short courses as well as business and computer science degree and diploma programs which the AVU brokers (generally provided by Australian and Canadian universities) and delivers across its network. Over the course of the Business Studies project the AVU changed direction from brokering programs provided by other universities towards a focus on the development and dissemination of open source distance and e-learning content across the African content.

Notwithstanding our extensive experience in offshore provision, the AVU Project was ground breaking for Curtin involving as it did an innovative approach to transnational online distance education in four African countries. Thus, Curtin was contracted to provide fully accredited Bachelor of Business Administration (BBA) and Diploma of Business programs to two cohorts of students in AVU Learning Centres located in Ethiopia, Tanzania, Rwanda and Kenya. The BBA was provided by the Curtin Business School (CBS) whilst the competency based Diploma was provided by Curtin's Vocational Training and Education Centre located in Kalgoorlie. Curtin's Learning Support Network (LSN), a central unit with responsibility for distance education and staff professional development across the University, coordinated the design, development and delivery of the programs.

Transnational Quality Assurance Framework

"Transnational education is now high stakes, high risk core business for most Australian universities and it is appropriate that this activity be placed under rigorous scrutiny" (McLean, 2006, p. 57). In Australia the Federal Government has developed a regulatory framework for the quality assurance of international education which includes the National Protocols for Higher Education Approval Processes, the Educational Services for Overseas Students Act and the Commonwealth Register of Institutions and Courses for Overseas Students (CRICOS) (Hyam, 2003). Governmental quality agencies are also recognising the importance of assuring a country's offshore programs (see for example, Stephen Jackson and Martin Carroll for UK and Australian initiatives in Baird (2006)), with the emergence of quality assurance (QA) and audit protocols which focus specifically on an institution's transnational offerings (Baird, 2006). More recently, the Australian Universities Quality Agency (AUQA) has further strengthened its framework for the quality audit of Australian universities' international operations (Woodhouse & Stella, 2008). At Curtin the main regulatory mechanism for QA of offshore programs is the Collaborative Education Services Policy which aligns with the relevant Federal Government QA initiatives. This policy covers all aspects of the process of initiating, operating, reviewing and terminating offshore programs.

Quality Assurance of Program Design and Delivery

In designing the AVU programs we were mindful that as McLoughlin (1999) and others have pointed out, educational programs are often tailored for particular cultural groups and assume a homogeneous student body. In this regard, there were a range of ethnic, socio-economic and linguistic backgrounds amongst the student cohort including those from Francophone backgrounds. Also, although some entered the programs from high school many were mature-age students. By the same token, as McLoughlin (1999) warns it is important not to adopt a 'deficit' model of cultural differences, because whilst students from other cultures may need specialised support, they also bring cultural values that can enrich the learning experience. However, in the context of the AVU Project we were re-purposing existing programs into an online format and this placed constraints on the extent to which the materials could be adapted. The delivery model also did not lend itself to input from African academics and students, imposing restrictions on flexibility of access and the pedagogical approach. As noted above, the change to the project objectives from an emphasis on capacity building to the delivery of Curtin accredited programs had a significant impact on QA processes and procedures.

Quality Assurance of Course Materials

Prior to the inception of the AVU Project, an instructional design team was established to develop and contextualise the course materials and to prepare a range of staff and student support resources (Siragusa et al., 2004). This team worked closely with academic staff (disciplinary experts) in developing the

Diploma and Degree study units. The approach to contextualisation involved adapting learning materials, learning activities and assessment tasks to include Australian, international and, where possible, local African contexts. The aim was to ensure that the curriculum was sensitive to the social, political and religious environment of the learners and that there was a balance between Australian and international perspectives. Contextualisation strategies included:

- ensuring cultural issues were addressed by removing elements and images that may be insensitive to other social, cultural, political, economical and religious environments;
- broadening the content and learning activities beyond Australian perspectives to include international and/or global perspectives;
- providing comparative explanations, examples or additional information where the content was embedded in an Australian context and for various reasons could not be modified;
- providing learning activities such as problem solving exercises and case studies that encouraged students to apply knowledge in their own contexts;
- explaining ideas and concepts using analogies that students could identify with and relate to;
- removing jargon, idioms, acronyms, colloquialisms, and abbreviations; and
- quality assurance of learning materials through proof reading and editing.

Based on these strategies a contextualisation checklist was developed which focussed on the unit content including, teaching and learning processes, assessment, language and gender. As part of the contextualization process, language support was also provided through a glossary and new case studies were developed to enhance learner interactivity with the online materials.

Along with the development of the academic programs, additional resources for staff and student support were identified and developed alongside the preparation of program materials. For example, orientation activities such as an introduction to the WebCT learning environment were developed for the students to provide them with the requisite skills to begin and progress their studies successfully. For teaching staff involved in the AVU Project, both at Curtin and the African partner institutions, a range of resources were provided including background information on the partner institution countries and the educational background of students (for Curtin staff) as well as online, CD-ROM and print-based resources to assist facilitators (for AVU staff) with teaching online (Siragusa et al., 2004).

Quality Assurance of Program Delivery

Under the terms of the tri-partite Agreements between Curtin, AVU and the Partner Institutions, the Learning Centres (LC) in each collaborating university were to provide: (1) computing laboratories for access to the online learning resources; (2) class rooms or lecture theatres for students to view videos or DVDs; and (3) a resource centre where students could borrow text books or hard copies of the online materials. Prior to the inception of the project the facilities in each institution had been inspected to ensure the adequacy of technical and physical infrastructure. However, at the time of these visits we were unaware that another university had been contracted to provide a computer science program in the same learning centres. Thus, by the time the Curtin programs started the Learning Centres were already under strain and access to the computer facilities was limited. These problems increased as subsequent cohorts entered the programs, resulting in a detrimental impact on student learning in some Centres.

Inception workshops, facilitated by AVU and Curtin staff, were held before the first semester start up of the Business Studies programs. These were attended by the Learning Centre managers and Academic Coordinators from each of the partner institutions. At the inception workshop, comprehensive Program Administration and Quality Assurance manuals were provided by Curtin to each Learning Centre with details of the programs to be offered and relevant academic procedures and policies. Curtin staff also conducted workshops for Learning Centre staff on various aspects of the program design and delivery model. Staff were also provided with CD-ROMs with an introduction to online teaching and learning and the Web-CT learning environment for dissemination to local academic staff who were to be involved in facilitating the programs.

The delivery model required Learning Centre managers to schedule weekly classes and employ facilitators (local academic staff with relevant discipline expertise) to facilitate student learning following the Curtin study materials and semester schedules. The facilitators also led tutorial exercises, class discussions or group activities and undertook some assessments, although all final examinations were marked by Curtin academic staff. Additionally, sessions were to be scheduled in the computing laboratories so that students could work through the online materials at their own pace. To accommodate variations in ICT capacity and infrastructure at the Partner Institutions, all program materials were provided in multiple modes, i.e. Internet (WebCT), intranet, CD-ROM, as well as hard copy resources so students and facilitators could revert to whichever mode of tuition was appropriate depending on local conditions and to ensure learning was not disrupted.

The evaluation of program delivery and the learning environment was based on information derived from various sources including data from an online Student Evaluation of Learning Survey (SELS). This is a personalised instrument that asks students to indicate their involvement in the learning environment. When aggregated, the data show how students appear to experience the learning situation along various dimensions:

Relevance: Relevance of course content.

Reflection: Encouragement of students' critical reflective thinking.

Interactivity: Engagement in online dialogue and activity.

Tutor Support: Encouragement for students to participate in learning.

Peer Support: Student support for fellow students.

Interpretation: Sense made of online communications.
(Yeo, Taylor, & Kulski, 2005)

Data from the SELS was supplemented by the use of a paper based student evaluation of teaching form used as a QA measure in other Curtin off-shore programs. The Learning Centre in each partner institution was also audited biannually. During audit visits the project team conducted interviews with staff and students and inspected the technical facilities in the Learning Centres to determine the availability of resources. All course materials were reviewed at the end of each semester by a Joint AVU Curriculum Contextualisation and Quality Committee which had representation from AVU, Curtin and the partner institutions. This Committee also monitored student progress and reported on any issues which had arisen during the semester. The procedures for the evaluation of program delivery were designed to be iterative so that we could build on and improve program design and delivery based on feedback from the previous semester.

Nevertheless, it became evident in the early stages of the AVU Project that all the Learning Centres experienced problems to various extents in delivering the programs as initially designed. This required us to further modify the original delivery model. For example, the instructional design of the programs originally included satellite broadcasting of lectures between Curtin and the partner institutions. However, due to political and legislative restrictions surrounding electronic transmissions in the Sub-Saharan African region, the satellite broadcasts were suspended and we were required to provide pre-recorded lectures instead. There were also problems encountered with high staff turnover in some Centres leading to a lack of continuity in facilitators and program administrators. For print-based resources, we found textbooks were unaffordable for many students and some Centres found the cost of printing multiple copies of learning resources prohibitive. This was counteracted to some extent by the provision of multiple copies of Unit readers and textbooks. Study periods were also disrupted in some Centres when there was political unrest in the host country or where strikes by academic staff delayed the commencement of semester or impacted on the examination period. Whilst many of these problems were outside Curtin's control they placed considerable pressure on the Project team. Thus, issues related to a scarcity of resources, political unrest and the lack of connectivity and access to computers, compounded as the Project unfolded requiring in many instances flexible and sensitive responses from the Curtin Project team.

Project Outcomes

Although the conditions for learning deteriorated over the course of the project, particularly in three of the four partner institutions, data derived from the student surveys and the review of materials by the Joint AVU Curriculum Contextualisation and Quality Committee, indicated that students generally found the unit content relevant and that our efforts to make the material accessible and contextually meaningful were largely successful. On the other hand, due to internal accreditation and quality assurance pressures (Curtin and Australian Government policies prescribe equivalence between on-shore and off-shore provision) some content could not be altered despite the fact that it was not necessarily relevant to African students (e.g. Australian business law). Moreover, although we were aware that there were significant differences between the student cohorts across the four countries, we were unable to modify the programs to make them country specific. This led to some students being disadvantaged (e.g. those from Francophone backgrounds).

Student progress data from the first year of delivery indicated that despite the difficult learning environment in which the African students operated, pass rates for some units compared favourably with our Australian based on-campus cohort. However, in the second and third years of the BBA program it was found that pass rates at the unit level were generally lower than for students at the Curtin home campus with the exception of the Kenyan students who often outperformed the other locations. The performance of the Kenyan students was primarily attributed to the fact that the Kenyan Learning Centre had a relatively small cohort of high quality students who experienced fewer problems of access to the learning resources. Overall, at the program level the attrition rate was approximately 30 percent in comparison to approximately 15 percent for Australian-based students. Whilst there is considerable variation in DE attrition rates reported in the literature, this attrition rate compares favourably with those in other distance educations programs in Africa where rates in excess of 50 percent for some programs are reported (Adewale & Inegbedion, 2008).

Conclusion

Curtin's AVU Project demonstrates some of the many challenges universities may encounter when delivering online programs to students in developing countries. In undertaking this Project we found the establishment and fostering of good relationships and open communication with all stakeholders over the course of this endeavour was particularly challenging, but was of paramount importance to the Project's success. Moreover, analysis of the Project activities and outcomes reveals the importance of a systematic and comprehensive approach to quality audit and assurance of transnational programs and the capability for institutional responsiveness to the changing circumstances of students and host institution staff. Despite the fact that some of the problems we encountered were anticipated, such as poor Internet connectivity or ICT infrastructure in the partner institutions, others were not. Thus, although the possibility of political unrest in the host countries had been identified in a risk analysis we had not anticipated the extent to which this could impact on student performance or program delivery.

Nevertheless, we found that online communications greatly enhanced our ability to monitor the learning environment of the AVU students and was invaluable in overcoming the 'tyranny of distance' between students, teaching, and administrative staff, enabling us to respond to issues in a timely manner. Our review of the AVU Project also highlights the complexities involved when adapting and contextualising a university's QA procedures and programs for delivery in four disparate locations concurrently, and the need to adjust these processes to suit a host institution's circumstances. For example, in addition to the standard QA approaches required for accreditation and audit purposes, supplementary QA methods such as the Joint AVU Curriculum Contextualisation & Quality Committee have the potential to facilitate collegial exchange and academic input on QA matters from all partners involved in the Project. In this regard, the QA strategies used in the AVU project provides a model for other institutions seeking to offer online transnational distance educational programs.

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THE IMPLEMENTATION OF NEW TECHNOLOGIES IN EDUCATION: TEACHING ECONOMICS IN POST-SECONDARY LEVEL

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Abstract

The aim of this paper is to challenge the hypothesis: "the use of computers and the Internet in the teaching of economic modules does not affect student learning and retention." Research restrictions stipulated that the research was to be conducted at Institutes for Professional Training, during spring semester, 2007–2008. Seventy students, in total, participated in the research, comprising three classes of 25, 25 and 20 students respectively. "Money – Banks – Elements of Banking Techniques" was the course attended by these three classes. The lessons of the three classes took place in the computer laboratory where 25 computers were installed.

Introduction

Although the use of New Technologies in economic pedagogy has been growing, it has not received the corresponding attention in the economic education literature. Almost no studies to date have measured the impact of using technology on student learning and retention, perceptions of instructor effectiveness, and changes in attitudes towards economics.

We report the results from classroom experiments that tested the influence of computer use on economic education.

Using computer resources to enhance economic courses has two principal advantages for students. First, these resources offer a new medium of interaction that complements classroom instruction and facilitates learning. Second, they offer students the opportunity to learn and use technology and yield positive externalities for future academic and career paths.

Previous Literature and Research

In 1990 one of the most important books on the teaching of courses in economics *The Principles of Economics Course* [4] was published. Its three component parts refer to: the educational aims and objectives of the introductory course

(Economics in the first semester at the universities), the teaching methods, and evaluation of teaching.

In 1996 Agarwal and Day [1] in their research, under the title "The Impact of the Internet on Economic Education," presented one of the first empirical analysis examining the educational effectiveness of teaching techniques supported by the Internet.

They tested the following null hypotheses against two-tailed alternatives:

- Internet implementation in economics courses has no impact on student learning and retention.

- Internet implementation in economics courses has no impact on student evaluations of instructor effectiveness.

- Internet implementation in economics courses has no impact on student attitudes towards economics. The results of the analysis showed that the addition of Internet based activities and equipment to the education of economics offered very significant advantages in economic learning and the perception of students on the effectiveness of the teacher.

In 2008, the studies of E. Tsami [7], [8] on the teaching of economics at the University with the use of new technologies were published. The views of students on teaching through the use of computers were examined. The result of the first survey [7] is that students prefer teaching through the use of new technologies at 90% to traditional teaching.

The results of the second survey [8] to the students involved is that: the use of new technologies in the teaching of macroeconomics in relation to the teaching of microeconomics in the traditional mode had neither a positive nor a negative impact.

Research Description and Methodology

The research conducted for this paper was based on the mentioned literature. The basic hypothesis to be challenged is: "the use of computers and the Internet in the teaching of economic modules does not affect student learning and retention", posed by Agarwal and Day [1] in their research.

Seventy students, in total, participated in the research, comprising three classes of 25, 25 and 20 students respectively. "Money – Banks – Elements of Banking

Techniques" was the subject taught in these three classes during spring semester 2007–2008. Fourteen two-hour lessons were delivered in each class, out of which, six were computer based. The computer programme "Macroeconomics" by the Keystone Company was selected as a tool to assist the teaching procedure because it is an introductory and obligatory module for the study of economics. Each of the computer-based lessons comprised, in different format, the material covered, a glossary with the new terms for students, exercises and a knowledge test. How the lessons appeared on the computer screen and the units that were used is illustrated below.

The lessons of the three classes took place in the computer laboratory where 25 computers were installed, allowing the participating students to work individually.

The participating students were all present throughout the course of the research and attended all the six computer based lessons. Each student was given a copy of the programme "Macroeconomics" so as to be able to access the programme through the computer lab as well as his/her home computer. Therefore, students, on their own, could also practise the chapter's questions and exercises, revise and work more carefully on particular difficulties.

Some other students also attended the lessons but they did not take part in the experiment since they were not always present. The 70 students who participated were present in all six computer-based lessons.

Students logged on the programme with the help of the tutor, if necessary, and then they were taught the predefined material with the programme's guidance.

Prior to the beginning of the course "Money – Banks – Elements of Banking Techniques," students took a test on part of the syllabus of the course "Transactions' Technique", which the participating students had attended in the lecture hall, during the previous semester, (winter semester 2007–2008). The test consisted of five true-false questions and five multiple-choice questions.

In the final lesson of "Money – Banks – Elements of Banking Techniques," students took a test of five true-false questions and five multiple-choice questions based on the taught material. This particular number and type of questions were selected so that the second test on "Money – Banks – Elements of Banking Techniques" would have the same format as the first on "Transactions' Technique" in order to be easily corrected and graded. All the 70 students that comprised the three classes completed the test. Moreover, after the completion of the lessons, students filled in a questionnaire expressing their views on computers and the teaching procedure that had taken place both at the computer lab and the lecture hall.

The aim of the research was to assess the results of the two tests in order to compare the knowledge acquired with the use of computers (“Money – Banks – Elements of Banking Techniques”) to knowledge acquired without the use of computers (“Transactions’ Technique”).

The statistical analyses of the tests are presented in detail in a following chapter.

Research Restrictions

Research restrictions stipulated that research was carried out at Institutes for Professional Training (IEK) at the Organization for Professional Education and Training (OEEK) during the 2007–2008 spring semester. A considerable number of students contributed to the research with their views and knowledge so that relevant conclusions could be drawn.

Problems

Some minor problems emerged in the course of the research. More specifically:

- Gaining access to appropriate bibliographic sources and similar studies that could provide theoretical background was difficult. As mentioned by Simkins [5] and Sosin [6] most of the available data has not been published and there are very few empirical studies focusing on the teaching of economics at post-secondary level.

- The computer laboratory was equipped with slow access computers which were often the cause of delays during the computer-based sessions. This problem, however, was not so serious as to cause a lesson interruption.

- Some of the students visited irrelevant web pages and surfed in the Internet, during the computer-based lessons, which was the source of slight disruption.

- Some of the students lacked basic computer knowledge. Although the number of the computer — illiterate students was small, slight delays were caused.

- The computer based lessons did not rely exclusively on the electronic format because none of the students made use of the programme on their personal computers. This can be attributed to the following factors: 1) students were not accustomed to such a method of teaching; and 2) not all students owned or had access to a computer as the Computer labs at the Institutes for Professional Training (IEK) were, most of the times, occupied by classes which made it impossible for students to enter and use the computers in their free time. Had this been possible they, would have been able to use Word, Excel, PowerPoint or other programmes for their assignments, and surf the net in search of information as well as visit useful webpages. As a result, the exercises that had to be checked at home remained incomplete.

- There was a difference in the degree of difficulty between the two courses. The course “Money – Banks – Elements of Banking Techniques”, which included the six experimental computer-based lessons, is more difficult than the course “Transactions’ Technique,” taught in a lecture hall. On the other hand, the syllabus of the “Transactions’ Technique” course is longer than the syllabus of the “Money – Banks – Elements of Banking Techniques” course.

The Programme

The programme used for the design of the computer-based lesson was ‘Macroeconomics’ by Keystone Company.

The ‘Macroeconomics’ CD-ROM is from the key-book$^+$ series which consists of basic knowledge and reference CD-ROMs addressed to students, pupils, teachers and the wider public that wish to become acquainted with the particular subject-matter with the use of computer.

In addition, offered features such as electronic bookmarks, notes and printing are additional tools for conquering knowledge. Its philosophy is simplicity, practicality, speed and user-friendliness and it is characterized by substantiality and usefulness. It is rather substantial and utilitarian.

The electronic study aid ‘Macroeconomics’ CD-ROM of the key-book$^+$ series was designed bearing in mind that in order to substantially comprehend the laws and operational mechanisms of the economic system critical ability, creative, rational and methodical thinking, as well as continuous linking of theory and practice are essential.

The Macroeconomic material contained in the CD-ROM is presented in two ways: thematically (Concepts – Definitions) and alphabetically (Index) so that they can be best comprehended and consolidated. It is divided in 9 units each of which comprises of five sections:

1. Concepts – Definitions, where the material is systematically presented and divided in self-contained parts. The texts are accompanied by

photographs and commentary, whereas a great number of concepts are presented with the aid of animation.

2. Comprehension Keys that help for the further knowledge consolidation and systematization as depending on the nature of the section they can contain: in-depth presentation of concepts important for understanding the unit, summary of the basic points, comparative and compositive presentation of the unit's concept groups, methodology presentation and examples of how to solve the exercises for the units that contain exercises.

3. Questions (open type) that test theory comprehension.

4. Exercises that test content comprehension at practical and computational level.

5. Objective type exercises that cover two different categories the answers of which are graded and clocked by the programme:
   - Multiple choice exercises where students have to choose one out of five possible answers
   - Gap and table filling exercises where students are given either a text with omitted words or a table with omitted numbers and they have to fill in the gaps.

Total Score Comparisons

Table 1 presents the descriptive means of position and dispersion for the students who took part in the research in the lesson of "Money – Banks – Elements of Banking Techniques".

Table 1: Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
grade_diff	Control group	20	.1000	1.02084	.22827
	Intervention group	50	1.3200	2.29854	.32506

Table 2 presents the Grade of the pre-test for the lesson "Transactions' Technique" for the three different groups of 70 students.

Table 2: Grade Pre-test

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10	3	4.3	4.3	4.3
	12	12	17.1	17.1	21.4
	14	3	4.3	4.3	25.7
	15	18	25.7	25.7	51.4
	16	20	28.6	28.6	80.0
	17	7	10.0	10.0	90.0
	20	7	10.0	10.0	100.0
	Total	70	100.0	100.0	

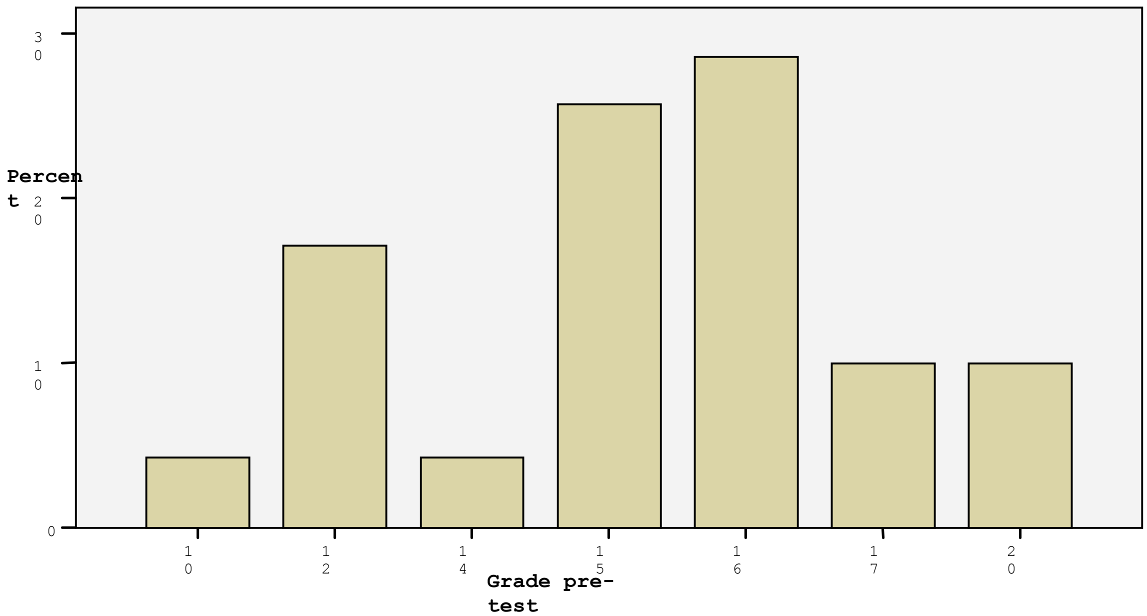
Table 3 presents the Grade of the post-test for the lesson "Money – Banks – Elements of Banking Techniques" for the three different groups of 70 students.

Table 3: Grade Post-test

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10	2	2.9	2.9	2.9
	13	6	8.6	8.6	11.4
	14	7	10.0	10.0	21.4
	15	12	17.1	17.1	38.6
	16	11	15.7	15.7	54.3
	17	12	17.1	17.1	71.4
	18	7	10.0	10.0	81.4
	19	9	12.9	12.9	94.3
	20	4	5.7	5.7	100.0
	Total	70	100.0	100.0	

Graph 1 illustrates the histograms of the Pre-test grades.

Graph 1: Grade Re-test



Graph 2 illustrates the histograms of the Post-test grades.

Graph 2: Grade post-test

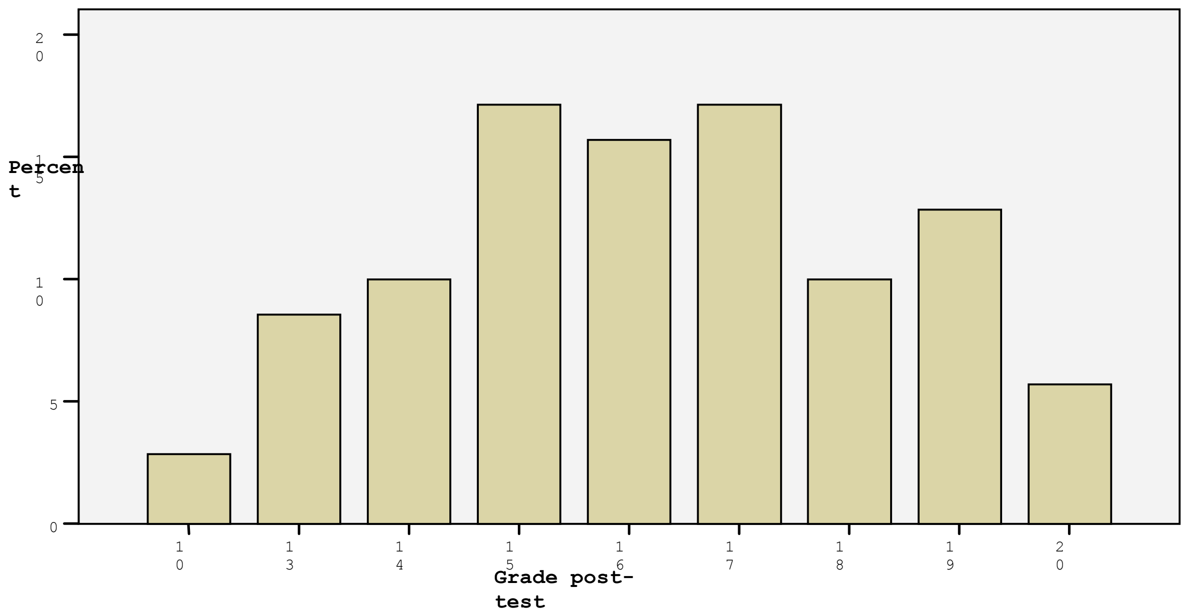


Table 4 presents the group statistics about the grade difference of the sex of the students

Table 5 presents the Independent Samples Test for grade differences for the lessons “Transactions’ Technique” and “Money – Banks – Elements of Banking Techniques.”

Table 4: Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
grade_diff	Male	20	1.3000	2.34184	.52365
	Female	50	.8400	1.98319	.28047

Table 5: Independent Samples Test

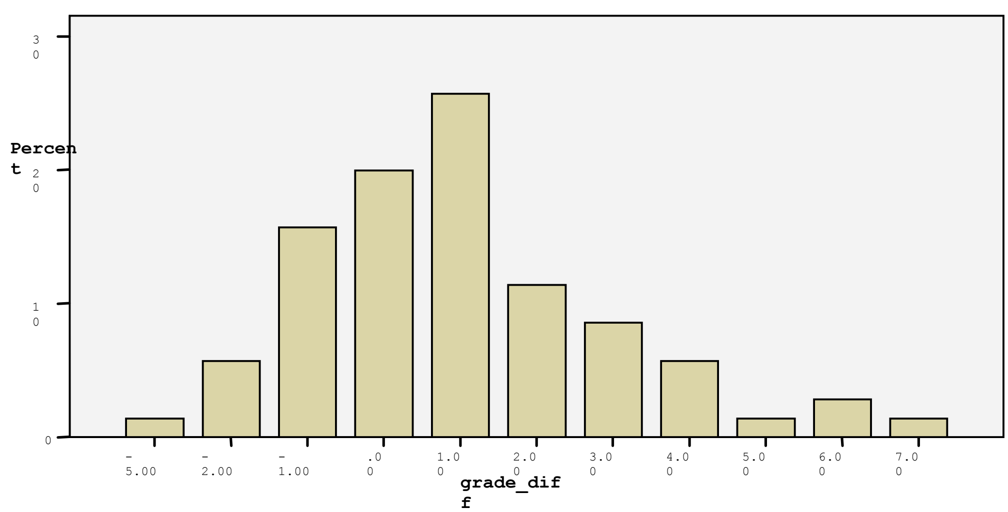
Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confi dence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
grade_diff	Equal variances assumed	8.110	.006	-2.278	68	.026	-1.22000	.53561	-2.28879	-.15121
	Equal variances not assumed			-3.071	67.138	.003	-1.22000	.39720	-2.01279	-.42721

Thus we observe that there is a statistically important differentiation between the average Pre-test and Post-test grades.

Graph 3 illustrates the histograms of the difference in grades between the pre-test and the post-test.

Graph 3: Grade Difference



Conclusions

The important role of informatics in the educational process is beyond arguments and this does not only mean introducing a new tool in all levels of teaching but developing a new dimension in educational technology as well. Computers are being diversely used in education, although there are various views as to their effectiveness in teaching. However, it has been claimed by many researchers that computers can be of invaluable assistance both to teachers and students in teaching economics. Computers can offer learning opportunities with the general aim to enhance teachers' communicability of knowledge and students' understanding. Thus, teachers of economics are aware of the benefits of technology and are trying to get acquainted with it. At the same time they should assist the creation of appropriate educational software.

Educational software development is at a very early stage in Greece. The inflexibility of our educational system along with the insufficient teacher training in new technologies make the task of incorporating new informatic applications in the teaching process difficult. The teaching hours available for economic modules are few. The number of economic modules at the Institutes for Professional Training (IEK) at the Organization for Professional Education and Training (OEEK) are restricted and most of the courses are choice courses.

New Technologies enhancement of courses facilitates communication between the instructor and students, and easy access of information using the medium promotes use of economic data and real-world applications to enhance the teaching of theory.

The point of using the computer is to add value to the classes that we teach and to allow us to meet the challenges of teaching. The use of new technologies significantly enhances economic education for two reasons. First, contact time with students substantially increases through e-mail and discussion lists. The instructor is able to communicate effectively with many students at the same time through the discussion list. Being able to correspond among them regarding the relevant theory and problems gives students an additional opportunity to focus on problem areas and seek help from each other. We believe the added communications element goes a long way in fostering both thought and interest in the subject matter.

Second, the computer assignments allow students to observe the real-life implications of the economic theory they learn in class. The hands-on experience provides a better understanding of the subject matter and makes the learning process more active.

The area is rich in future avenues for research. Similar studies need to be conducted in universities, colleges and Institutes for Professional Training before one can say with certainty that the use of computer has a positive impact on economic education.

In addition, knowing how the use of new technologies affects students as they progress through the entire economics program, rather than just one course, would be useful. Another interesting question is whether the Internet is more effective for good versus poor students. Finally, computer enhanced “distance learning” courses represent innovative ways of reducing the costs of education , but the quality differences between these types of courses and traditional courses needs to be addressed.

Both aspects of new technologies use in economic pedagogy provide a real increase in the quality of education. The results of this study suggest beneficial effects of implementing new technologies enhancements. The hypothesis that the use of computers has no impact on student learning and retention is rejected in favor of a positive influence when scores on a standardized test and the final grade are considered as dependent variables.

The research ultimately showed that, according to Graph 3, the score of students in post-test was 1 point higher on average than the scores of students in pre-test. Therefore teaching with the use of computers was more effective than traditional teaching. This is certainly something that should be investigated in larger scale in other Institutes for Professional Training (IEK), of the Organization for Professional Education and Training (OEEK) and universities in Greece as well as abroad in order to compare and assess results more validly.

Clarity in presentation, along with enthusiasm and respect towards student views had the greatest positive influence on lesson evaluation by students. On the contrary, teachers tend to underestimate significantly these two factors and overestimate the importance of being well prepared for the lesson and knowing their subject-matter.

Students’ effort plays a key role to obtaining high grades. Students claiming to have tried harder at a module acquired higher grades. Thus, we could support that tension and the total amount of time spent on studying affects the learning of Economics.

Different students of economics learn the subject in different ways. Very little is known about how particular teaching methods influence particular student traits. More recent studies [7] support that student learning styles, dependent, independent or co operational, affect the total of economic knowledge.

Having studied economics at school was neither a negative factor for student performance at the Institutes for Professional Training (IEK), of the Organization for Professional Education and Training (OEEK) nor did it provide an important advantage. In general, further research is required with larger student samples and from different educational systems.

Teaching assisted by games and computers is almost as effective as conventional teaching but probably costs more. Computer-based study systems appear to be more effective than game and simulations especially for students of weaker performance. Educational programmes are effective because students can reach a standard level of qualification sufficiency in less time but students are not very fond of them. Students enjoy being taught according to their personal style and this increases performance in some cases. In general research results show that the advantages of applying the use of computers in teaching economic modules are controversial.

The size of the class little affects performance. However, some researches[8] have discovered that larger classes can have negative effects in some economic fields and may influence financial benefits from education. According to Blinder[2] the issue is of great importance and further research is required.

Students prefer computer-based lessons over traditional lessons to a very high percentage [7]. The conclusions from this research are related to the conclusions of researches carried out at Greek Universities [7],[8].

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MAKING ROOM TO RECONCEPTUALISE LEARNING IN BUSINESS: EDUCATIONAL TECHNOLOGIES AND TEACHING SPACES

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Abstract

This paper considers ICT usage in three Professional Development (PD) units of study at Victoria University (VU), Melbourne, Australia. The PD units were developed in response to an employer and graduate survey as part of a review of the Bachelor of Business at VU. The question of how well we have integrated the collaboration, communication and constructivist capabilities of available technologies into PD curriculum is considered in the light of preliminary responses of staff and students to the new units of study, the innovative learning spaces and the educational technologies available to facilitators. In the 2006 survey of business practitioners, Business academics and VU Business alumni recommended the PD units be introduced into Business degrees after respondents emphasised the importance of developing undergraduates' employability skills including, most importantly, ICT skills. Acknowledging student preference for, and effectiveness of, learning by doing, the lecture/tutorial format at VU had to change to effectively develop these skills. Lectures and tutorials were replaced by a 3-hour seminar of 40 students in seven purpose-built rooms that boast a range of ICT. The 3-hour seminar in new learning spaces allows for ways of developing and assessing students' skills in ICT, information literacy, communication, team work and problem solving. This paper begins a consideration of how, and even if, ICT in PD units is being exploited to its full educational potential.

Introduction

This paper considers ICT usage in three Professional Development (PD) units of study at Victoria University (VU), Melbourne, Australia which were developed after a review of all undergraduate Business programs at the university (Papadopoulos et al., 2006). The units were developed to fully exploit both the interactive, collaborative and creative potential of available ICT and innovative teaching spaces to develop students' employability skills and, particularly in first year, to support students' transition into university. This paper considers how well the curriculum has encouraged the uptake of ICT especially in the new, purpose-built learning spaces. Preliminary findings from an online survey suggest that facilitators of the PD units are highly individual in their use of ICT, that some facilitators find some technologies 'very useful' and have developed creative ways to connect with students, capture student work and encourage student reflection while others may consider the same technology 'not appropriate' for teaching. Without having yet run focus groups to interrogate these findings further, it is clear that the faculty's educational developers must consider creative ways of embedding more ICT into the curriculum, sharing the creative ICT usage that already occurs and supporting more facilitators to embrace a range of ICT options.

The review into the Business programs at VU surveyed business practitioners, HR managers, VU Business alumni and VU Business academics. These groups were asked to rank the professional skills and knowledge required of a new, work-ready business graduate. Over 700 respondents completed the survey. Respondents rated each knowledge area by a level of importance ranging on a five-point Likert scale: 'unimportant' (1); 'moderately important' (2); 'important' (3); 'very important' (4); and 'essential' (5). Interestingly, ICT literacy was ranked by mean score as an important area of academic knowledge as shown in Table 1 below. The Table shows the first 10 of 18 knowledge areas ranked.

Table 1: Findings on the Survey Component of the Bachelor of Business

Academic Knowledge (Ranked in Descending Order)	Total (mean score)	Business (mean score)	Alumni (mean score)	F(726,2)	Sig.
1. Computer literacy	4.22	4.15	4.27	2.228	.108
2. Business communications	3.73**	3.61	3.82↑↑	4.731	.009
3. Ethics of business	3.7**	3.84	3.54↓↓	7.774	.001
4. Information literacy and analysis skills	3.59**	3.52	3.57	7.628	.001
5. Organisational behaviour	3.55	3.53	3.62	2.777	.065
6. Project management skills	3.51	3.51		n/a	n/a
7. Financial literacy	3.39*	3.5↑	3.3	3.749	.025
8. Strategic planning and implementation skills	3.37	3.35		.466┼	.643
9. Innovation and entrepreneurial skills	3.29*	3.21	3.4↑	3.733	.026
10. Marketing principles	3.18*	3.11	3.28↑	3.214	.042

* Significance level ANOVA p<.05; ** Significance level ANOVA p<.01; *** Significance level ANOVA p<.001
↑Significance level S-N-K p<.05; ↑↑ Significance level S-N-K p<.01; ↑↑↑ Significance level S-N-K p<.001
↓Significance level S-N-K p<.05; ↓↓ Significance level S-N-K p<.01; ↓↓↓ Significance level S-N-K p<.001
┼ Students independent samples t-test used as survey item as only 2 groups represented for that item.

(Source: Papadopoulos et al., 2006.)

Employability Skills or Professional Literacies

The Business Review recommended the development of specific, mandatory units in the Business degree that would maximize students' employability skills, including ICT skills. Professional Development 1: Critical Thinking and Problem Solving (PD1); Professional Development 2: Analysis and Strategy (PD2); and Professional Development 3: Challenge and Leadership (PD3) were developed to be taught sequentially in the undergraduate degree. Delivery began in 2008. Employability skills, also called generic skills, soft skills, professional literacies or enterprise skills (DIUS, 2008), feature in all undergraduate programs in Australia. Their prominence in curriculum comes from the students themselves, industry and professional bodies and from State and Federal Governments. Certainly, universities are increasingly mindful that graduates' transition into professions should be supported by a range of preparatory initiatives in the curriculum. Occupation preparedness is one reason for focusing on employability skills but such skills simultaneously support students' capacity to participate effectively in academic discourse. Arguably, ICT skills have the capacity to support and extend the development of all generic skills regarded by academics and professionals alike as vital. Employability skills typically include communication skills, teamwork skills, problem solving skills, self-management skills, planning and organising skills, technology skills that contribute to effective execution of tasks, life-long learning skills and initiative and enterprise skills (DEST, 2002). Research, defined broadly, is an often-included skill. Clearly, ICT can support the development of all of these skills but how well are curriculum developers exploiting that potential?

The university has a role in the development of employability skills, professional literacies or graduate capabilities (DEST, 2006). Professional literacies should be developed in undergraduate degrees by a range of means. A pivotal means of supporting skills development in the PD units includes the embedded (and the serendipitous) use of ICT both inside and outside the classroom. Of course, merely *using* ICT does not equate to good teaching. The interactive, collaborative and creative potential of ICT must be foregrounded over its overwhelming capacity to simply transmit information more insistently and ubiquitously.

In the development of the PD curriculum, the team favoured the phrase "professionally relevant learning" in conceptualising the curriculum as it suggests the skills, qualities and attributes that are required by a profession as well as the processes through which those skills are learnt. While professionally relevant learning may well include industry placements, industry based projects and the like the PD units of study are not designed to incorporate work placement. That function is provided at VU by the Centre for Work Integrated Learning which organises both Co-operative Education where students undertake full-time employment and Business Integrated Learning which sees students working on industry projects. PD units complement these work-based approaches.

The PD units develop students' professional literacies. In fact, all units taught at VU must embed VU's six Graduate Capabilities into the curriculum: "the university accepts that it has the dual responsibility of enhancing the employability of its students and developing their effectiveness as lifelong learners" (VU, 2008). VU's Graduate Capabilities are like most Australian universities' attributes. The terminology changes from graduates skills, attributes, capabilities or qualities, but VU graduates, like most university graduates, are expected to be able to "problem solve . . . locate, critically evaluate, manage and use written, numerical and electronic information; communicate in a variety of contexts and modes; work both autonomously and collaboratively; work in an environmentally, socially and culturally responsible manner; and manage learning and career development opportunities" (VU, 2008). PD units, however, especially focus on developing and assessing these attributes and are distinguished from other units in the university by several features. They are characterised primarily by *how* they are taught: namely, in a three-hour, collaborative seminar; with a multi-disciplinary mix of students from across Faculty (including Accounting, Management, Events Management, Economics, Law, Information Systems, Finance, Tourism, Hospitality and Marketing students as well as some Engineering students electing to enrol); using constructivist pedagogies, and; in the specially designed teaching spaces.

Attrition and the First-year Experience

The PD units were designed to achieve the outcomes of the business review; that is, to develop and assess students' professional literacies. Beyond developing professional and academic attributes, the units also seek to address the attrition rate at first year and the concern that students have little sense of belonging to the university (Krause, 2005). We want to improve the odds that 2 out of 3 students are confident that at least one teacher knew their names (Krause, 2005) to 3 out of 3.

Attrition is an institutional concern. Australia's Department of Education, Employment and Workplace Relations (DEEWR) uses universities' attrition rates as one of many performance indicators. Like all performance indicators, there is significant funding attached to attrition. For numerous reasons, attrition rates at VU are high compared to other Australian universities. Over a 10-year period, the rates have often hovered around 25% (Gabb et al., 2006). Student engagement is a key factor in attrition. VU's students typically have lower levels of engagement than peers at other Australian universities; they spend less time on campus and less time in private study and they have fewer contact hours per week (Gabb, 2006).

The first year is crucial as far as attrition is concerned (Gabb et al., 2006; McMillan, 2005) and a key way to reduce attrition is to attend to the transition of students. The PD units have embedded a range of the strategies to address attrition: collaborative learning activities, early "at risk" assessment and follow up support, multiple formative assessment tasks, explicit pedagogies in regard to academic requirements of university (referencing exercises, plagiarism exercises). Each seminar includes a theme-related icebreaker aimed at building relationships within the group. This ensures that the idea of learning being "pleasurable. There is no rule against hard work being fun" (Ramsden, 1992, p. 102) is integrated into the curriculum, not bolted on to the end of class. In PD units, attrition problems are particularly addressed through increased social and academic engagement of students in class through a range of collaborative learning activities and outside of class through team projects. Student engagement has been enhanced through embedding ICT in the assessment. Less embedded but no less engaging has been students' own propensity to use online social networking platforms like Facebook and Twitter for group work, preparing group classroom presentations, sharing research and simply socialising. Of course, the links between good teaching and reducing attrition are also vital and we need to ask, how can ICT enhance good teaching in the PD units?

Student-centred Pedagogies

The purpose of PD units is to explicitly develop Graduate Capabilities though active-learning in a "constructive process" (Kozma, 1991, pp. 179–180). PD units have been designed to encourage this constructivist approach assisted by ICT. The units further aim to support the development of technologically literate graduates who are unafraid of technology, able to use it effectively to communicate and generate ideas, to connect, to find, to effectively work, study and live as "digitally enhanced" graduates (Prensky, 2009).

Collaborative Learning Suites

The delivery of the PD units at VU have necessitated the development of seven purpose-built learning spaces with a range of technologies that support collaboration, communication and ICT competencies at an average cost of approximately AU$400,000 per room. A further two rooms are being built in a café style for PD 3 students at a similar cost. Beattie's 2005 survey of learning spaces at VU, “Make room! Make room!”, alludes to commonplace expressions that often describe the student learning experience at first year: “sardines,” “cattle,” and “squashed” all convey various images of overcrowding. Such congestion is a common feature of the tertiary education system. A recent report examining overcrowding at Victorian universities said that lectures were so crowded, students frequently had to sit on the floor, some students skipped overcrowded classes with 40% of students saying that “lecture facilities were unable to meet the educational needs of the people crammed into them” (Perkins, 2009). To reconfigure teaching and learning in a move away from cost-effective lectures and tutorials is, really, an expensive exercise but also, given the report mentioned by Perkins, a timely effort that will make students feel valued. Krause (2005) warns that for first year students may feel especially alienated in large classes, that students lack both a sense of community and a sense of connectedness. The PD spaces and curriculum aim to overcome these problems.

The PD classes are taught in 3-hour seminars of no more than 40 students, with kidney-shaped tables of 8, one computer per team of 4 and projector capacity for students to share their computer work with the class on one or all of the five 52" LCD monitors around the room. In PD lecturers are referred to as facilitators to signify a shift in the pedagogies underpinning the curriculum. Facilitators control all the LCD monitors (three 40" LCD monitors are for facilitator display only but facilitators can elect to use all monitors simultaneously). Facilitators can switch between teacher, student groups and student presentation modes on their console which controls LCD monitors. They can encourage students to share individual, group and whole of class activities. Facilitators also have DVD, VHS and document camera facilities that can project onto all LCD monitors. Transmission from facilitators is discouraged: “Resist the urge to tell!” became the motto in facilitator training, so strong was the emphasis on encouraging a constructivist approach of supporting students to discover, develop and demonstrate skills, knowledge and information autonomously and collaboratively with peers. Socratic questioning is urged over any transmission of information. The students have all the resources to investigate but some facilitators cannot resist the urge to tell: they just have to “cover” this, “go over” that and tell students something else. The constructivist teaching approach expected in PD clearly “requires a paradigm shift in the faculty’s general approach to teaching and learning” (Papadopoulos & Woodley, 2008); certainly, the move to a learning paradigm” (Bowden & Masters, 1993) requires that far more than teaching spaces needs reconfiguring. Facilitation does not mean that seminars forgo teacher direction. In fact, the facilitator’s role is complex — requiring thinking on one’s feet, time management skills, the capacity to reflect and to pose intriguing questions to encourage critical thinking. Facilitators need strategies to evaluate how well students are understanding, learning, and collaborating. And they need to be ICT savvy in a student-centred way.

Students are encouraged to use whatever software and media are available and suitable for learning tasks — so activities from finding information, comparing information, synthesising information, communicating with other groups via chat, discussion, e-mail or other means and presenting findings all insist on the use of ICT *in a team* of no more than four students. A deliberate decision was made in designing the rooms and the activities: this was no computer lab. Students would need to share computers. Students were not, during class, going to work alone on a computer: "students [would] not be working in isolation — just being interactive with a screen. Classroom interaction is vital" (Woodley in Biggs, 2003, p. 218). In addition to electronic educational technologies, the PD spaces are also equipped with glass whiteboards and students have a range of whiteboard markers, Post-it notes and other media to present information, create mind maps or comment on other students' board work. In fact, low-tech technologies have proven very popular with many team activities and we certainly did not want the "technology-enabled" (Brown & Lippincott, 2003) learning spaces to result in technology-dependent learners. The table design encourages students to feel comfortable and connected — padded swivel seats are adjustable and computer screens and keyboards can be moved about to accommodate, not dominate, learners. Students can see each other and are configured so as to be part of a learning network — not just looking towards the lecturer in immovable rows. The PD learning space, then, offers students the room in which to practise interpersonal interaction.

The multimedia environment of the PD rooms means teaching has the potential to be less dictatorial, less linear and more exploratory than teaching in lecture theatres and tutorials. Kozma (1991) argues that such environments can challenge learners to develop their critical thinking skills in ways that traditional transmissionist spaces might not. But the shift from lecture and tutorial has proved to be a greater shift in practice for some facilitators than it has been perhaps for first year students. The spaces have been created to support the development of professional literacies, academic literacies and social cohesion. The technologies used in the curriculum should support and enhance these aims but do they? How well have we integrated the collaborative and investigative capabilities of ICT into course instruction and classroom use? Have we merely created more ways to transmit information?

Teaching PD

PD units currently have 60 seminar groups each week (semester one, 2009, PD1 has 39 seminars and PD2 has 20 seminars). The seminars run at 4 campuses and are taught by 35 different facilitators. PD units use Learning Modules in Blackboard to structure seminars and to provide before and after class activities for students as well as vital functions like communication, assessment and Turnitin. Blackboard and e-mail also help students and facilitators to share resources and “keep on the same page” with the curriculum. Attempts to ensure comparability across seminars is enhanced through weekly Lesson Plans provided to all facilitators and by facilitators sharing their classroom experiences (sometimes during class) via group e-mail. While “our ability to take advantage of the power of emerging technologies will depend on the creativity of designers” (Kozma, 1991), the onus as far as the PD units is concerned is also on the facilitators. The creativity of curriculum developers and the high-tech look of the PD learning spaces will not salvage a class if the facilitator is unwilling or lacking in confidence to use ICT or to let students occupy the learning space in active and creative ways. Biggs (2003) reminds us that ICT can “make bad teaching worse” — so ICT for ICT sake is to be avoided while the interactive capacity for ICT must be exploited. Findings from a 2009 survey suggest that training for facilitators of PD is more critical than the curriculum developers expected.

Survey of Facilitators

A 2009 survey using Survey Monkey examined PD facilitators’ use of ICT and, specifically, Blackboard in the PD units for the semester beginning February 2009. The survey asked facilitators to self-report on their ICT skill level, to indicate the frequency of their ICT usage of a range of technologies (for example, Internet, Skyping, Mobile Phone, Digital Camera, Document Camera, Twitter (or similar), Podcasts, Blog/Vlog, Wiki, MP3) for teaching PD, teaching units of study other than PD and administration. More specifically, the survey asked respondents to consider selected Blackboard functions (Who’s Online, E-mail, Announcement, Discussion, eJournal, Grade Book, Quiz, Learning Modules and Student Tracking) and to indicate frequency of use with the options: ‘Never’, ‘Several times a month’, ‘Weekly’, ‘Several times a Week’ or ‘Daily’. The survey also asked for facilitator examples of particular ICT usage in PD and their overall perception of the impact of ICT on teaching and learning in PD. This response, it must be noted, was overwhelmingly positive. Finally, respondents were asked about their own professional development habits and needs

In relation to the use of Blackboard functions, it was interesting to note that many interactive communication tools like Who's Online and Chat were "Never" used by most respondents; E-mail, Discussion, Announcement were "Never" used by some respondents and, despite the e-journal being an assessment task, 1 respondent 'Never' used that function either. Student Tracking was not used by several respondents. As this function provides another indicator of students "at risk" of attrition, this finding will be acted on immediately. The fact that 1 respondent claimed not to use Learning Modules either might suggest that some facilitators are not familiar with Blackboard nomenclature rather than the functions themselves. This, too, will be followed up in the focus groups.

The number of facilitators who "Never" use Twitter, Digital cameras or scanners, CD-ROM, DVD, Podcasts, Blogs, Vlogs, Wikis, Mobile Phones or MP3s for their teaching or student learning was substantial (over 50%). Responses to the question: "If you do not use a specific ICT resource in any of the contexts specified . . . please indicate why" (Not familiar with, Lack of skills, Not appropriate, Lack of technical support, Lack of time), for technologies as omnipresent and user friendly as mobile phones (Armatas. et al., 2009), over 80% of respondents indicated that they "Never" used them for teaching. The number of respondents who did not use a specific ICT resource in any teaching context not because they were unfamiliar with it or lacked the skills but because they felt it was "Not Appropriate" was unexpected. This question included Twitter (or similar), Digital camera, scanner, mobile phones, and Wikis. This response was surprising because we know anecdotally that, in some classes, facilitators actively encourage these technologies. Students do take photos with their mobile phones of mindmaps they have created on whiteboards and use the photos in their reflective journals, one facilitator takes photos of students and creates a class list with photos which is distributed to aid name recall (especially important when working online), one facilitator uses mobile phones to text reminders to students and encourages students to text her in addition to e-mail. As a facilitator, the authors have often engaged in impromptu chat with students using Who's Online. Students do use Facebook to work on their projects. They do upload podcasts. They blog and vlog and contribute to Wikis.

Examples offered by facilitators of particular ICT usage in PD were highly individual from playing music in class to daily dialogue in the Discussion forum. Most facilitators commented positively on the immediacy, the currency and visual appeal of multimedia resources. One facilitator noted that an unexpected outcome of ICT in PD is that "students write more during and after class." This survey, then, has provided some interesting findings. Participants of the survey have been invited to attend a focus group. Of the

15 respondents, 9 have agreed to attend the focus group when some of these preliminary findings can be explored. The PD units need to tap into existing ICT leanings to better engage with students. The curriculum development team, facilitators and students need to collaboratively reconsider the curriculum to better exploit ICT and the way contemporary students learn.

While multimedia environments, such as the PD rooms, have the potential to be radically different from traditional learning environments (Lawless & Brown, 1997) and were intended to be drastically different from lecture and tutorials, it is largely dependent on the curriculum and the facilitator whether this is achieved. Lectures, videos, textbooks, "tend to dictate an established order in which information is learned and the manner in which this information is presented is controlled" while the online component of the curriculum has the capacity to increase "dimensionality" (Lawless & Brown, 1997, p. 125). This increased dimensionality would only happen if students had a reason to use ICT. Lawless and Brown note that "By nature, multimedia environments are dramatically different from traditional learning environments" (p. 118). Despite the learning spaces, the technologies and the curriculum, it is clear that facilitators can still impose a more traditional transmission style of teaching — and, in fact, ICT can support them to do that. However, if Wikis were assessable student effort would be more generative than consumptive, if a learning blog substituted the less interactive journal or if evidence of using a collaborative platform were required alongside the more traditional report, then perhaps the use of ICT in teaching PD would have been more creative and less predictable. Assessment tasks must be considered in an evaluation of curriculum.

Conclusion

The survey suggests a divergence of teaching practices, utilisation of technologies and facilitator approaches to learning spaces. The survey also hints that individuals are using ICT in ways not envisaged by the curriculum developers. Facilitator responses suggest that they, like students, learn from colleagues and they learn by doing. It is vital that facilitators be ICT literate to actualise the potential of ICT to engage students. In future curriculum development, the team will examine opportunities to increase facilitators' ICT repertoire to encourage effective inclusion of technologies that are currently being left out of some learning spaces despite being firmly entrenched in students' social spaces.

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CONNECT OR DISCONNECT: THE INFLUENCE OF TECHNOLOGY-ENABLED UNIVERSITY SUPPORT SERVICES ON ENTREPRENEURIAL INTENTIONS

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Abstract

The purpose of this paper to describe the entrepreneurial intentions of South African university students and to determine the influence of university information technology-enabled support services (ITeS) on their entrepreneurial intentions. A cross-sectional web-based survey was conducted from August to November 2008 and 2203 university students participated. The results indicate that more than half of students consider an entrepreneurial career more than five years after graduation and even though they regard ITeS as important, few make use of more than contacts, business plan and entrepreneurship seminars and lectures.

Introduction

Entrepreneurship has become the new dogma of the 21st century. It has been promoted as a career choice, entrepreneurs are profiled as heroes in the popular business press, and governments encourage entrepreneurship as the solution to economic growth and job creation (Verreynne & Scheepers, 2008). However as career choices go, becoming an entrepreneur is one of the most risky, unstructured and probably rewarding choices students can make.

Despite these risks, research studies in recent years (based on the Global Entrepreneurship Monitor-reports) have shown a strong relationship between education and enterprise creation (Von Broembsen et al., 2005). Individuals with tertiary education have the potential to create sustainable enterprises, which survive beyond the "three year crunch" and tend to create more jobs, compared to individuals with secondary or primary education. These findings are supported by earlier research (Robinson & Sexton, 1994) which indicated that the self-employed more often have a formal university education, compared to people in wage and salaried employment.

Technological developments in education have led to more Information Technology enabled support Services (ITeS) that can be offered to students. ITeS is one of the major drivers of growth in the global IT Industry and adds value to entrepreneurs in most industries (Arnold, 2007). Universities all over the world also make use of these support services in different ways. ITeS can also be utilised to facilitate and promote entrepreneurship within universities. The rationale behind offering ITeS to students who intend becoming entrepreneurs, are to provide students with learning materials for their entrepreneurship modules, offer simulations, mentorship and provide networking opportunities.

The need for entrepreneurship is especially relevant in developing countries, such as South Africa (SA). In the current SA economy it is estimated that more than 8 million people will be unemployed by 2010, therefore SA is in dire need of high potential entrepreneurial ventures, which create jobs and wealth (Nieuwenhuizen & Groenewald, 2008). Thus, the entrepreneurial career intentions of university students are especially important to analyse, since university educators can adapt curriculum offerings to the needs of students, and improve technology-enabled support services. The purpose of this paper is to determine the entrepreneurial intentions of SA students and determine how intentions are influenced by university ITeS.

Literature Review

Various reasons are offered as to why individuals start and build their own businesses. Among the leading motives cited are the desire for independence, the challenges of creating and building a business and the profit motive (Rwigema & Venter, 2004, p.13). On the one hand these three motivations often lead to the creation of opportunity-based business, anchored in a real market problem or growing need, “pulling” individuals to start businesses. On the other hand entrepreneurs may also be “pushed” into entrepreneurship by poor prospects and disillusionment with their current employer, the lack of innovation within their current employer’s business or through negative displacement or lack of alternatives, such as retrenchment and corporate downsizing (Rwigema & Venter, 2004, p. 13).

Today’s students are tomorrow’s potential entrepreneurs, however there is limited understanding of the factors which affect students’ career expectations and intentions to become entrepreneurs (Basu & Virick, 2008). For students, the decision to start a business reflects a process in which attitudes and intentions evolve based on the development of individual skills, experiences and relations to the business context (Davidsson, 1991; Katz, 1992).

Entrepreneurial Intentions

Intentionality is rooted in socio-psychology theories of behaviour, based on the premise that much of human behaviour is planned and therefore preceded by intentions towards that behaviour (Basu & Virick, 2008). Intentions are a proactive commitment to bring about future actions, not just an expectation of future actions

(Bandura, 2001). Furthermore in cases where behaviour is difficult to observe, rare, or involves time lags, intention is seen as an accurate predictor of planned behaviour (Fishbein & Azjen, 1975). Entrepreneurial behaviour is an example of such behaviour and thus several empirical studies of entrepreneurship have applied the theory of planned behaviour (Kolvereid & Isaksen, 2006; Urban, 2006). Krueger et al. (2000) assert that entrepreneurial activity can more accurately be predicated by studying intentions, rather than studying personality traits, demographic characteristics, or situational factors.

Two intention-based models that are widely recognised in the entrepreneurship intention-field of research and offer a well-developed theoretical basis for intention based research are: Ajzen's (1991) theory of planned behaviour (developed and validated in social psychology) and Shapero's (1982) model of entrepreneurial event (not well tested). The theory of planned behaviour contends that intentions are a function of three sets of factors: attitudes, subjective norms, and perceived behavioural control (also known as self-efficacy). Attitudes are defined as beliefs and perceptions regarding the personal desirability of performing the behaviour, which are in turn related to expectations regarding the personal impact of outcomes resulting from that behaviour (Azjen, 1991). Subjective norms or perceived social norms are defined as individuals' perceptions about the values, beliefs and norms held by people whom they respect or regard as important and the individuals' desire to comply with those norms. Krueger et al. (2000) argues that the intentions of individuals with a high internal locus of control are less influenced by social norms. Perceived behavioural control (PBC) or self-efficacy is defined as the personal belief that one can execute planned behaviour and the perception that the decision-maker has control over the behaviour (Basu & Virick, 2008).

Applying the theory of planned behaviour to entrepreneurship, entrepreneurial intentions are viewed as being dependent on an individual's attitude toward the desirability of an entrepreneurial career, subjective norms, including perceived family and other role models expectations and beliefs to perform the behaviour, as well as the perceived ability to execute the intended behaviour of entering entrepreneurship (PBC) (Basu & Virick, 2008; Urban, 2006). PBC has been shown to be influenced by prior experience, especially entrepreneurship education (Noel, 1998).

Influence of Education in Shaping Entrepreneurial Intent

Student career expectations are influenced by a variety of factors such as the changing career world, characteristics of various careers, financial factors, education-related factors, family background and role models (Kroon & Meyer, 2001; Von Broembsen et al., 2005). Entrepreneurship educators are often urged to consider how their modules and approach to teaching entrepreneurship can influence students' attitudes and intentions towards entrepreneurship (Kroon & Meyer, 2001; Nieuwenhuizen & Groenewald, 2008).

Earlier empirical work of Owusu-Ansah and Fleming (2002) and Ibrahim and Soufani (2002) found that entrepreneurs, who participated in entrepreneurship courses exhibited higher tendencies to start their own businesses compared to those attending other business courses, or not attending any courses. Ladzani and Van Vuuren (2002) share this view, by highlighting the pivotal role training plays in supporting small businesses. They propose that entrepreneurship education is essential for starting and managing a business and therefore it has a powerful influence on entrepreneurial intentions.

While some may argue that tertiary entrepreneurship courses are too theoretical, Sullivan (2000) found that entrepreneurs believe that the foundational knowledge gained by participating in academic courses were valuable, when confronted with "real life" incidents. Explicit knowledge of entrepreneurship concepts enabled graduates to cognitively reflect on the incidents and determine what learning took place. In other words the ability to dissect, reflect, learn and act on a critical incident was seen to be of great importance (Nieuwenhuizen & Groenewald, 2008). Therefore it is expected that education can positively influence entrepreneurial intentions.

Technology-enabled Support Services For Entrepreneurship

Information Technology enabled support Services at universities could potentially enhance the entrepreneurial intentions of students. Several examples of university partnerships, supported by ITeS can found globally. For example in the United Kingdom the *SET squared Partnership* is enterprise collaboration between UK Universities of Bath, Bristol, Southampton and Surrey. The Partnership supports the creation of new technology businesses and licenses from its research base and the local community as well as facilitating industry-academia collaborative research and providing enterprise education and training to its researchers and entrepreneurs. In the last three years four SET squared Partnership companies have achieved IPOs, with a total market cap of £160 million and 170 early stage technology companies have been supported through its Business Acceleration Centres (Brooks & Smailes, 2009). The Triple Helix[1] concept focuses on the role of Industry, Universities and Government relationships in creating new high tech businesses. Classic examples are the Boston area with its universities and high tech industry, and the Stanford/Northern California area in the USA.

[1] This concept refers to the relationships between industry, universities and government.

Another example is ATP Innovations. ATP Innovations, owned by four of Australia's top universities, is a leading technology business incubator and accelerator that support emerging businesses in the biotechnology, ICT and electronics sectors. Though their subsidiary company bizCapital, matching funds for pre-seed investments are available for early stage ventures. Additional skills development programs are offered through Enterprise Workshops, which provides emerging companies the opportunity to test their business case through intensive team-based business plan workshops. Located within the Australian Technology Park, ATP Innovations supports Australia's largest cluster of emerging technology businesses (Hawthorn, 2007).

SA universities also facilitate entrepreneurial development of students by offering various services such as technology transfer, commercialisation advice, business development services, incubators, start-up financing, contacts for general questions, and founder exchange experiences. University-industry partnerships also offer start-up games and business simulations, such as First National Bank Universities Business Challenge (FNB UBC), that encourage future entrepreneurs to achieve their full potential. Additionally Management departments offer entrepreneurship seminars and lectures, business plan projects and start-up coaching through the classroom and virtual environments. Therefore, university ITeS can influence students, through socialisation into entrepreneurship as a possible career path (Kolvereid & Moen, 1997).

Methodology

The purpose of this paper is to determine the entrepreneurial intentions of SA university students and determine the relationship between these intentions and university ITeS, facilitating entrepreneurship. To achieve this objective, a cross-sectional web-based survey focused on a sample of South African university students was conducted.

The data set on which the data from this study is based was collected as part of the "Global University Entrepreneurial Spirit Student Survey" (Guesss). This survey focuses on collecting data globally (19 countries participated in 2008), using a standardised web-based questionnaire, translated into English, French and German. Representatives in each country were responsible for approaching relevant universities in each country. Participation was voluntary and students were offered lottery prizes to take part in the survey. Globally 63 580 students in 19 countries took part including 2,203 South African students. Students from the following SA universities took part: University of Stellenbosch, University of the Free State, Nelson Mandela Metropolitan University, University of Johannesburg, Northwest University, University of the Western Cape, University of Cape Town, and the University of Pretoria. Due to the voluntary participation of students, responses varied between universities.

Data was collected from August to November 2008. The web-based questionnaire focused on assessing students' entrepreneurial intentions, entrepreneurial activities undertaken to date, their individual socio-demographic characteristics and values as well as their university context, based on a scale, verified by Klandt (1984). This paper draws on the data of entrepreneurial intentions, some socio-demographic variables and the university context, specifically technology-enabled support services.

Results

The results presented firstly describes the sample, secondly present descriptive statistics of entrepreneurial intention and university support services and, thirdly, examine the relationships between these variables.

Sample Profile

The sample of students participating in the study is presented in Table 1. As shown in Table 1 most respondents are young (up to 24 years of age (84.7%)); there are slightly more male (52.8%) than female (47.2%) students; and most students in the sample are busy with their undergraduate studies (86%). In terms of the area of study, the largest portion in the sample is commerce students (38%), then maths, computing and engineering (10.4%); and then life and natural science (8.8%).

Table 2 shows the career choices of the students in the sample directly after their studies, compared to five years after graduation. While the largest portion of students (20.8%) indicated that they would like to work for a large enterprise directly after their studies, another large portion (18%) indicated that they would like to work for a medium-sized enterprise. However when all the different routes to entrepreneurship are considered as a whole, including continuing the family business, taking over an existing business, starting a franchise, continue my own already founded business or starting my own business, more than a fifth (21.4%) indicated they preferred an entrepreneurial career directly after their studies. When their career intentions are considered five years after graduation the picture changes significantly. More than half of the respondents (52.4%) consider an entrepreneurial career, while only 14.9 % of the respondents express their intentions of working for a large enterprise.

Table 1: Characteristics of the Sample

Age of respondents	Number	Percentage	Cumulative percentage
Younger and up to 24 years	1866	84.7	84.7
25 – 30 years	214	9.7	94,6
Older than 31 years	118	5.4	100
Gender			
Male	1163	52.8	52.8
Female	1040	47.2	100
Level of studies			
Undergraduate	1895	86.0	86.0
Graduate (Honours or Masters)	213	9.7	95.7
Post-graduate (PhD)	95	4.3	100
Area of study			
Teacher & Training	72	3.3	3.3
Arts & Humanities	124	5.63%	8.9
Social & behavioural sciences	180	8.2	17.1
Business & administration	836	37.95	55.0
Law	120	5.5	60.1
Life and natural sciences	193	8.8	69.2
Maths, computing and engineering	230	10.4	79.7
Architecture	53	2.41	82.1
Agriculture	71	3.2	85.3
Health Sciences	144	6.5	91.8
Other	180	8.17	100

n = 2203

Table 2: Career Choices

	Directly after studies			5 years after graduation	
Career options	**Number**	**Percentage**		**Number**	**Percentage**
Working in a micro or small enterprise (0 – 49 employees)	359	16.3		83	3.8
Working in a medium-sized enterprise (50 – 199 employees)	396	18.0		134	6.1
Working for large enterprise (200 and more employees)	459	20.8		328	14.9
Working at university	126	5.7		88	4.0
Working in civil service	87	3.9		38	1.7
Continuing the family business	67	3.0		55	2.5
Taking over or investing in an existing business	141	6.4		302	13.7
Starting or setting up a franchise	55	2.5		108	4.9
Continuing my own already founded business	40	1.8		107	4.9
Starting up my own business	177	8.0		582	26.4
Working part-time (freelance)	72	3.3		198	9.0
Other (including don't know yet)	224	10.2		180	8.2
Total	**2203**	**100**		**2203**	**100**

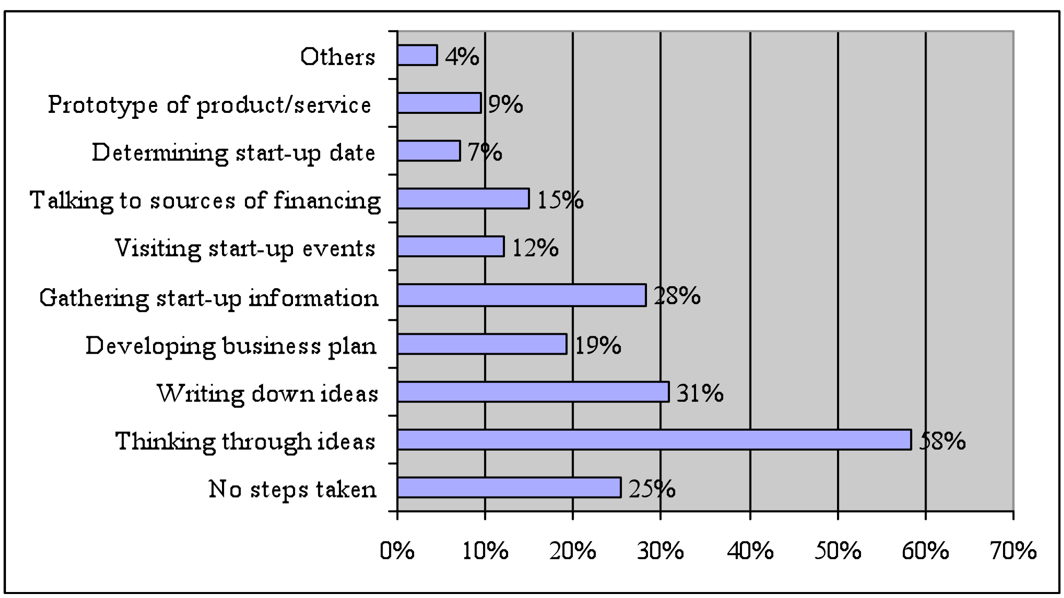
Table 3 indicates how seriously students have considered the possibility of starting their own enterprises. While almost half (47.6%) indicated that they did consider the idea for a short time, but abandoned the idea, a large portion (41.9%) showed their determination to enter entrepreneurship as a career, while only 2.4 per cent reported that they are or were self-employed.

Table 3: Seriousness of Entrepreneurial Intentions

Response	Number	Percentage
No, never	181	8.2
Yes briefly, but I dropped the idea	1048	47.6
Yes I am determined, I'm just starting to do so	922	41.9
Yes, I am already / I was self-employed	52	2.4
Total	2203	100

Figure 1 provides an indication of the steps respondents have taken towards starting a business. While more than half (58%) indicated that they have been thinking through initial ideas, a little less than a third (31%) have written any ideas down, 28 per cent have gathered start-up information, while 19 per cent have worked on developing a business plan. These numbers indicate that while respondents may have thought about getting involved in entrepreneurship, most of them are not currently actively involved with turning this intention into a reality.

Figure 1: Steps Taken towards Starting a Business



Respondents were also asked to indicate how important they viewed Information Technology enabled support Services (ITeS) to facilitate entrepreneurship and if they had made use of these services. From Table 4 it can be seen that respondents viewed contacts for general questions, start-up financing through universities, business plan project seminars, start-up coaching and entrepreneurship seminars and lectures as most important in facilitating entrepreneurship.

Table 4: Importance of University ITeS Facilitating Entrepreneurship

University ITeS	**Pretty unimportant**	**Rather unimportant**	**Rather important**	**Pretty important**
Business plan project seminars	4.4%	10.8%	24.7%	60.1%
Start-up coaching	4.1%	11.6%	25.1%	59.2%
Entrepreneurship seminars & lectures	4.0%	12.0%	25.0%	59.0%
Start-up games & simulations	6.9%	14.7%	22.9%	51.1%
Regular round tables for founders (exchange experiences)	5.3%	15.3%	26.3%	53.1%
Contacts for general questions	2.6%	9.5%	23.8%	64.1%
Start-up financing through university	6.0%	10.7%	23.0%	60.3%
Incubators (service centres for early start-ups)	4.5%	12.3%	25.9%	52.8%
Others	3.2%	1.7%	3.4%	8.0%

n = 2203

Despite their views of the importance of these ITeS facilitating entrepreneurship, Table 5 shows that relatively few students have made use of these services. The largest number of respondents indicated that they used contacts for general questions (48.7%) and entrepreneurship seminars and lectures (47.4%). Other services also used by more than a third of the respondents were business plan project seminars (38.1%) and founder exchange experiences (34.3%).

Table 5: Use Made of University ITeS Facilitating Entrepreneurship

Made use of service	N	Yes	No
Business plan project seminars	743	38.1%	61.9%
Start-up coaching	439	29.2%	70.8%
Entrepreneurship seminars & lectures	1324	47.4%	52.6%
Start-up games & simulations	371	30.7%	69.3%
Regular round tables for founders (exchange experiences)	332	34.3%	65.7%
Contacts for general questions	1104	48.7%	51.3%
Start-up financing through university	351	24.5%	75.5%
Incubators (service centres for early start-ups)	213	24.4%	75.6%

Correlation Analysis

Correlation analysis was undertaken to determine the relationship between respondents indicating high entrepreneurial intentions and ITeS. Firstly the relationship between their views of the importance of ITeS and high entrepreneurial intentions were calculated, there-after the relationship between the use of ITeS and high entrepreneurial intentions was determined. The results are shown in Table 6.

Table 6: Pearson Correlations of ITeS and High Entrepreneurial Intentions

	Importance of service				Service used		
ITeS correlated with High Entrepreneurial Intentions	**Pearson**	**p**	**n**		**Pearson**	**p**	**n**
Business plan project seminars	0.155	0.000	2203		0.114	0.002	743
Start-up coaching	0.129	0.000	2203		0.041	0.393	439
Entrepreneurship lectures	0.138	0.000	2203		0.112	0.000	1324
Start-up games & simulations	0.124	0.000	2203		0.009	0.865	371
Founder experience exchange	0.141	0.000	2203		0.081	0.140	332
Contacts for general questions	0.115	0.000	2203		0.036	0.237	1104
Start-up financing	0.093	0.000	2203		0.020	0.714	351
Incubators	0.114	0.000	2203		0.034	0.625	213

$p < 0.05$ = significant

Table 6 reveals that although respondents with high entrepreneurial intentions all regarded university ITeS facilitating entrepreneurship as important and statistically significant, the strength of the correlations is weak. An explanation could be that a number of other factors would have a stronger relationship with entrepreneurial intentions, such as attitudes, subjective norms and self-efficacy; nevertheless the correlations do indicate that universities should offer these services. Additionally although students with high entrepreneurial intentions regard these ITeS as important, only business plan project seminars and entrepreneurship lectures show significant, weak correlations with entrepreneurial intentions. These results seem to suggest that while students may be thinking of entrepreneurship as a career at university, their primary goal is to obtain knowledge and not engage in start-up behaviour.

Discussion and Conclusion

The findings show that while a fifth of students consider an entrepreneurial career directly after their studies, slightly more than half of respondents consider entrepreneurial careers, five years after graduation, when they have obtained work experience, knowledge of an industry and have established contacts within networks. Even though such a large number of students consider an entrepreneurial career, few engage in concrete actions steps at present. Most steps taken are just exploratory, such as thinking of ideas and gathering start-up information. Few students proceed to writing business plans or seeking financing. This could be ascribed to the stage of their studies, since most students in the sample are undergraduate students.

When the relationship between entrepreneurial intentions and university ITeS facilitating entrepreneurship is considered, most students regard ITeS as important, however most students only make use of business plan project seminars and entrepreneurship lectures. These results seem to suggest that while students may be thinking of entrepreneurship as a career at university, their primary goal is to obtain knowledge and reduce the risks of an entrepreneurial career, and not engage in start-up behaviour at present.

This study has several limitations that arise from cross-sectional self-reported data. Self-reported data tend to inflate relationships and causality can not be determined using cross-sectional data. Students were incentivised, using lottery prizes; however respondents who took less than 15 minutes to complete the online questionnaire, responses were eliminated. Despite these limitations this study makes a contribution by showing that ITeS can be used to enhance entrepreneurial intentions of students. However ITeS should be used in conjunction with other educational offerings and experiential learning to increase students' attitudes and perceived behavioural control.

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THE USE OF SPREADSHEET MODELLING IN THE TEACHING OF CORPORATE FINANCE

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Abstract

The use of spreadsheets and computer simulations using programs such as Excel has become pervasive in practice. Although the use of spreadsheets and computer simulation are relevant in the teaching of corporate finance, research on the use of spreadsheets has tended to focus on the teaching of financial accounting and management accounting. Yet, the use of spreadsheets and financial modelling in the teaching of finance has grown due to the perceived educational benefits as well as the demand by business that students should develop skills to enable them to undertake corporate finance applications rather than simply understand corporate finance theory. The introduction of spreadsheet models will enhance the students' ability to apply corporate finance theory to real world applications.

Introduction

The objectives of this paper are to document and set out why spreadsheet modelling is valuable to the learning process and to explore the tools in Excel that can be used in "what-if" analysis. We address some key issues relating to spreadsheet design, documentation and minimising spreadsheet errors, which are often overlooked when spreadsheet models are used in an educational setting. We consider that Excel can be used to support student understanding of the key concepts in finance. Spreadsheets may also enable students to see beyond the formulae and understand some of the more complex and quantitative aspects of corporate finance. We submit that spreadsheet modelling can be employed in a corporate finance course to enable students not only to apply financial theory but more importantly to bring financial concepts to life. The focus should be on spreadsheets and technology enabling the learning process, particularly in relation to the use of case studies and business simulations in the teaching of corporate finance.

The Role of Spreadsheet Modelling in the Learning Process

Coldwell and Rose (2006) state that one of the main challenges facing educators seeking to enhance learning, as well as practitioner and student satisfaction, is to create opportunities for students to apply financial concepts and theory to real world cases. Bennis and O'Toole (2005) argue that business education has been preoccupied with imparting theory and concepts rather than practical skills which would enable students to be successful business professionals. According to Albrecht and Sack (2000) educational models focus excessively on content at the expense of skill development. Marriott (2004) argues that if students wish to learn spreadsheets because proficiency in financial modelling will enhance their skills and job opportunities, then educators should facilitate the use of spreadsheets in the classroom.

Brooks and Oliver (2004) introduced a new course designed to combine management accounting concepts and technology. The technology component emphasized spreadsheet design and communication. The use of cases studies ensured that the curriculum was relevant and simulated "real life" situations. This enhanced the relevance of the course. It also enabled the educators to change their role to facilitators rather than instructors as the students took on a greater responsibility for their own learning (Brooks & Oliver, 2004).

In the pedagogical literature, this is often termed as 'constructivism' as students take responsibility for the learning process and become autonomous and independent. The lecturer is no longer the sole authority but acts rather as a facilitator, a guide, supporting learners in the process of constructing knowledge (Neo, Neo, & Tai, 2007). Students develop important thinking and problem solving skills and acquire the skills required to work in a team. Experiential learning leads to the enhancement of their knowledge base and the ability to learn how to learn. David Kolb is often regarded as the founder of experiential learning and with Roger Fry, set out a learning cycle which included four elements: concrete experience, observation and reflection, the formation of abstract concepts and testing in new situations (Kolb & Fry, 1975). Learning involves the use of concrete experience to test ideas. Technology is a critical component of the learning process (Neo, Neo, & Tai, 2007). Information and communications technologies can be used to support experiential learning environments (Di Challis & Rice, 2005).

Brooks and Oliver (2004) reported a continual improvement in skills and confidence over the course of the unit and an improved ability by students to deal with problem solving situations.

In the Masters of Financial Management programme at the University of Cape Town (UCT), we use Bruner (2007) which contains real world cases involving mostly well known companies facing corporate finance decisions. The focus is on decision making. These case studies are lengthy and extensive, involving advanced data analysis. Technology enables "learning by doing" and it is not possible to undertake a relevant case study mode of education in corporate finance without students acquiring financial modelling skills. Spreadsheets enable the teaching of corporate finance using the case study approach.

At UCT, financial modelling is integrated within the programme and each case study requires students to apply financial modelling in Excel such as preparing pro forma financial statements and cash flows and applying Excel tools such as Goalseek, Data Tables, Scenario Manager, Monte Carlo Simulation, Financial functions and specific add-ins and add-ons. These follow a building block approach which is integrated with specific cases. For example, in analysing the prospects of a new drug in the pharmaceutical/biotech sector, students will be required to undertake a Monte Carlo Simulation in Excel as well as using CrystalBall™. At UCT, the combination of using Excel financial modelling skills and the case study approach results in a significant improvement in the ability of students to deal with complex business situations and apply advanced spreadsheet modelling skills.

The effectiveness of the learning model is reflected in extremely positive student evaluations at the end of the first year of the programme.[1] It is also true that students experience difficulties in the first 3 months of the programme as they come to terms with the new learning model.[2] The focus is on applied corporate finance and financial decision making. However, there is a need to ensure that students do not become model centric. The course is focused on financial decision making and that the focus is on industry and strategic analysis, financial analysis and valuations. Spreadsheet and financial modelling is only a part of the process of getting to a decision. Solutions are sometimes hard to pin down as there are alternative courses of action. There may not be one solution but there is one decision.

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[1] Students in course evaluations often state that the case study method is the most positive aspect of the course.

[2]Difficulties to overcome include the integrated nature of cases which deal with strategic and industry issues, and often include a number of corporate finance topics in a single case, the length of cases, the financial modelling requirements and the focus on reaching a decision rather than a solution.

The setting of spreadsheet modelling as only part of the process of solving a case study in corporate finance is consistent with the experience of Marriott (2004) who employed spreadsheet modelling as a key component in a course requiring students to deal with business simulations. Marriott (2004) states that students were required to use the information set out in the introduction to the business simulation to prepare a spreadsheet model to produce financial forecasts for a business plan. The spreadsheet model was required to be placed in a practical setting but is secondary to the main purpose of the assessment which is to prepare a business plan. In relation to the use of computerised business simulations, Marriott states that “it presents an opportunity for students to develop algorithmic thinking, to use spreadsheet-modelling skills in a realistic setting, to enhance cognition in understanding the ‘whole’ of a business problem, and to reduce instrumentality through the intrinsic enjoyment of problem-based learning” (Marriott, 2004, p.55).

The use of business simulations achieves learning objectives from acquiring computer modelling skills to students acquiring a wider and deeper understanding of the financial management of companies. Marriott (2004) sees computer modelling skills as part of experiential learning which requires active involvement by students. Although computer simulation and a case study forms the focus of student learning, it is also true that spreadsheet modelling enables and facilitates the use of case studies and business simulations. It may be argued that without spreadsheet modelling, that the use of case studies in corporate finance would be difficult to implement. Holden and Womack (2000) contrast spreadsheet modelling to the use of spreadsheet templates and state that templates can become “black boxes” if students do not build the equations or graphs. Templates represent passive learning whilst spreadsheet modelling represents active learning.

Spreadsheets and Mathematical Equations

Holden and Womack (2000) state that spreadsheet modelling enables students to overcome “equation phobia” as spreadsheets enable the use of equations in non-equation form. Time lines and graphs can be effective alternatives to mathematical equations. However, financial modelling, in contrast to using Excel templates, may require students to build formulae or relationships between variables.

Spreadsheets can break down barriers that students have when trying to learn formulae with summation signs, integrals and other notations. Time value of money problems are more easily understood by students once the cash flows are set out in a spreadsheet format. The use of formulae may represent “short-cuts” to solving business problems but may result in complex equations to relatively simple problems. For example, let's evaluate the case of a growing annuity which requires us to apply the following formula:

$$\text{PV of a Growing Annuity} = \text{PMT}\ (1+g)\left\{\left[\frac{1-\dfrac{(1+g)^n}{(1+r)^n}}{r-g}\right]\right\} \quad \text{(Formula 1.1)}$$

Students often find Formula 1.1 rather challenging, and yet Formula 1.1 refers to a conceptually simple time value of money problem if we set out the example in a spreadsheet form. Assume that the required return is 9% and the annuity growth rate is 6% per year for 10 years. The first payment is $45 000 (1+0.06). The cash flows of this growing annuity are depicted in Figure 1 over a timeline of 10 years.

Figure 1: The Present Value of a Growing Annuity

	0	1	2	3	4	5	6	7	8	9	10
Annuity	45 000	47 700	50 562	53 596	56 811	60 220	63 833	67 663	71 723	76 027	80 588
Present Value	387 207										

Students are required to increase each year's annuity by 6% to determine the cash flow for the following year and use the NPV function in Excel to determine the Present Value of the future growing annuity. Conceptually, this is much easier to understand and "see through" than the formula for a growing annuity.

Before the widespread use of spreadsheets, the use of a formula represented a practical short-cut to manually setting out the cash flows over the next 10 years. As we indicate to students, doing it the long way in Excel only takes seconds to achieve. Essentially, doing it the long way is not what it used to be. The use of a formula may not be a short cut to a solution after all and may create an impediment to the understanding of financial concepts. Although the use of spreadsheet models can play a pivotal role in the teaching of corporate finance, we find that there is little attention by educators to spreadsheet design, documentation and minimising the potential for spreadsheet errors.

The Design and Layout of Financial Models

The flexibility of Excel enables financial analysts, accountants and practitioners to create and design applications to solve advanced business problems. Yet, this flexibility and simplicity will often lead users to ignore important design considerations in setting up their models. This may lead to poor documentation standards and more importantly may lead to significant errors. Setting documentation standards enables users of the model to understand the how the model works. We consider three, often interrelated, issues of *design and layout*, *documentation*, and *avoidance of errors* to be crucial in setting up a financial model.

In a corporate finance course that uses spreadsheet models, students should be made aware of the importance of design and layout principles, inserting appropriate documentation within the model and always being conscious of the potential for errors. The design and layout of the financial model will assist in minimising errors but is not a sufficient condition for avoiding most errors. Examples of poor design, poor documentation and errors in spreadsheets are often very effective in conveying to students the need for adhering to good practice in relation to designing and building financial models. The integrity of a financial model, the ability to maintain a model as circumstances change and the ability to undertake "what-if" analysis is critical to in setting up any model.

There has been a significant increase in the number of corporate finance textbooks that include Excel spreadsheets. Unfortunately, textbooks often do not adhere to layouts that will enhance the ability for students to undertake sensitivity or "what-if" analysis. Instructors that use Bruner's otherwise excellent case book (Bruner, 2007), might be expected to attest to the poor design of many of the Excel models found in the solutions.

It is important that even at the undergraduate level, students adhere to good design and layout methods in setting up a financial model. For example, in setting a simple capital budgeting example, students should be exposed to the proper methods of design and layout even if this increases the time required to complete a simple model.

The layout of a spreadsheet model should follow certain principles depending on the application.

- Inputs. There should be a separate section for inputs. All formulae should refer to this section for data values. Data values should not be included in formulae and input data values should be colour coded.

- Outputs/Results. The results of the financial model should be placed in a separate section that is close to the Input section, therefore enabling changes to inputs to be analysed immediately in terms of the effect on the results.

- Calculations section. In a capital budgeting or valuation application, this section depicts the cash flows per section. In Capital budgeting applications, tax calculations should form a separate section and in a valuation case, inputs may be related to each period. This section should only consist of formulae linked to values in the input section. Data values should not be embedded in any cells of this part of the section — it should consist only of references to the input section.

- Sensitivity or "What if" analysis section. The use of data tables in Excel or tornado graphs as well as Scenario Manager Tool can be useful to depict potential changes in results to changes in inputs.

- Workings section. Workings are an important part of the spreadsheet design. Workings should be referenced and will enable preparers to reduce the complexity of formulae used in the main section of the spreadsheet.

Individual applications will require adjustments to this layout of a financial model, particularly for valuation models which will include projected financial statements as well as free cash flows, financing flows and projected financial ratios. The separation of inputs, calculations and results is useful and is often applied in valuations and capital budgeting applications. It also optimises the functionality of Excel. However the insertion and particularly the deletion of columns can create risks for maintaining the integrity of the model and this should be balanced against the ease of moving from one section to another section of the spreadsheet.

A cascade approach to spreadsheet design will enable the deletion and insertion of columns without this impacting on other parts of the financial model, but will make it more difficult to move around the spreadsheet model. However, the allocation of range names to sections of the model, which can be set out in a separate reference section, will enable users to move around quickly in within a spreadsheet model. Although, the cascade approach may have advantages, its use is limited in practice as practitioners use separate worksheets within a workbook to manage the different sections of a financial model.

Formulae within a spreadsheet should not include both numbers and cell references within the same formula. A cell formula should only include references to the values in the input section. This will facilitate undertaking "what if" analysis as well as making changes to variables that will apply across the model. For example, the corporate tax rate will be located in the input section and formulae in the spreadsheet requiring the inclusion of the tax rate will refer to a single cell in the input section. If the corporate tax rate changes, this will enable the model to implement the effect of a change to the tax rate throughout the model and will minimise possible errors where there are multiple inputs.

Avoiding Spreadsheet Errors

Although spreadsheets are extensively used in practice, it has been found that most financial models have errors. Janvrin (2008) offers the example of a mutual fund that was required to change the distribution from $4.32 to $0.00 per share due to an analyst omitting to insert the minus sign in reporting a $1.2 billion capital loss when completing the distribution spreadsheet.

Janvrin (2008) refers to studies that indicate that 20 percent to 80 percent of all operational spreadsheets contain errors. A financial model review by KPMG (1997) confirmed the frequency and seriousness of spreadsheet errors. Their report states that in 95% of the financial models reviewed, at least five errors were found.

Beaman, Waldman and Krueger (2005) undertook a survey of accounting students who were required to undertake a spreadsheet exercise. The study found that quantitative and spreadsheet design errors were widespread but were reduced significantly after a semester of teaching spreadsheet design principles. Beaman et al. conclude that educators should include a course in spreadsheet design principles and problem-solving techniques as part of an undergraduate accounting program.

It is important that students should be exposed to good design principles for setting up spreadsheet models which will minimise the potential for quantitative and qualitative errors. Understanding the nature of spreadsheet errors may lead to a significant reduction in spreadsheet errors. Spreadsheet errors have been divided into two different types — quantitative and qualitative errors (Panko & Halverson, 1996; Teo & Tan, 1999).

Qualitative errors arise mainly from poor spreadsheet design (Beaman et al., 2005). Although qualitative errors may not result in immediate “errors” in results, they increase the potential for errors once a user applies “what-if analysis” or changes variables when circumstances change. Qualitative errors are indicated by the following attributes:

- Lack of separation of inputs, calculations and results.

- Data embedded in formulae in different parts of the spreadsheet, particularly data that may be subject to change. It is not practical to change data in formulae when a user wishes to undertake “what-if” analysis. It is much easier to simply change data values in the input section of a spreadsheet.

- Data that is placed irregularly and haphazardly across a model which makes it difficult to keep track of input values.

- Complex formulae within cells. Whilst it may not be possible to avoid complexity in relation to the use of functions, formulae should be simplified as much as possible, by for example, creating separate intermediate calculations in separate parts of the worksheet. A complex formula increases the potential for error if changes need to be made to a formula at a later stage.

- No documentation or poor explanatory notes. Use a separate worksheet to explain the parameters and objectives of the model. Use the cell comments facility in Excel to explain a cell's data or formula. Use version numbers, author information and use names for cells.

- Unprotected worksheet. It is recommended that formulae should be protected to avoid accidental overwriting.

- Data validation. It is possible to set limits to data inputs. For example, a discount rate may be limited to a feasible range of between 4% and 40%. An error alert will mean that you cannot proceed unless a user complies with the validation terms. Combo boxes can also be used to limit the possible changes made to a model's input values.

The following is a formula in a single cell from a spreadsheet to one of Bruner (1999)[3] case study Excel spreadsheets.

```
=(('Exh. 11'!F10*'Exh. 11'!G10)+('Exh. 11'!F11*'Exh. 11'!G11)+('Exh. 11'!F12*'Exh. 11'!G12)+('Exh. 11'!F14*'Exh. 11'!G14)+('Exh. 11'!F15*'Exh. 11'!G15)+('Exh. 11'!F16*'Exh. 11'!G16)+('Exh. 11'!F17*'Exh. 11'!G17)+('Exh. 11'!F18*'Exh. 11'!G18)+('Exh. 11'!F19*'Exh. 11'!G19)+('Exh. 11'!F20*'Exh. 11'!G20)+('Exh. 11'!F21*'Exh. 11'!G21)+('Exh. 11'!F22*'Exh. 11'!G22)+('Exh. 11'!F23*'Exh. 11'!G23)+('Exh. 11'!F24*'Exh. 11'!G24)+('Exh. 11'!F25*'Exh. 11'!G25)+('Exh. 11'!F26*'Exh. 11'!G26)+('Exh. 11'!F31*'Exh. 11'!G31)+('Exh. 11'!F32*'Exh. 11'!G32)+('Exh. 11'!F33*'Exh. 11'!G33)+('Exh. 11'!F35*'Exh. 11'!G35))/1000
```

[3] Calaveras Vineyards Case Study — see Exhibit 7 of the Student Spreadsheet supplement.

This demonstrates clearly how formulae should *not* be set out in a spreadsheet model. Quantitative errors result in incorrect bottom line values (Panko & Halverson, 1996). Calculations are incorrect and input values may be incorrect. Quantitative errors have been further categorised by Panko and Halverson (1996) into three major types:

- Mechanical or accidental errors such as mistyping a number or pointing to the wrong cell when setting up a reference or formula. Errors may occur when a user or developer accidentally alters a formula or value or uses an existing model as the base for a new model but forgets to update all formulae and carries over information from a prior model.

- Logic errors which reflect errors in formulae due to poor reasoning skills.

- Omission errors which reflect errors arising from data or inputs that are missing but should have been included in the analysis. These type of errors may be difficult to detect in a complex model.

The use of Excel may itself prove a barrier to an accurate solution. Further the particular rules of Excel need to be understood to ensure accuracy and reduce the potential for errors. For example, applying the NPV function[4] will result in the discounting of any range of cells even if period zero has been included within the range. Another example relates to the insertion of the last row prior to the summation row whose value may not be included in the total. However, this has now been fixed in Excel2007. Statistical functions may not be accurate although Excel2007 has improved things in this areas well.

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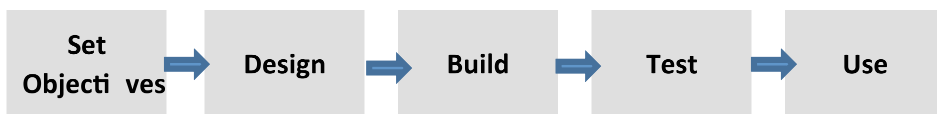
[4] The NPV function in Excel can be used to determine the present value of a future series of cash flows. Although termed as Net Present Value (NPV), the function assumes that the first cash flow occurs in one period's time. We need to make adjustments to determine the NPV if the first cash flow occurs at time zero.

The Use of Spreadsheet Models in Teaching Corporate Finance

It is paramount to recognise that finance graduates as financial analysts, brokers, accountants, and CFOs will be employing spreadsheet modelling as a core component of the requirements of the job and spreadsheet models will often be used as decision supports. It is critical that if students are required to use spreadsheet models in corporate finance, then students should be exposed to the principles of good design and be taught how to avoid the potential for errors. Students should be required to go through the following steps in the construction of spreadsheet models in corporate finance:



Students should be required to write up the objectives, reports and explain the design criteria. It is recommended that, as far as possible, financial modelling should be integrated into the corporate finance course. This will be facilitated at the post-graduate level, yet at the undergraduate level, students should be required to undertake a project in Excel which requires students to follow good practice in setting up financial models. Separate sections should be used for inputs, calculations and results. These may be set up in separate spreadsheets but we encourage the use of a single worksheet to facilitate the audit of the model using the audit toolbar which cannot easily move from one worksheet to the other. Students should be exposed to the type of errors found in Excel spreadsheets and the tools to minimise errors such as data validation and balancing totals.

Further, students should be exposed to the extent of errors found in practice and possible impacts on financial decision making. The importance of testing is paramount, particularly stress testing where we employ extreme values for input variables to ensure that the model works and results in credible results.

The use of tools such as the auditing toolbar and named ranges are useful. Students should construct models with view that maintainability and “what-if” analysis is critical. This will promote avoiding the use of hard coded cells and formulae with embedded data values. Students should be exposed to the importance of documentation in setting up a model and students should be required to protect cell formulae as well as use data validation. Spreadsheets are effective at displaying timelines and lecturers should use the spreadsheet format to explain most concepts in finance.

Setting documentation standards, good design practice at an early stage of the course will facilitate the ability of lecturers to grade financial models at a later stage. The reality is that spreadsheet models are easy to prepare and hard to verify.

The Application of “What-if” Analysis in Excel

A key objective of a spreadsheet model is to undertake “what-if” analysis. Students should be exposed to the following Excel functions that will enhance the ability of a financial model to perform what-if analysis:

- **Form Controls** — the use of combo boxes, scroll bars and spin buttons can assist in quickly analysing the impact of changes in key variables on the result. The use of the **Offset** function can also be useful to minimise errors when doing what-if analysis on key variables and this may be combined with the dynamic graphical abilities of Excel.

- **Data Tables** are very useful to depict possible results, like the NPVs of a project, for a range of varying values of a key input variable. Using a Data Table, we can for example display the NPVs for a range of discount rates or we can display the values of a company for a range of WACCs and terminal growth rates.

- The **Scenario Manager** facility in Excel enables setting out a number of possible scenarios — combinations of input variables that may include worst case and best case scenarios. This may require some hard coding of input variables (due to the limitations of Excel) and often is undertaken as a separate exercise within a model.

- The use of a **Tornado Graph** is very effective at displaying the relative impact of a change of in an input variable on the final result. This may be modelled within Excel or it is possible to employ an add-in to Excel.

- **Goalseek** is a very effective tool in Excel which works backward from a result to change an input variable. For example, assume you have estimated a future share price and determined based on this price and future dividend flows that the IRR is 10%. Using Goalseek, we can ask the model to work out the future share price so that a target IRR of 25% is achieved.

- **Solver** which is an Excel add-in is an optimisation tool which enables input variables to be changed subject to specified constraints so that the target NPV is achieved.

- **Monte Carlo Simulation** may be set up in Excel by setting up a capital budgeting with simulations by for example employing the =RAND() function. It is however preferable to use an add-on program such at Crystal Ball or @RISK to perform detailed Monte Carlo Simulations.

We submit that finance graduates will be using many of these functions in practice as supports to financial decision making once they commence employment and it is possible to integrate the use of these functions within the corporate finance course. In Annexure 1, we have set out examples of using Scenario Manager in Excel, a Tornado Graph for indicating relative sensitivities for the same example and a Monte Carlo simulation histogram and cumulative probability graph. Although, corporate finance textbooks are starting to use Excel spreadsheets, the use of these "what-if" tools is limited. However, Correia et al. (2005) and Correia et al. (2007) do make use of Scenario Manager, Data Tables, and Monte Carlo Simulation. Then there are the specialised textbooks such as Benninga (2008) on financial modelling.

Topics in Corporate Finance

In relation to the content of a corporate finance course, topics such as Time Value of Money, Risk and Return, Capital Budgeting and Valuations are particularly well suited for the use of spreadsheet modelling. In practice, the use of spreadsheet modelling is pervasive in the areas of capital budgeting, leasing, valuations, financial analysis and option pricing. The teaching of corporate finance should include spreadsheet modelling particularly in these areas of a corporate finance course. Further, it is submitted that spreadsheet models are highly effective in explaining finance concepts. Understanding portfolio theory and efficient frontiers is facilitated by the use of an Excel model. The use of Regression and scatter graphs may explain the use of betas and CAPM. Explaining how IRR and YTM work and the effect of the implied reinvestment assumption when using IRR for decision is facilitated through the use of a simplified model. Our experience in teaching finance, particularly to accounting students, is that they understand the numbers and we use this background to translate numbers into graphs and to improve the understanding of corporate finance concepts. This applies when we depict option pay-off structures. We stress test Excel option pricing models in front of the class in order to explain how option pricing works. When we explain that owning a deep-in-the-money option is like owning a share, understanding this is facilitated by doing the numbers in Excel. We ask students to apply a discrete process but stretch this in order to facilitate the understanding of continuous discounting. Students are required to build a simplified binomial option pricing model (although this leads to inaccurate results) so that they understand the process of option pricing models. We then expand this by using a more complex binomial model in Excel. Students are also required to use the ASX binomial option pricing model. In Annexure 2, we have set in greater detail how we use Excel in the teaching of a corporate finance course.

Conclusion

Spreadsheet modelling represents "learning by doing" and may empower students to take charge of the learning process. This is particularly relevant when spreadsheet modelling is integrated within the corporate finance course and is used in case studies or business simulations. Spreadsheet modelling often enables the use of case studies in the learning of corporate finance. Further, financial modelling skills are important for the employment of finance graduates and finance and accounting job advertisements often specify that applicants should have strong Excel skills. Although the flexibility of spreadsheet models is powerful, and its use is pervasive, spreadsheet errors are widespread. If students are to use spreadsheet models in learning corporate finance, then good design practices and how to minimise the potential for errors should be part of the learning process.

Spreadsheet modelling should be integrated within the corporate finance course and the powerful "what-if" tools in Excel should form a key component in the teaching of capital budgeting, risk analysis and valuations. The application of spreadsheet models particularly to such areas as portfolio theory, time value of money, capital budgeting and option pricing can facilitate the understanding of some complex financial concepts. However, spreadsheet modelling should be an enabler and students should not become model centric. The objective is financial decision making and the use of spreadsheet modelling is only an, albeit important, decision support.

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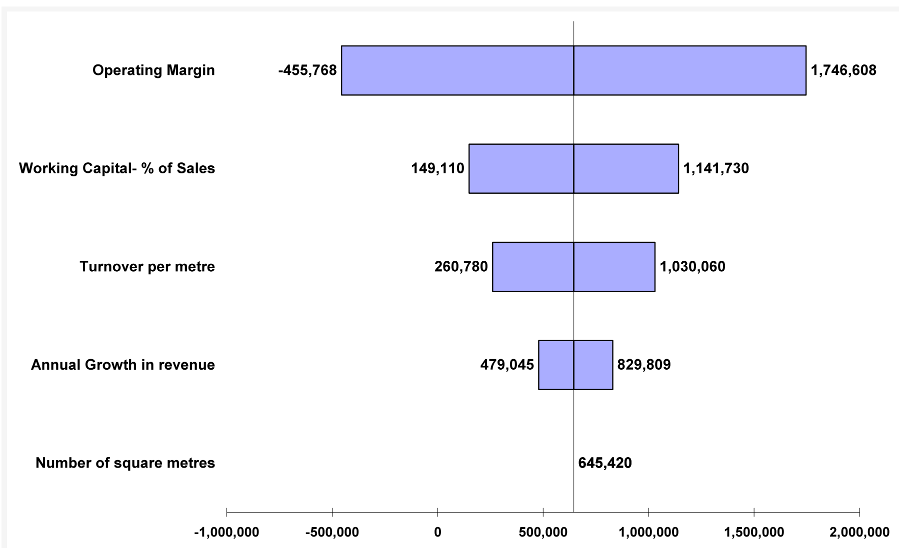
Annexure 1 Examples of Scenario Manager, Tornado Graph and Monte Carlo Simulation

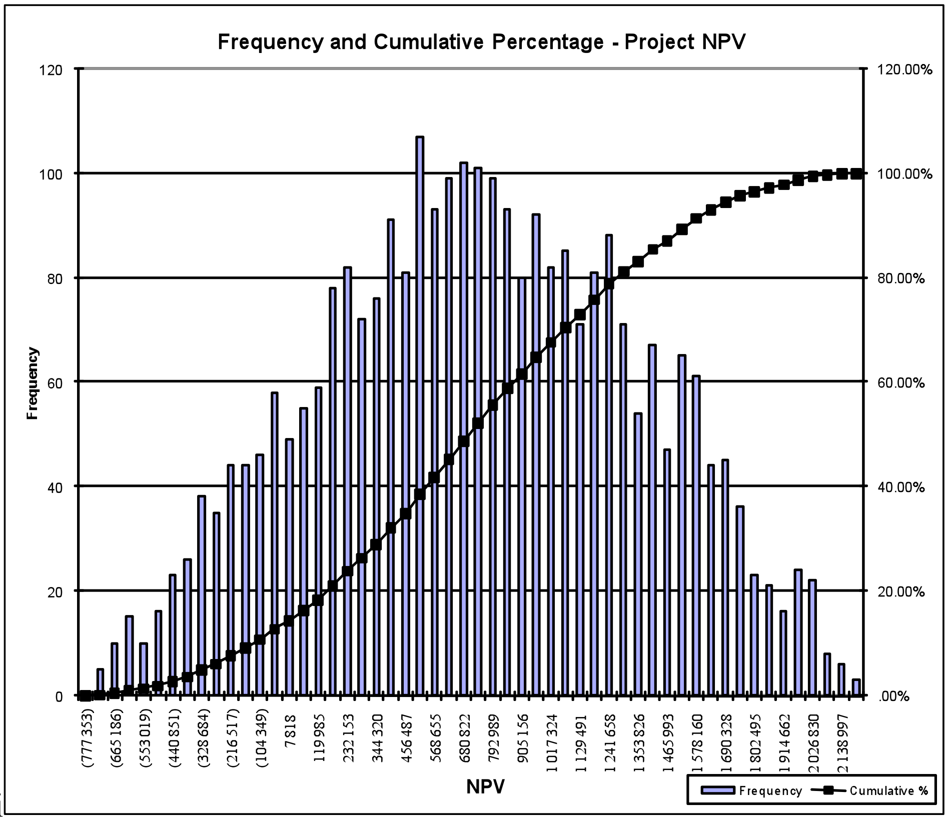
Scenario Summary					
		Current Values:	Expected	Best	Worst
Changing Cells:					
Operating margin	**C4**	4.0%	4.0%	5.0%	3.0%
Turnover p/metre	**C5**	25000	25000	30000	20000
No. of metres	**C6**	900	900	900	900
Working capital %	**C7**	10%	10%	8%	12%
Growth in revenue	**C8**	8%	8%	10%	6%
Result Cells:					
NPV	**B23**	**645,420**	**645,420**	**3,352,118**	**-1,039,760**
IRR	**B24**	**18.4%**	**18.4%**	**27.7%**	**11.9%**

Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

Sensitivity Analysis: Tornado Graph



Monte Carlo Simulation



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Annexure 2 Spreadsheet modelling for selected topics in corporate finance

Financial statement analysis	Set up financial statements in Excel. Download financial statements in Excel (if available) from company websites. Comparative analysis and determining trends in Excel. Use Graphs. Undertake Index Analysis in Excel by linking revenue, costs and income figures such as EBIT and NI to sales Common size analysis in Excel where income statement and balance sheet items are stated as a % of sales Calculate financial ratios in Excel and insert industry ratio benchmarks. Refer to rating agency ratio benchmarks and use pivot tables to allot a simulated rating to the company. Du Pont analysis (structured ratio analysis) in Excel with "What-if" analysis Application of Altman's Financial distress model Calculate a company's Economic Value Added (Link to WACC spreadsheet)
Time value of money	Use time value of money functions in Excel such as PV, NPER, FV, RATE and PMT. Effective rates for different compounding periods including continuous compounding Use time lines to depict cash flows and use PV, NPV, and IRR functions Growing perpetuities and growing annuities - compare formulae to cash flows on a timeline. For growing perpetuities - use time periods such as 100 periods to indicate how eternity reaches a limit. Loan amortisation table with separate input section and use graph to depict the payment of interest and principal amount over time.
Risk and return	Degree of operating leverage (DOL). Set up contribution statements in Excel with production volumes, variable cost and selling price set within an input section. Apply and test the DOL formulae. Apply the DOL formulae and test DOL in the contribution statement. Expand DOL by including the Degree of financial leverage (DFL)calculation and test with changes in production. Setup table of possible returns with related probabilities and calculate the variance and standard deviation the "long way" in Excel by calculating deviations from the mean, squared deviations and the product of the probabilities and the squared deviation. Use Excel functions of STDEV and STDEVP to determine the standard deviation of a series of returns. Use the COVAR function to determine the covariance between two series or returns and also use the CORREL function to detemine the correlation between the two series of returns. Download a series of share prices for two listed companies and use such Excel functions as AVERAGE, STDEV and COVAR and CORREL to detemine average returns, standard deviations and correlations.
Portfolio Theory	Determine average returns and standard deviations for two companies for a number of periods. Use the GRAPH capabilities of Excel to depict returns for individual companies as well as the return for the portfolio of the two companies. Show graphically how a portfolio will reduce the variability of returns by comparing individual returns to the portfolio return for each period. Calculate the standard deviations for each company and the standard deviation of the portfolio. Use examples that indicate a high degree of correlation as well as an example indicating a low degree of correlation. Set up a table in Excel showing different weightings of each share in a portfolio and show the resulting portfolio returns and portfolio standard deviations. Plot this as a scatter diagram in Excel to show the feasible set of portfolio of two assets. Do an efficient frontier in Excel. For Beta analysis, plot as a scatter graph in Excel the excess returns of investing in a company in relation to the excess returns of investing in the market index. Use the Regression tool in Excel (under Data analysis) or add a trendline (linear) and specify Excel to include the y= a +bx function on the chart with R^2.
Valuations	
Fixed income securities	Set out spreadsheet with coupon payments and the redemption of principal. Use an input section. Undertake sensitivity analysis by setting varying terms to maturity and varying coupon rates for different bonds and plot the resulting bond values so that students can see the impact of interest rate risk on values. Also, use data tables. Use Excel tables to determine the duration of a bond. Plot the term structure of interest rates at different times to indicate upward and downward sloping yield curves. Use examples, where the bond value is given, and use the IRR function in Excel to determine the YTM of a bond. Determine Yield to Call if applicable. Use Excel graphs to explain convexity and plot interest rate spreads.
Equity/Company valuations	Set up a dividend discount model for a listed company. Determine compound growth rates for dividends and earnings (to indicate sustainability) and divide the model into a two or three stage model. Use an input section. Set up a detailed Free Cash Flow Model to value a listed company including proforma financial statements, free cash flows, financing flows and financial ratios. Use Data tables, Scenario manager, Goal Seek functions in Excel. Undertake an EVA valuation in Excel. Design separate sections for inputs, results, historical data and ratios, prospective data will include checks such as free cash flows should equal the financing flows. Calculate future financial ratios which can also be used to check the integrity of the assumptions as well as the calculations. Show use of plugs, impacts of possible circular references and how to deal with iterations.
Weighted Average Cost of Capital	Structure of WACC spreadsheet with references and link to Free Cash Flow valuations if applicable. Focus on CAPM parameters and links to market data and beta services. However, also undertake regression analysis to determine a company beta. Use scatter diagrams and trend lines. Include unlevering and relevering formula if applicable and set up capital structures based on book values, market values and target capital structures.
Capital Budgeting	Set out separate sections for inputs, results, calculations with intermediate workings. Do a separate taxation section and link to main calculations section. Employ Data Tables, Scenario Manager and Tornado graph for sensitivity purposes. Set up Monte Carlo simulation for a simple capital budgeting case and plot histogram and cumulative probability. Set up a NPV profile in Excel. For internal rate of return, use a financial model to explain the impact of the reinvestment rate assumption and apply the MIRR function in Excel to overcome the problems with the IRR function. Use equivalent annual costs to detemine an optimal replacement cycle. Use Excel's Solver function in capital rationing by setting out capital constraints.
Working Capital Mngt	Set up a working capital cycle showing how financing requirements change with changes in inputs Set up an EOQ inventory model in Excel using varying EOQ input values and use Graphs. Cash budgeting can be effectively set up as an Excel worksheet to indicate financing requirements

OUR NEXT GENERATION OF ROBOTICS RESEARCHERS? TEACHING ROBOTICS AT PRIMARY SCHOOL LEVEL

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Abstract

In this paper, we present our experience in designing and teaching of our first robotics course for students at primary school level. The course was carried out over a comparatively short period of time, namely 6 weeks, 2 hours per week. In contrast to many other projects, we use robots that researchers used to conduct their research and discuss problems faced by these researchers. Thus, this is not a behavioural study but a hands-on learning experience for the students. The aim is to highlight the development of autonomous robots and artificial intelligence as well as to promote science and robotics in schools.

Introduction

Robots have been used for educational purposes for quite some time already, mainly at high-school and undergraduate level. The purpose of teaching robotics to undergraduates is quite clear, as they have usually chosen a field of study that is related to robotics or artificial intelligence, so it fits well into the curriculum. Obviously, teaching robotics at university level is very different to teaching it in schools, as most of the university students know how to program and know the fundamental mathematics necessary to design and develop software for mobile robots. Using robots in schools is mainly to spark interest in science and engineering. In particular at primary school level, it is important that learning is fun and practical, at least to an extent that keeps the children interested, as their attention span is often short. This may be one of the reasons why the Lego robotics kit has been so popular for robotics courses, not only in schools but also at universities (Beer et al., 1999; Fossum et al., 2001; Lau et al., 1999).

Many courses are therefore targeted at high-school (Nourbakhsh et al., 2005; Nourbakhsh et al., 2004; Rodger & Walker, 1996) and undergraduate students

(Billard, 2003; Blank et al., 2003; Kumar & Meeden, 1998; Lalonde et al., 2006), or even both (Ahlgren & Verner, 2002; Beer et al., 1999; Miglino et al., 1999). A popular means of attracting students and keeping them interested are contests, see e.g. Ahlgren & Verner, 2002. Some courses are especially designed to get girls interested in engineering and science at an early age, as this group is often underrepresented in the corresponding university degree courses (Rodger & Walker, 1996).

Most publications regarding robotics for educational purposes at primary school level are in fact social studies and do not focus on programming or the type of robots that are commonly used in research. They concentrate on how children interact with robots and behave in their presence (Bumby & Dautenhahn, 1999; Salter et al., 2004), or how they communicate with toy robots (Kanda & Ishiguro, 2005). Another important aspect are gender-based studies, where social scientists study the behavioural differences between boys and girls when they interact with robots (Fossum et al., 2001). Exceptions are Qaiyumi et al., 1998 and Lau et al., 1999. The first uses robots to teach concepts of science and engineering to primary and middle school students. The latter is particularly interesting because of the wide age range (10 to 18 years) targeted.

Most robotics courses are designed to be taught either as a compact course or over an extended period of time. Typical durations are for example 10 weeks with 1.5 hours per week (Lau et al., 1999), one week (Rodger & Walker, 1996) or even seven weeks full time (Nourbakhsh et al., 2005; Nourbakhsh et al., 2004).

In contrast to these publications, we will present a robotics course that has been designed for primary school students, about 10 years old. The time-frame is quite tight, namely, 6 weeks, 2 hours per week; the course was held during October/ November 2005. It was organised for a group of nine talented students from a private girls' school in Auckland, New Zealand. The aim of the course was to highlight the development of autonomous robotics and artificial intelligence, including programming the robots, as well as to promote science and robotics in schools, and at the same time to stimulate leadership, confidence, inquisitive, and team work skills. The topics that were taught during the duration of the course included an introduction to robotics (what are they and what are they used for?), as well as presenting the mechanics and sensors of the robots to the students. In contrast to similar projects, we did not use toy robots such as provided by the Lego kits, but three mobile platforms that we use in our research projects (see Figure 1).

At the start of the course, the students were divided into three groups of three. Each group was assigned a computer and a robot; details on the actual hardware used will be presented in the next section. In order to get the students acquainted with the robots, particularly their restrictions and inaccuracies, we designed a few experiments that can be done with the robots before the students are actually introduced into programming. These experiments are described in the section on experiments performed by students. The programming language we chose for the students is Python, which has been used successfully for teaching robotics at undergraduate level before (Blank et al., 2003). The main reasons for choosing Python will be discussed in the section on software development.

Figure 1: The three Pioneer robots used for the course. Each is equipped with eight sonar sensors, the one in the middle has an additional laser range finder.

As mentioned before, contests are a popular means of keeping students interested, which is why we decided to have a competition between the three groups at the end of the course. To encourage the students to become creative, we tried not to restrict what they could do but, at the same time, it is important to give them a task that is actually solvable within the tight time-frame. Our final choice is to have a robot dancing contest. The aim was to provide an opportunity to apply the knowledge on robotics that they gained during the course in a single application, and encourage them to become creative and have fun. Each group chose a song for the dance performance, and programmed the robot to move synchronously to the music, being allowed to move only within a pre-defined region of the dance floor. The competition was held at the school, which organised an open day and invited the parents and classmates to attend the function. The judges for the competition were the dean of our faculty and the school's principal.

Hard- and Software Environment

This section describes the hardware and software that was used for the course.

Robot Hardware

We used three mobile robot platforms from MobileRobots Inc (formerly ActivMedia Robotics) (MobileRobots Inc., 2008), one Pioneer 2 and two Pioneer 3 (see Figure 1). All robots are equipped with eight sonar sensors and an odometer, which were the only sensors used for the classes. Although one of the robots is additionally equipped with a laser range finder and bumper sensors, we decided not use these sensors in order not to favour one of the three groups. The robots are controlled by a PC running Linux, which is on-board in one case, and mounted externally on top of the robot (in form of a laptop) in the other two cases. The students could logon remotely from an external Windows-PC using secure shell and a wireless network connection. Most students were already familiar with the Windows environment, so we did not encounter any major problems regarding the remote login and transferring files that were written on the PC to the robot.

Software

Before we started with the actual programming of the robot, the students were given a set of experiments which they had to perform, thus giving them a stepwise introduction to the functional aspects of the robots, its capabilities as well as its limitations. The experiments will be discussed in more detail in the next section. To make it easy to use, we provided a set of commands that can be executed by the students from the (remote) command-line. This includes commands for moving the robot forwards and backwards by a certain distance, given as a command-line parameter, commands for turning left and right by a certain angle, and a program to output the current sonar readings of all eight sensors. For the programming exercises we chose Python as the programming language, mostly because of the ease of use: the students can write a program on the Windows-PC, transfer it to the robot and execute it straight away, without needing to compile it first as Python is an interpreted language. We provided a template that contains all the necessary startup commands, like connecting to the robot, initialization of the sensors, etc, so that the students did not have to care about these things and could rather concentrate on problem solving.

Experiments Performed by Students

As mentioned earlier, one of the main goals of this course is to expose the “behind the scenes” of working with autonomous robots. Consequently we designed our experiments to highlight two major problems faced by robotics researchers: the errors accumulated via translational and rotational movements and the inaccuracies introduced from the sensors. These experiments, together with the findings of the students, are described in details below.

Translational Errors

To demonstrate what exactly are translational errors and its effects, we devised three experiments. Figure 2 shows a picture of one of the groups performing a translational error experiment.

Figure 2: Picture of one team performing a translational error experiment.

Experiment 1: Simple movement. In this experiment, students were required to instruct the robot to move forward by four different distances: 500mm, 1000mm, 2000mm and 3000mm. For each of these distances, the students had to measure the exact distances the robot actually travelled and compared that to the presumed distance travelled. *Result:* The students found that there were minor errors for the smaller distances but became more inaccurate for larger distances.

Experiment 2: Drift. For this exercise, the students learned all about drift: “What is drift?”, “Why does it occur?” and more importantly “How does it affect the results?” The students measured a straight line with a length of five meters. They then commanded the robot to move five meters from one end of the straight line and recorded their findings. They were also asked to note differences in the surface of the flooring when the robot starts drifting, as the robot traversed. *Result:* The students were amazed to find how significant the floor surface adversely affects the way the robot travels. In the experimental setup, they found that the main contributor to drifts is uneven carpeting.

Experiment 3: Repetition inaccuracies. To illustrate the cumulative effects of translational errors, this experiment involved the students repeatedly moving the robot forwards and backwards (reversed) over three meters for three times. They noted the end location of the robot, compared to where the robot started originally and measured the distance. *Result:* The students by now expected that the robot would make translational errors and were therefore not surprised that the robot did not end up where it started.

Rotational Errors

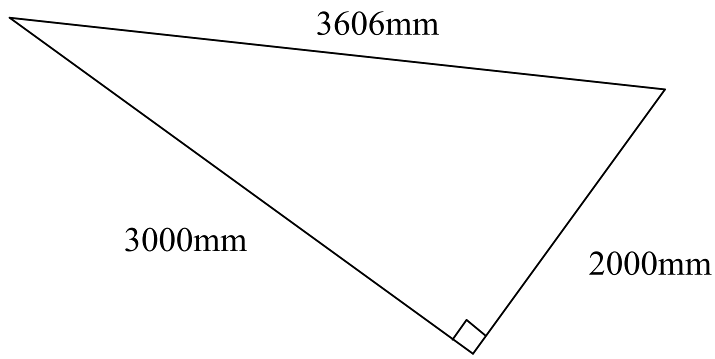
Similar to the experiments demonstrating translational errors, these experiments were to show the students the cause and effect of rotational errors.

Experiment 4: Simple rotation. Here the students had to rotate the robot by 360 degrees and upon completion, they had to note if the robot is still heading the same direction as its initial heading. *Result:* The students only found some minor rotational errors, which sometimes can be visually undetectable.

Experiment 5: Repetition errors. For this experiment, the students rotated the robot clockwise and anticlockwise alternately by 360 degrees for four times and recorded the difference between the original and final headings of the robot. *Result:* Although not surprised, the students were amazed to find large discrepancies between the two headings. Furthermore, the students also noted that the robot moved translationally during rotation as well.

Experiment 6: Combined translational and rotational errors. To allow the students to appreciate the problems roboticists face during navigation, the students were asked to program the robot to move according to the diagram shown in Figure 3 (with the robot starting and finishing at spot A). The commands for turning the robot by the correct angle at the corners were given to the students, as they are not familiar with trigonometry at that age. *Result:* As expected, the robot was not back at the starting point of the experiment.

Figure 3: Diagram showing the movement for the combined translational and rotational error experiments.



Sonar Sensors

The other goal of the course was to familiarize the students with the sensing capabilities of robots, more specifically sonar sensors. We wanted to explain to them how measurements of the environment are acquired and why sonar sensors are another source of inaccuracy that roboticists have to deal with. To do this, we devised another three experiments, which are described shortly in the following.

Experiment 7: Data gathering. For this experiment, we wanted to familiarize the students with sonar sensing by collecting sonar distances of an object at four distances: 50mm, 500mm, 2000mm, and 5000mm. *Result:* The students found that they were not able to collect any measurement for the 50mm and 5000mm tasks, due to the limited range of the sensors. However, measurements made for the other two distances were very accurate.

Experiment 8: Detection of various objects. This exercise was to get the students measuring objects of different sizes, material and shape. The objects used were paper dart, pen, and foam cup. *Result:* The students were quite astonished to find that they were not able to measure small objects and found that at different angles, the readings sometimes disappear, as if nothing is in front of the sonar sensor.

Experiment 9: Angle of measurement. This experiment was to demonstrate the affects sonar beamwidth has on measurements and how it causes inaccuracies in data collection. For this, the students held an object at a fixed distance from a sensor and noted the reading as the object is moved angularly. *Result:* The students noted that, even when the object is being moved, the sonar sensor kept detecting the object. They realized that one cannot rely on the reading, in terms of exact direction of the object.

Software Development

After performing the experiments, the students had a good impression on what the robot is capable of doing, and to what extend errors have an influence on the accuracy of motions and sensor data. At this point, they were ready to be introduced into actually programming the robot, rather than just issuing single commands in the shell. The allocated time for programming was approximately five hours (out of a total of 12). There are a number of problems that need to be addressed, in particular: How do you teach a new programming language (Python) to ten year old children, who have not done much programming before, in a few hours? How do you keep them interested? Can they actually use the complex functions that are provided by the libraries coming with the robot?

As mentioned before, the programming language we chose is Python. Although a Python wrapper for the C++ libraries has been provided by the robots' manufacturer, we still found that most functions are too complicated to use in a course like ours. Therefore, we wrote additional Python functions for the basic functionalities of the robot, i.e., for moving a certain distance with a given velocity, turning to the left and right, turning by a given angle, and checking the sonar sensors. The set of commands for obtaining sonar sensor readings was simplified considerably by grouping the sensors into left (three leftmost sensors), front (two middle sensors), and right (three rightmost sensors), and returning either the actual distance reading from the sensor group, or alternatively a "boolean" value that tells whether there is an obstacle within a given distance or not. To keep it simple, this value was in fact not "boolean" as such, but rather "yes" or "no", which is very easy to handle in Python as well. As most of these commands were very similar to those used for doing experiments using the command-line interface, the children did not have any problems using a list of these functions provided for programming.

Before the students started to program, we gave a short introduction to using Python and programming in general, where we presented the basic concepts like variables, if-, for-, and while-statements, as well the template containing the robot initialization, which the students used afterwards as a skeleton for inserting their own code. We then went straight into practice, i.e., the students tried out the provided template and started adding their own commands.

In order to keep them interested, we decided to give them the task of programming the robot to "dance", i.e., they were supposed to choose a song they liked and choreograph the movement of the robot to the song. The only restrictions were the size of the stage (3m × 4m) and the length of the song (2 minutes). Originally, the idea was to start on an empty stage, and have a second part where the robot has to avoid some obstacles placed on the dance floor. We ended up with dancing without any obstacles, though, as the given time frame was too tight for programming obstacle avoidance. To make it even more interesting, it was decided to have a competition between the three groups at the end of the course. This was held at their school, and classmates as well as parents were invited to attend the performance. The students were encouraged to become creative by dressing up the robot for the competition.

Conclusion

The paper presented a robotics course especially designed for primary school students. It was held in October/November 2005, for a duration of six weeks, the students were about 10 years old and attend a private girls school in Auckland. The students were very enthusiastic to learn and participated in all the activities throughout the whole course very well. We were very impressed with their learning skills, adventurous nature and their ability to think outside the square with little assistance. During the course, their mental picture of robots changed significantly, the initial impression being mainly influenced by movies and television. The students found that today's robots are still far from achieving what they have seen on the screen, and that they are prone to many inaccuracies and errors. Yet, they also discovered that research can be challenging while being fun at the same time, and that they can achieve the set goals by working as a team.

Having a competition at the end was definitely a good choice, as the students had the freedom to use their own creativity on what they have learned. We would recommend having a contest to anyone designing a robotics course, be it at primary school or university level. Particularly when working with the primary school students, we found that it helps considerably in keeping them interested in what they are doing, as they have a common goal in mind.

Programming the robot using Python worked quite well, at a basic level anyway. We found that the students wrote only sequential programs, i.e., they did not use loops or if-statements. We believe that there are two main reasons for this: Firstly, the time-frame was probably too tight for more sophisticated programming; we are positive that the students would have been able to use these commands given more time. Secondly, it was not really necessary to use any of these commands in the dancing contest. However, having a more complex competition goes hand in hand with allocating more time to the course.

To conclude, we were really impressed by the students' capabilities, and how they approach problem solving tasks when programming mobile robots, without being hindered by what they know about what computers and robots can or cannot do, which is probably an advantage they have over older students. As to whether the course was successful? We believe the following departing quote from one of the students says it all: “See you in 10 years!”

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CLASSROOM INTERVENTION AFTER TEACHERS' PEDAGOGICAL AND CONTENT KNOWLEDGE OF STATISTICS THROUGH DISTANCE LEARNING

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Abstract

Recognizing teachers' ongoing professional development and learning as a linchpin of instructional innovation and success for their students, the paper presents an EU-funded project that exploits the affordances offered by ODL technologies to help improve the quality of statistics instruction offered in European schools. Twelve in-service teachers participated in the course, originating from three of the partner countries — Cyprus, Spain and Greece. Participating teachers developed and delivered teaching episodes integrating the use of the course tools and resources provided to them. In the paper, firstly, we describe the pedagogical and didactical approach underlying EarlyStatistics and the course content and structure. Moreover, the feedback from the target user groups from all partner countries, as well as from the external experts regarding the project content, services, and didactical approaches was generally very positive. In this paper we present teacher's opinion of the program from the pilot delivery of the course and the follow-up classroom intervention.

Introduction

The development of a statistically literate society is a key factor in achieving the objective of an educated citizenry. In a world where the ability to analyze, interpret and communicate information from data are skills needed for daily life and effective citizenship, statistical concepts will occupy an increasingly important role in mathematics curricula. The overall objective of *EarlyStatistics: Enhancing the Teaching and Learning of Early Statistical Reasoning in European Schools* was to develop an innovative professional development program for the teaching and learning of statistical reasoning at the elementary and middle school levels. The project utilized distance education to offer high-quality innovative experiences to geographically-dispersed teachers across Europe, offered the opportunity to teachers in different countries to collaborate and build communities of practice in social constructivist learning environments and offered access to usable and validated pedagogical models, didactic approaches, and innovative instructional materials for the teaching and learning of statistics. Recognizing teachers' ongoing professional development and learning as a linchpin of instructional innovation and success for their students (Ginsberg, 2003), the EU-funded project *EarlyStatistics* exploits the affordances offered by open and distance learning (ODL) technologies to help improve the quality of statistics instruction offered in European schools: learn and/or better understand the concepts and methods of statistics; understand statistics as a comprehensive approach to data analysis; develop pedagogical knowledge of statistics; become familiar with a variety of methodologies, tools, and resources for teaching statistics; use real data, active learning, and technology to teach statistics; and develop a long-lasting trans-national community of teaching practitioners who advise and support each other about classroom practices, pedagogy, and statistical concepts (Gould & Peck, 2004).

In brief, the feedback from the target user groups from all partner countries, as well as from the external experts regarding the project content, services, and didactical approaches was generally very positive. This feedback was not only focused on validating the outputs developed, but also on evaluating them in terms of their potential value from the perspective of a range of end users. Key conclusions from the analysis of the user feedback were that *EarlyStatistics* meets its objectives because it helps improve understanding of utilizing interactive learning content, it offers services that improve the instructional process, it offers the opportunity to collaborate with other teachers and begin the construction of a community of practice. In the particular this paper presents teacher's opinion of the program from the pilot delivery of the course and the follow-up classroom intervention.

Pedagogical and Didactic Approach

Recognizing that teachers would bring a diverse variety of strategies into the course as a result of their own professional experiences, and that professional development is most effective when deeply contextualized in teachers' professional activity, *EarlyStatistics* adopted an approach that respects and utilizes teachers' professional knowledge. The distance education environment has been designed as a framework for flexible learning (Collis & Moonen, 2001), regarding teachers as the main agents of their professional development, supported by an environment rich in challenges and interactions. A central conviction underlying *EarlyStatistics* is that learning is a social act best supported through collaborative activities (Vygotsky, 1978), and thus learning as part of a community of practice can provide a useful model for teacher professional development. *EarlyStatistics* participants are provided with ample opportunities for interactive and collaborative learning through use of a wide array of tools, artefacts and resources (Gordon et al., 2007). They are actively involved in constructing their own knowledge, through their participation in authentic educational activities such as projects, experiments, computer explorations with real and simulated data, group work and discussions. Central to the course design is the functional integration of technology with existing core curricular ideas, and specifically, the integration of new types of tools (e.g. the dynamic statistics software Tinkerplots©), which provide teachers, and subsequently their students, with the opportunity to model and investigate real world problems of statistics.

The *EarlyStatistics* Course Content and Structure

The *EarlyStatistics* course design focuses on activity-based learning. The course aims at enriching teachers' (i) knowledge of and about statistics; (ii) knowledge about teaching and learning, and (iii) practical knowledge (Azcarate et al., 2006), through hands-on and computer-based practice, experimentation, intensive use of simulations and visualizations, feedback from each other, and reflection. Teachers participate in a number of collaborative and participatory activities that help them improve their content and pedagogical knowledge of statistics and, being actual practitioners, then apply what they learn to a real classroom setting.

The course lasts for 13 weeks, and is made up of six Modules. In Modules 1–3 (Weeks 1–7), the focus is on enriching participants' statistical content and pedagogical knowledge. To help teachers go beyond procedural memorization and acquire a well-organized body of knowledge, the course emphasizes and revisits a set of central statistical ideas rather than presenting statistical content as a sequenced list of curricular topics. The conceptual "Framework for Teaching Statistics within the K–12 Mathematics Curriculum" (GAISE, 2005), has been used to structure the content presentation. This framework uses a spiral approach so that instructional programs from pre-kindergarten through high school encourage students to gradually develop understanding of statistics as an investigative process with four components: (i) clarifying the problem at hand and formulating questions that can be answered with data; (ii) designing and employing a plan to collect appropriate data; (iii) selecting appropriate graphical or numerical methods to analyze the data; and (iv) interpreting the results. In Modules 4-6, the focus shifts to classroom implementation issues. Teachers customize and expand upon materials provided (Module 4; Weeks 8–9), and then apply them in their own classrooms with the support of the design team (Module 5; Weeks 10-11). Teacher then write up their experiences, including a critical analysis of their work and that resulting from their pupils. This helps them to reflect on their practice, and to apply self-criticism constructively. Finally, once the teaching experiment is completed, teachers report on their experiences to the other course participants, and provide video-taped teaching episodes and samples of their students' work for group reflection and evaluation (Module 6; Weeks 12–13).

EarlyStatistics uses a blended learning approach. There were a few face-to-face meetings with local teachers, but the biggest part of the course is being delivered online by utilizing the project information base for teaching, support and coordination purposes. In addition to the course content, the site offers access to various other links and resources: *Technologically enhanced instructional materials* for the teaching and learning of statistics in the elementary and middle school; *Manuals and guides* related to the course: study calendar, assignment guides, including how to prepare a portfolio of evidence, software manuals etc.; *A digital video case library* containing segments of real teaching episodes, obtained in the classrooms of the teachers participating in the pilot delivery of the course, representing the landscape of practice in statistics instruction throughout Europe; *A database with student work samples* developed through contributions of the participating teachers, providing examples of good practice in European schools; *Collaboration tools* for professional dialogue and support including e-mail, conferencing, chat rooms, discussion forums, wikis, etc.; *Archived forum discussions; Reports and articles* developed through the project; *Links to statistics education resources* available on the Internet; and *Multilingual interfaces* (EN, EL, ES) to partly overcome linguistic barriers.

In order to offer teachers flexibility and to accommodate different time zones, the largest portion of the course is delivered asynchronously. Asynchronous means of communication include discussion forums and mail groups. There is also some synchronous communication through use of technologies such as audio/video streaming, and videoconferencing. One-way informational postings such as articles and videos also serve as objects for supporting interaction.

Teachers work according to a loose schedule. This has been deemed necessary for balancing the amount of freedom available in the course with a sense of structure. Each module involves a range of activities, readings and contributions to discussion, as well as completion of group and/or individual assignments. Online moderated discussions allow teachers to share content, ideas, and instructional strategies. Teachers are provided with a space to discuss and grapple with the complexities of teaching and learning, to foster alternative perspectives, and to apply educational theory to practice (Kayler & Weller, 2007).

Methodology

In order to evaluate the applicability and success of the training modules, participating teachers were asked to develop and deliver teaching episodes integrating the use of the available tools. Further, a follow-up evaluation might also be conducted several weeks after completion of the training course, through completion of a follow-up online questionnaire that inquired information regarding actual application of the training on the teachers' instructional practices. At the end of the evaluation process the groups completed training in the use of the system and its integration into the educational process. The experiences of the groups from their engagement with the system and training modules to be developed in the project were analyzed, and potential areas of improvement was identified and documented in the project evaluation report for the benefit of institutions wishing to implement similar services.

During the intervention, some cases studies were carried out. For this purpose were used the techniques of data collection: (a) participative observation, (b) video recording of instructive episode and (c) samples of children's work.

Teachers' Opinion for the Program

In this paragraph we present the conclusions obtained from the last face-to-face meeting with teachers about the whole program. Their opinion is presented in the following four categories: distance training, self-learning, urgent communication and alternative instructive proposal of statistics. When the teachers were asked to participate in the course and do an innovative statistical intervention in their classrooms, they expressed that they wanted to learn more about teaching this course. At the end they expressed that the proposal of cooperation between teachers of different countries, the face-to-face meeting to discuss and improve their work helped them to feel more comfortable teaching statistics.

Distance Training

They expressed that distance training for them has helped to understand that the problems that they have when teaching statistics are common also in other European Countries. This helps to enrich their experiences when contrasting information with other teachers around Europe and they were able to ask to Consortium teachers that they give them well-constructed knowledge.

They expressed that the papers, bibliography, presented in the course were too many and their time to work on them was limited, because of their work. Two teachers of the twelve claimed "I like distance training. You do things in your own time. But, many times, there is no own time and not time for extra reading." They said that the theoretical part was interesting, but they were more interested in the practical part because 'this part showed as how to use theory in our own classes. Furthermore, they said that the course shouldn't have so many assignments on the theoretical part, as there is not time for working on them. They claimed that the approach selected that introduces the method of investigation as a path to construct knowledge was more interesting, but also more difficult to introduce it as you need extra time from the curriculum to introduce projects or investigations. They expressed that in this case they were innovating in statistics knowledge, methodology and materials.

Self Learning

They expressed that it was very interesting the proposal of pick-up more papers than the ones that were compulsory, to look into the scenarios from different point of views, and looking the viability of working like that with their students. The organization of the program with the aim that they learn by themselves, analyse what they know, and reflect about their practice was a different way of permanent in-service learning. They thought that in the first moment it was very difficult because they had to express what they have understood and its application let a lot of time. So they think that it is very important that this self-learning let teacher freedom on time expending.

Urgent Communication

They expressed that the combination of the use of forum and face-to-face meetings let them to contrast information and it was very important to go in deep in looking for more information. They expressed that it was very useful to be able to communicate with teachers of different levels and perspectives in education that let them to understand the differences in teaching. This direct communication to everybody has helped to continue the hard work of self-learning. Moreover, they claimed that it is good to ‘hear’ colleagues from other countries that they faced similar problems like you and sometimes because of a different view on a point, suggesting ideas that you didn’t thought of it.

An Alternative Instructive Proposal of Statistics

Teachers were impressed how statistics education can be so applicable in everyday life at school. One of the twelve teachers claimed “At the beginning of the course I thought that I would not be able to apply these things, but when I did my teaching intervention and I understood better the idea of scenarios and statistics in everyday life I feel that my students and I earned a lot.”

They claimed that within this project they found that there is always a topic on which you can do statistics. The idea of using scenarios and projects for investigation was found very interesting and very motivated way to students. They claimed that although with this way you feel that you are going to get out from the curriculum, at the end the learning that students gained is unpredictable.

Conclusions

Distance education is a useful framework for in-service teacher training, but it can represent a large variety of pedagogical perspectives. The most common approach is to follow a highly structured format, setting objectives and sub-objectives in detail and designing tasks to fit these objectives. Recognizing the fact that professional development is most effective when deeply contextualized in the teacher's professional activity and that teachers bring a diverse variety of strategies into the program as a result of their own professional experiences, *EarlyStatistics* uses an approach that respects and utilizes teachers' professional knowledge. An important consideration of any model of professional development is whether teachers feel the project is useful and supportive of their efforts to improve their teaching practice (Whitaker et al., 2007). As Robinson (1998) points out, staff development often fails to transfer to the learners' 'real-work' situations, because it might be too remote from 'real-work' needs or organizational realities. The course is based on current pedagogical methodologies utilizing collaboration, statistical investigation, and exploration with online interactive problem-solving activities. Particular care has been taken to build on participating teachers' knowledge and experiences, and to promote collaborative and participatory learning (Barab & Duffy, 2000). Teachers from different countries have the opportunity to improve their content and pedagogical knowledge of statistics through open-ended investigations, simulations, visualizations, collaboration and reflection on one's own and on others' ideas and experience.

The distance education environment was designed as a framework for flexible learning (Collis & Moonen, 2001), regarding teachers as the main agents of their professional development, supported by an environment rich in challenges and interactions. The design was based on the importance of collaboration and reflection, and of inquiry and exploration as a process of knowledge construction Rather than using text-based, static content, that tends to be the norm in distance education of mathematics/science courses, teachers were provided with ample opportunities for interactive and collaborative learning through use of contemporary multimedia and internet technologies. The strategies employed included open-ended investigations, simulations, visualizations, collaboration and reflection on one's own and on others' ideas and experiences. Through use of these strategies, the project provided a learning environment that served as a model to the participating teachers.

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A STUDY ON EFFECTIVENESS AND COGNITIVE LOAD OF SECONDARY MATH TEACHING USING DYNAMIC GEOMETRY SOFTWARE PG_LAB

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Abstract

The experiment-based dynamic math teaching method is an instruction model which enables students to acquire knowledge through personal operation and reflection with the aid of information technology. This study aims at investigating the effectiveness of secondary math teaching using the experiment-based dynamic teaching method. A quasi-experiment was conducted to compare the students' achievements and cognitive load (CL) between traditional teaching and experiment-based dynamic teaching groups. Results indicated that though there was no significant difference in either the test scores or the CL between the experimental group and the control group, the experiment group reported lower CL than the control group did. Combining the CL with the students' math achievements, it could be concluded that the traditional teaching was more suitable for the high performance students, while the experiment-based dynamic math teaching method was more suitable for the medium performance students.

Introduction

Cognitive load theory (CLT) originated in the 1980s and underwent substantial development and expansion in the 1990s by researchers from all over the globe. The theory is now a contributor to both research and debate on issues associated with instructional design. CLT, according to Sweller (2004; 2007), is an integrated theory that uses the evolutionary origins of human cognition as a base from which to generate instructional implications and applications. It is based on concepts from cognitive architecture and cognitive psychology, including working-memory, long-term memory, and schema theory.

CLT researchers have recognized three categories of load during instruction. They are Intrinsic, Extraneous and Germane cognitive loads (Paas, Renkl, & Sweller, 2003; Sweller, 2007; Sweller, van Merrienboer & Paas, 1998; van Merrienboer, Sweller, 2005). First, *Intrinsic cognitive load* refers to the load placed on working memory by the intrinsic of the materials to be learnt. It is entirely determined by levels of element interactivity (Sweller, 1994; 2007). Simultaneously, it is affected by the expertise levels of leaner (Kalyuga, Ayres, Chandler, & Sweller, 2003). Second, *Extraneous cognitive load* is the load placed on working memory by the instructional design itself (Ayres, 2006). Unlike intrinsic cognitive load, extraneous cognitive load is imposed by inappropriate instructional procedures

(Sweller, 2007). It is under control of the instructor. Last, *Germane cognitive load* is the load placed on working memory during schema formation and automation (Ayres, 2006; Paas et al., 2003; Sweller et al., 1998). CLT assumes a limited working memory connected to an unlimited long-term memory (Kirschner, 2002). How to decrease the extraneous cognitive load, in order to free the working memory for tasks associated with the germane cognitive load is the prime goal of instruction (Sweller, 2007).

There are three classic categories of cognitive load measurement techniques: Subjective, Physiological and Task Performance. Subject techniques use rating scales to report the experienced effort or the capacity expenditure (Sweller et al., 1998). This study used direct subject measurement to assess the extraneous cognitive load of the subject who was learning in the multimedia learning environment. According to a review of CLT measurement (van Gog & Paas, 2008), the instrument used the 9 points scale, ranging from 1 (Extremely Easy) to 9 (Extremely Difficult). Participants were required to rate "How easy or difficult was this task?"

The experiment-based dynamic math teaching method is a new teaching model which enables students to acquire knowledge through observation, reflection and induction with the aid of information technology. It is a combination of information technology and instruction. Dynamic geometry software PG_Lab (Plane Geometry Laboratory) is one of the teaching software series. They were developed by the school which conducted this experiment (Wai, 2002). Its function is similar to the Geometer's Sketchpad (GSP). It is a dynamic construction and exploration tool that enables students to explore and understand the mathematics in ways that are simply not possible with traditional tools. Students can construct an object and then explore its mathematical properties by dragging the object with the mouse. Students can work on independent explorations.

This study is set to investigate the following research questions:

- Is the experiment-based dynamic teaching method more effective than the traditional teaching method for secondary math teaching?
- Do the students have lower cognitive load (CL) in the experiment-based dynamic math teaching than in the traditional teaching?

Experiment Design

An experiment described in this paper was designed to compare student achievements and cognitive load from two groups of students. Since the students could not be randomly assigned, a quasi-experiment was used in the study. The independent variable was the two different teaching methods. The dependent variables include the following:

- Math achievement, which was defined as the scores achieved on the tests.
- Learners' perceived cognitive load, which was defined using the scales of the "Self-reporting Questionnaire of Cognitive Load".

Participants

The participants in this study consisted of 71 F2 students in a secondary school in Macao. Class A with 36 students was selected as the control group. This group was taught by traditional instruction alone. Class B with 35 students was selected as the experimental group and was taught using the experiment-based dynamic mathematics teaching. Based on the previous semester's math averages, each group of students were divided into three clusters: high performance, medium performance and low performance.

Teaching Materials and Measurement Tools

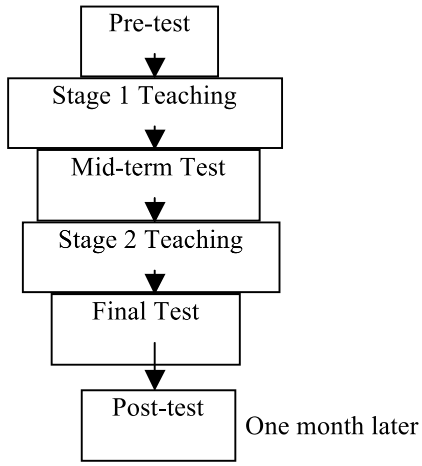
In this study, the Parallelogram Unit in elementary geometry was selected as the content which was to be taught to the students. The content primarily consisted of two sections: Basic Properties and Determinants of Parallelogram, Basic Properties and Determinants of Rectangle, Rhombus, and Square.

The measurement tool for student achievement was the school-based test papers "Parallelogram Unit Quiz I, II, and III." The reliabilities of these three tests are 0.889, 0.811, and 0.742, respectively. The product-moment correlation coefficient, that is, external validities of these three tests are 0.590, 0.799, and 0.682, respectively. So these three test papers had a relatively high reliability and validity. The Self-reporting Questionnaire of Cognitive Load was also used in the experiment to measure the perceived cognitive load. The questionnaire, which consisted of a single question with a 9 points scale, was adopted in this study. It had been developed by Chuang (2007) with reliability of $\alpha = 0.889$. Being adjusted with advice from the supervisor, professors, and senior math teachers, it had a relatively high validity of experts.

Teaching Design

The experiment took place over two weeks during the routine hours of the school day. Both the experiment and control group took 14 geometric lessons. Each lesson lasted 40 minutes. The topic "Basic Properties and Determinants of Parallelogram" was the stage one and was taught in 7 lessons while the topic "Basic Properties and Determinants of Rectangle, Rhombus, and Square" was the stage two and was taught in further 7 lessons. The flowchart of the experiment procedure is illustrated in Figure 1.

Figure 1: Flowchart of the Experiment Procedure



In the computer room, the students in the experimental group sat separately in front of the computers. At the beginning of each lesson, the teacher asked the students to review what they had learnt from the previous lab lesson. Then the teacher started to elaborate the principles and steps of the operation process by using PG_Lab and a LCD projector as an aid. It took about 10 minutes. Then the students were asked to use the dynamic geometry courseware PG_Lab by themselves, to support their exploration of basic geometry concepts. Meanwhile they needed to complete the Experiment Report Sheet step by step. For example, Experiment Report 1 included the following steps:

- Draw Parallelogram ABCD with tool icons in PG_Lab.
- Observe the diagrams.
- Check the authenticity of the Presumption: Use the calculation-tool to measure the length of the edges of the parallelogram ABCD, then come to a conclusion.
- Move any one of the parallelogram's vertexes to a new point. Observe the coordinates and measure the length of the edges again.

This session took approximately 20 minutes, during which the teacher could walk around and help the students' to solve the problems. Then another 10 minutes was given to the session of questions and conclusions. Students drew some conceptual conclusions themselves by answering teacher's questions according to the Experiment Report Sheet. At the end of the class, two exercise topics were left to the students as homework. During the experiment, 6 lab-based lessons were given in the computer room, and 8 exercise-based lessons were delivered in the traditional classroom.

The same math teacher delivered the entire courses to the control group in a traditional classroom. For the first session of every lecture, the teacher began by reviewing the main geometrical theorems from the previous lesson. This was followed by a session of geometric demonstration. First the teacher raised a geometry problem to promote student thinking. Then the teacher demonstrated the detailed problem solving procedures on the blackboard. If necessary, related images would be shown on an overhead LCD projector in front of the blackboard. Students followed the teacher's guidance; meanwhile they might make scribal notes of the geometric theorem proof and relative calculations. In last 10 minutes, students were given two questions for exercise or homework. The teaching contents were same in both the experiment and control groups.

Experiment Results and Analysis

The data of the study came from test papers of pre-test, Parallelogram Unit Quiz I, II, III and Self-reporting Questionnaire of Cognitive Load. Quiz I, Quiz II, and Quiz III were regarded as the mid-test, final-test, and post-test, respectively. The former two tests were conducted during the experiment period with the cognitive load questionnaire together. The post-test was conducted one month after the experiment with no cognitive load questionnaire assessment. All data was analyzed by independent sample *t*-tests on SPSS 15.0.

The experiment results consisted of two parts: students' math achievements, and self-reporting cognitive load.

Students' Math Achievements

Independent sample t-tests were conducted on four test scores. The results were illustrated in Tables1–5, respectively.

Overall students' math achievements comparison between the control group and the experiment group. Table 1 showed the means and standard deviations of the scores of the pre-test, mid-test, final-test and post-test in both the control and experiment groups. Table 2 showed that there were no significant differences of the four test scores between the experiment and control groups. Table 1 also illustrated that in the pre-test, the mean of the control group was higher than that of the experiment group. After the stage 1 teaching, the mean of the experiment group became higher than that of the control group. The means of the control group, however, turned to higher in the final and post tests than those in the experiment group. To explore the reason, further analysis was conducted to the different performance clusters — high performance, medium performance and low performance students in both the control and experiment groups.

Table 1: Means and Standard Deviations on Four Test Scores

	Teaching-method	N	Mean	Std. Deviation
Pre-test	Control Group	36	48.31	17.10
	Experiment Group	35	44.20	19.11
Mid-test	Control Group	36	60.92	17.76
	Experiment Group	35	61.11	18.22
Final-test	Control Group	36	54.00	18.15
	Experiment Group	35	47.00	16.08
Post-test	Control Group	36	61.14	21.23
	Experiment Group	35	58.14	17.36

Table 2: Summary of Variance Significance on Pre-test and Quiz I, II, III Test Scores

	df	t	Sig.
Pre-test	69	.954	.34
Mid-test	69	-0.46	.96
Final-test	69	1.72	.09
Post-test	68	0.65	.52

* The mean difference is significant at the .05 level. (P<.05)

Students' math achievements comparison between different performance clusters of the control group and the experiment group. There were no significant difference of the students' achievements between different performance clusters of the control and the experiment groups. The results were not illustrated in the paper. Tables 3–5 showed the means and standard deviations of test scores in high, medium and low performance clusters, respectively.

Table 3: Mean and Standard Deviation of High Performance Group on Four Tests

	Teaching-method	N	Mean	Std. Deviation
Pre-test	Control Group	9	58.67	14.95
	Experiment Group	9	55.44	9.85
Mid-test	Control Group	9	75.78	15.79
	Experiment Group	9	72.33	16.24
Final-test	Control Group	9	72.56	13.66
	Experiment Group	9	59.56	15.99
Post-test	Control Group	9	85.89	8.91
	Experiment Group	9	74.11	14.41

Table 4: Mean and Standard Deviation of Medium Performance Group on Four Tests

	Teaching-method	N	Mean	Std. Deviation
Pre-test	Control Group	18	47.33	14.88
	Experiment Group	17	43.47	20.67
Mid-test	Control Group	18	59.89	12.63
	Experiment Group	17	60.47	19.41
Final-test	Control Group	18	50.39	15.39
	Experiment Group	17	46.71	15.28
Post-test	Control Group	18	55.00	14.84
	Experiment Group	17	56.41	14.61

Table 5: Mean and Standard Deviation of Low Performance Group on Four Tests

	Teaching-method	N	Mean	Std. Deviation
Pre-test	Control Group	9	39.89	19.59
	Experiment Group	9	34.33	18.66
Mid-test	Control Group	9	48.11	18.89
	Experiment Group	9	51.11	11.74
Final-test	Control Group	9	42.67	13.77
	Experiment Group	9	35.00	6.06
Post-test	Control Group	9	47.13	21.32
	Experiment Group	9	45.44	13.10

From Tables 3–5, the following observations could be drawn.

- After the first stage teaching, the medium and low performance students in the experiment group got higher average scores than those in the control group. Considering that the pre-test scores of medium and low performance students in the experiment group were lower than those in the control group, the experiment-based dynamic math teaching method was helpful to the medium and low performance students in a short term to understand better the math concepts. To the high performance students, the experiment-based dynamic math teaching method did not show any advantage.

- After the second stage teaching all three different performance students in the experimental group got lower average scores than those in the control group. Among them the high performance students showed the largest difference in test scores in the experiment group than those in the control group. It indicated that in a long term, the experiment-based dynamic math teaching method seemed not only no advantage but also had negative effect for high performance students.

Self-reporting Questionnaire of Cognitive Load

The cognitive load questionnaire was conducted during the mid-test and final-test, respectively. The results are illustrated in Tables 6–10.

Overall CL comparison between the control group and the experiment group. Table 6 showed the means and standard deviations on CL of both the control and experiment groups during the mid-term and final tests. Table 7 showed that there were no significant differences of the two CL points between the experiment and control groups. Table 6 also showed that the CL claimed by the experiment group was lower than that claimed by the control group during both mid-test and final-test.

Table 6: Sum, Mean, Std. Deviation and Variance on Self-reporting Cognitive Load in Two Stages

	Teaching-method	N	Sum	Mean	Std. Deviation	Variance
Mid-term CL	Control Group	36	202.0	5.61	1.68	2.82
	Experiment Group	35	180.0	5.14	1.82	3.30
Final-term CL	Control Group	36	242.0	6.72	1.78	3.18
	Experiment Group	35	225.0	6.43	1.52	2.31

Table 7: Summary of Between Subjects Independent Samples t-test for Equality of Means on CL points

	df	t	Sig.
Mid-term CL	69	1.128	.263
Final-term CL	69	0.746	.458

* The mean difference is significant at the .05 level. ($P<.05$)

CL comparison between different performance clusters of the control group and the experiment group. There was no significant difference on the students' self-reported CL between different performance clusters of the control and the experiment groups. The results were not illustrated in the paper, either. Tables 8–10 showed the means and standard deviations of students' self-reported CL in high, medium and low performance clusters, respectively.

Table 8: High Performance Students' Self-Reported Cognitive Load in Mid-Term and Final-Term

	Teaching-method	N	Mean	Std. Deviation
Mid-term CL	Control Group	9	4.56	1.51
	Experiment Group	9	4.44	1.88
Final-term CL	Control Group	9	6.44	1.59
	Experiment Group	9	6.11	2.03

Table 9: Medium Performance Students' Self-Reported Cognitive Load in Mid-Term and Final-Term

	Teaching-method	N	Mean	Std. Deviation
Mid-term CL	Control Group	18	5.83	1.58
	Experiment Group	17	5.12	1.96
Final-term CL	Control Group	18	6.72	1.67
	Experiment Group	17	6.59	1.28

Table 10: Low Performance Students' Self-Reported Cognitive Load in Mid-Term and Final-Term

	Teaching-method	N	Mean	Std. Deviation
Mid-term CL	Control Group	9	6.22	1.72
	Experiment Group	9	5.89	1.27
Final-term CL	Control Group	9	7.00	2.29
	Experiment Group	9	6.44	1.51

From Tables 8–10, the following observations could be drawn.

- Though there was no significant difference on CL between the experiment and control groups, all high, medium and low performance students in the experiment group claimed lower CL than those in the control group. It indicated that the experiment-based dynamic math teaching method could help the students to reduce their CL in understanding the math concepts.

- After the first stage teaching, medium performance students showed the maximum mean difference of learning CL among the three different performance clusters. It indicated that the experiment-based dynamic math teaching method was more helpful for the medium performance students to reduce their learning CL in a short term.

- After the second stage teaching, low performance students showed the maximum mean difference of learning CL among the three different performance clusters. It indicated that the experiment-based dynamic math teaching method was more helpful for the low performance students to reduce their learning CL in a long term.

Conclusions

This study showed that there was no significant difference of math achievements between the experiment and control groups. Based on the test scores, the experiment-based dynamic math teaching method had negative effect to the high performance students. The traditional teaching method was more suitable for them. In a short term, the experiment-based dynamic math teaching method was more suitable for the medium and low performance students to improve their learning achievements. In a long term, however, there was no advantage.

This study also showed that there was no significant difference on CL between the experiment and control groups. However, the experiment group reported lower CL than the one reported by the control group. It indicated that the experiment-based dynamic math teaching method could help the students to reduce their CL in understanding the math concepts.

Combining the CL with the students' math achievements, the results showed that in a short term, the medium performance students made a relatively bigger progress in their achievements and claimed a relatively lower CL. Though their achievements were lower in the final test, their scores became higher in the post test. So it could be concluded that the experiment-based dynamic math teaching was more suitable for the medium performance students.

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SMASH: ONLINE TRAINING IN MATHEMATICS AND SCIENCE EDUCATION FOR PARENTS

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Abstract

Acknowledging the central role of parents in children's learning, the EU-funded project SMASH aims to raise the educational standards of European youth in mathematics and science by cultivating underlying home cultures as springboards for learning. The project consortium has developed an innovative intercultural parent-trainer training course and related resources for professionals involved in parent education initiatives. The course provides these professionals with current knowledge, techniques, and implementation tools for the provision of high-quality, culturally differentiated training in mathematics and science education to parents of elementary and middle school children (ages 6–15) in their communities. Online multilingual resources support and promote the program's activities and objectives by offering open access to the parent-trainer training course content and tools.

Introduction

In technology-based society, where mathematics and science provide essential knowledge tools and the foundations for more advanced or specialized training either in higher education or through lifelong learning, several studies indicate the lack of mathematical and scientific competence of a considerable proportion of both the adult and student population around Europe (IALS, PISA, TIMSS). Research also indicates that pupils with poor quantitative skills are likely to have fallen behind by the age of ten. Thus, if the European Union is to achieve the objective set by the European Council for a considerable increase in the number of European college-level students graduating in mathematics, science and technology and pursuing technical careers, it should put more focus on improving student achievement in mathematics and science at a young age (Commission of the European Communities, 2007). The Joint Interim Report "Education and Training 2010" adopted by the Council and the Commission in 2004, highlights the need for accelerated reforms and calls on Member States to take action in order to motivate young people to take a greater interest in science and mathematics, and to undertake scientific and technical studies and careers (Council of the European Union, 2004). Several of the Lisbon Education and Training Indicators measure progress towards improved recruitment and performance of students in mathematics and science.

Parents are the central contributors to a child's education, thus having them involved and engaged in the educational process of their children is of paramount importance to their academic achievement in mathematics and science. The research literature indicates a very strong positive relationship between school performance and a conducive to learning home environment (Carter, 2002; Chen, 2001; Downey, 2005; Huntsinger et al., 1999; Kellaghan et al., 1993). Given the fundamental changes that have occurred in both the content and pedagogy of mathematics and science, the majority of parents do not have the needed knowledge to create an environment within the home that fosters their child's development and is coordinated with classroom work. The vast majority of parents encountered school mathematics and science as drill-oriented subjects, made up of rules and procedures to be memorized, thus many of them maintain a very algorithmic approach and, often, negative attitudes towards the subjects. Moreover, most parents lack the necessary knowledge to guide their children towards constructive uses of technology in support of their learning and developmental needs (Becta, 2001; Mavrotheris et al., 2004; Ramboll Management, 2006).

Parent education is considered an "essential component" of successful parental involvement (Covarrubia, 2000; DiCamillo, 2001; Freedman & Montgomery, 1994). To spur reform in mathematics and science education, parents should be provided with guidance on how to enhance their children's learning experiences.

SMASH (**S**uccess in **MA**th and **S**cience at **H**ome), a project funded by the European Union under the Lifelong Learning Grundtvig action, was proposed in response to the need for reaching out to parents and informing them about new developments in mathematics and science education. The overall aim of the SMASH program, which has a 2-year duration (December 2007–November 2009), is to offer high-quality training to parent educators around Europe that will equip them with the required knowledge, skills, and resources to provide professional guidance to parents of elementary and middle school children (ages 6–15) in how to best support their child's development in mathematics and science. To achieve this aim, the project consortium — comprised of seven partner institutions in five European countries (Cyprus, Greece, Spain, Czech Republic, and UK) — has/will undertake the following during the lifetime of the project:

- Develop, pilot test, and offer *an intercultural parent-trainer training course* for European teachers, school administrators, representatives of parent associations, and others involved in training activities for parents, that will prepare them through combined use of e-learning and physical meetings to implement in their communities *culturally differentiated parent-training programs* for supporting children's development in mathematics and science.

- Develop, pilot test, and distribute to parent educators for use in their parent-training programs *a culturally differentiated training pack for parents* offering technology-enhanced, research-based educational aids and resources for parents to support the development of their children's mathematical and scientific knowledge and skills.

- Design and develop *a multilingual information base* to support and promote the program's activities and objectives by offering open access to the parent-trainer training course content and pedagogical approach, to the parent training pack, and to various other links and resources.

- Initialize *networking among parent educators across Europe* by building an online community for the exchange of ideas, content, tools, and didactic approaches relating to parent education in mathematics and science. The long-term objective is to sustain and, if possible, to expand this community into a pan-European network of communication.

A pilot delivery of the parent-trainer training course is currently underway. The SMASH course is being tested locally is three of the partner countries (Cyprus, Spain, Czech Republic), on groups of 15–20 parent educators per country. Upon completion of the parent-trainer training course, some of the course participants will run parent training workshops in their respective communities, using the parent training pack developed by the consortium. Various forms of assessment tools and protocols are being used to collect and document evidence of changes in parent educators' pedagogical and content knowledge of mathematics and science, attitudes towards the subjects and teaching practices, and the impact that these changes might have on their ability to provide effective parent training. The analysis of these data will inform the revision of the instructional materials and services.

The revised parent-training course will enter the EU Lifelong Learning Training Database for increasing visibility and access to parent educators across Europe. Final revisions and enhancements will also be made to the information base content and services, and it will then be opened to all interested teachers and teacher educators.

This paper provides an overview of the SMASH parent-training course course design: course objectives, pedagogical and didactical approach, and course content and structure. At the conference, we will also be able to present a synopsis of the main findings from the course pilot delivery.

Objectives of the Parent-Trainer Training Course

The SMASH course aims to equip parent educators with the required knowledge, techniques, and implementation tools for the provision of high-quality, culturally differentiated training in mathematics and science education to parents of elementary and middle school children (ages 6–15) in their communities. Parent educators will be trained in how to plan, design, and facilitate an effective parent training course in mathematics and science education. They will:

- develop effective strategies for parent training by getting acquainted with the main principles of adult mathematics and science learning, and of parent education;
- gain better understanding of informal mathematics/science education and inquiry, and of ways to encourage family-based informal mathematics/ science education practices;
- get familiarized with innovative methodologies, tools and technologies that parents can employ at home to facilitate their children's learning;
- get familiarized with the rationale and content of the parent-training pack prepared by the consortium, and with ways to facilitate its use during the parent-training course;
- develop strategies for promoting parental engagement and learning, and particularly for increasing the involvement of "hard-to-reach families";
- learn how to convey complicated scientific ideas in a simple language that families can understand; and
- learn how to effectively communicate with parents coming from different cultural and/or socio-economic backgrounds.

Pedagogical and Didactic Approach

The theory of learning underlying SMASH is social constructivism. The design of the parent-trainer training course has been based on the importance of dialogue and collaboration between parents, parent educators, and researchers, and of inquiry and exploration as a process of knowledge construction (Ponte, 2001). The course has been jointly designed by a multinational consortium of educators, representatives of parents' and teachers' organizations, experienced distance learning instructors, authors of technology supported courses, and technicians, in order to ensure consideration of all different perspectives into the integrated pedagogical framework. Particular care has been taken to build on parents' knowledge and experiences and to respect cultural differences in parenting approaches (Onikama et al., 1998). Educators participating in the parent-trainer training course developed through the project will be trained to provide parent training that goes beyond the transfer of knowledge and development of skills, but is rather based on dialogic learning (Flecha, 2000), viewing parents as valuable intellectual resources to the learning process (Civil, 2002).

SMASH has adopted "learning" and "community" rather than "instructional" models of parent-trainer training (Barab & Duffy, 2000). The SMASH parent-trainer training course promotes intercultural awareness and exchange of experiences and ideas among European parent educators. Course participants will interact and learn from each other by engaging in joint activities and discussions, helping each other, and sharing best pedagogical strategies. Through these interactions, they will build relationships and construct a multinational community that will support best practices and innovation in parent training in mathematics and science education.

SMASH course participants will be provided with ample opportunities for interactive and collaborative learning through use of a wide array of tools, artefacts and resources (Gordon et al., 2007). They will be actively involved in constructing their own knowledge, through their participation in authentic educational activities such as projects, experiments, computer explorations with real and simulated data, group work, discussions, and reflection on one's own and on others' ideas and experiences. Through use of these strategies, we aim to offer a learning environment that will serve as a model to the participating parent educators as to the type of learning situations, technologies and curricula they could employ in their parent training workshops.

The *SMASH* Course Content and Structure

As already pointed out, the revised SMASH course will enter the EU Lifelong Learning Training Database to increase access to educators around Europe. It will be offered as a Grundtvig training course targeting school and/or adult mathematics and science teachers, school administrators, counselors, representatives of parent associations, or other professionals involved in training activities for parents. The SMASH course has been scheduled for offering twice during Fall 2009, in two of the partner countries (Cyprus and the Czech Republic). After completion of the project, the consortium will continue to offer the parent-trainer training course as a LLP Grundtvig course, thus increasing access to large numbers of educators involved in parent education.

Next, we offer a brief description of the SMASH course content and structure.

Course Content

The project consortium has designed the parent-trainer training course pack and the accompanying parent-training pack based on the guidelines set in the project pedagogical framework developed at the beginning of the program. The parent-trainer training course pack provides a state-of-the-art overview of new pedagogical methodologies and didactical routes in parent education. It explores a broad range of topics of interest to the mathematics and science parent educators, including the following: (i) Principles of child psychology and mathematics and science learning; (ii) Computer-supported teaching and learning; (iii) Mathematics and science curriculum issues; (iv) Principles of adult mathematics and science learning; (v) Parental involvement and student achievement; (vi) Basic principles of parent education; (vii) Recommended practices for promoting parental engagement and learning (e.g. family mathematics and science nights, family involvement case studies, etc.); (viii) Evaluation of parent education programs. Special emphasis has been paid to EU transversal policy issues, such as promoting participation of females, integration of disabled people, and inclusion of socially and economically excluded families.

The parent-training pack offers technology-enhanced, research-based and culturally adapted educational aids and resources to support children's development in mathematics and science at home, to be adapted and used by parent educators in their parent training programs. It consists of multimedia based training modules, to be delivered as a series of mini-workshops, that familiarize parents with some general principles of learning, with learning theories specific to mathematics and science, with school curricula, as well as with the use of learning technologies (e.g. use of state-of-the-art mathematics and science educational software as well as general-purpose software like Excel, guidelines for selecting appropriate educational software and for making internet surfing conducive to learning, etc.).

An isomorphic approach has been adopted for the development of course material targeting parent educators and parents. The program aims at educating parent educators and parents in the same principles and common language, to ensure the sharing of similar understandings regarding the ways in which parents can reinforce children's learning of mathematics and science at home. The intent is not to remediate or compensate for skills taught in school, but to spark children's scientific interest and to stimulate their informal learning of mathematics and science.

The teaching strategies employed in both the parent-trainer and the parent-training course to educate parent educators and parents about ways to promote informal mathematics and science learning at home, include the following:

- project-based learning
- inquiry-based learning
- case-based learning/scenario-based learning
- role playing
- narrative method — learning through stories

Material has been developed in English and will be translated into the partners' national languages (Greek, Czech, Spanish). It will be culturally differentiated to accommodate local conditions in each participating country. The content is in digital form and will be available online via the project information base. It will also be available in CD/DVD format to overcome potential bandwidth limitations.

Course Structure

Parent educators will receive training through combined use of e-learning and physical classroom meetings. The course will be made up of three parts:

(i) One-week Intensive training seminar: At the beginning of the course, parent educators from all over Europe will gather together to attend the seminar (they can finance their expenses by applying for a grant under the Lifelong Learning/Grundtvig-program). Course participants will be introduced to the objectives of the parent training program developed by the consortium and the pedagogical framework underlying its development, and will be offered background literature and practical strategies for effectively leading parent groups. They will also be familiarized with the facilities offered by the course e-Learning system. More importantly, they will get the chance to meet and interact with one another, and share issues and problems. We believe that this initial in-person meeting will reinforce parent educator online engagement (Kavanaugh et al., 2005) since it could mitigate the problem of trust and social presence online (Ardichvili et al., 2003).

The Intensive Training Seminar will have a six-day duration and will consist of a combination of mini-workshops that will include technology-based and hands-on activities in small groups (5–6 persons), presentations by experts, role-play, videos documenting learning activities of parents with children, and discussions. During the seminar, there will be particular emphasis on enhancing parent educators' skills in adapting the provided parent training material based on the context-specific needs and interests of parents in their community. Language of tuition will be English.

(ii) ICT-mediated instruction using the project information base: The second part of the course will be delivered online utilizing the interactive information base built specifically for this project. Parent educators will review the material that was provided to them during the Intensive Training Seminar and prepare for their guided field practice. Online moderated discussions — both asynchronous and synchronous — will allow participants to share content, ideas, and instructional strategies.

(iii) Guided field practice: At a final stage, parent educators will undertake a teaching experiment. They will customize and expand upon the parent-training materials provided to them, and apply them in their own communities. Partners will act as mentors, providing their support to parent educators using online communication tools. Once the guided field practice is completed, parent educators will report on their experiences to the other parent educators, and exchange ideas and insights as to how to further improve their parent training practices.

Upon successful completion of the course, participants will get certification as authorized trainers to run the parent training program developed through this project.

Concluding Remarks

In a technology-based society, mathematics and science literacy are among the key competencies that all individuals need for employment, inclusion, subsequent learning, as well as personal fulfilment and development (Commission of the European Communities, 2002). These competencies should be acquired by the end of compulsory schooling, since they are a prerequisite for participation in lifelong learning.

Recognizing the crucial role of mathematics and science education in achieving sustainable development and fulfilling the personal aspirations of European citizens, the SMASH project aspires to raise the educational standards of European youth in these disciplines through building European parents' capacity to contribute towards raising their children's achievement in mathematics and science. Taking into account best practices in mathematics and science education, adult education, parent education, and distance learning, the project aims to enrich

European elementary and middle school children's learning of mathematics and science through cultivating underlying home cultures as springboards for learning. The parent-trainer training course developed through the project goes far beyond traditional adult training practices. It builds parent educators' knowledge and skills through a hands-on, inquiry-based approach that seamlessly combines best pedagogical practices with contemporary technologies, including the Internet for maximum flexibility.

A central conviction underlying SMASH is that learning is a social act best supported through collaborative activities (McConnell, 2000; Vygotsky, 1978), and thus learning as part of a community of practice can provide a useful model for adult educator training. While the program employs innovative technological tools and resources to support educationally useful human-computer interactions, its focus is on exploiting technology to support human-human interactions (Barab et al., 2001). The SMASH parent-trainer training course provides a virtual space where European mathematics and science parent educators with a broad range of experiences and expertise will come together to reflect upon relevant education theory and practice, to exchange ideas and resources, and to build collaborations. Course participants will be encouraged and expected to engage in joint discussions and to work collaboratively in completing projects and other assignments. The aim is to build an open knowledge-building and sharing environment that will foster sustained participation and will allow parent educators to take an active role and ownership for the creation of their community (Barab & Duffy, 2000).

Maximum dissemination of the project outputs and services in different cultural contexts and long-term sustainability will be achieved through its information base, which supports multilingual interfaces, collaboration of parent educators around Europe, and accumulation of collective knowledge from end-users. The information base offers access to validated pedagogical models, didactic approaches, and technology-enhanced and culturally-adapted resource materials for parent educators and parents, that will be of use not only to the project participants, but also for independent study. The ultimate beneficiaries of the project will be children who will benefit from a conducive to learning home environment that enhances their mathematical and scientific development and prepares them to meet the challenges of the digital age.

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UNDERGRADUATE PRIMARY TEACHERS' LEARNING STYLES AND THEIR USE OF ICT & NATIONAL MATHEMATICS SOFTWARE

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Abstract

This research project was conducted at the Department of Primary Education at the University of Aegean. The 234 participants consisted of undergraduate primary school teachers. Their learning styles, their attitudes, as well as their self-efficacy in relation to ICT and the Mathematics Educational Software of the Pedagogical Institute were studied using four research instruments. The results show that students learning styles are mainly sensing, visual, sequential and active. Furthermore, it seems that students are well acquainted with the use of ICT and have, therefore, a positive attitude. Statistical significant differences were observed between the visual learning style and the use of ICT, and also between males and females.

Introduction

Over the past few decades, one of the most important issues related to educational change and educational innovation is the incorporation of ICT (Black & McClintock, 1996; Hoyles, Noss & Kent, 2004; Jonassen et al., 1999). ICT constitutes an essential tool for teachers of mathematics, too, since it can be used as: a) an educational method to support student learning; b) as a personal tool to prepare material for his lessons, to manage a variety of projects electronically and to search for information; c) as a tool to collaborate with other teachers or colleagues (Da Ponte, Oliveira & Varandas, 2002).

According to NCTM (2000), ICT can encourage the development of significant abilities in students, develop a positive attitude towards maths and contribute to the way students view mathematics.

In order to take advantage of ICT in mathematics, in-service and pre-service teachers must familiarise themselves with the potentials of ICT in the teaching of mathematics so as to become more confident. They must also know how to use such ICT tools as office management software as well as Mathematics Educational Software (NCTM, 1991). According to Mishra & Koehler (2006), to achieve the above goals it is essential that the relations among users, technologies, practices and tools be understood, since "*. . . technology is a knowledge system that comes with its own biases, and affordances*. . ." (Mishra & Koehler, 2006, p. 132).

Recently, research in educational technology suggests the need for "Technological Pedagogical Content Knowledge" (TPCK), which is based on Shulman's (1986) idea of "pedagogical content knowledge", so as to incorporate technology in pedagogy (e.g., Angeli & Valanides, 2009; Cavin, 2007; Keating & Evans, 2001; Mishra & Koehler, 2006; Niess, 2005). This interconnectedness among content, pedagogy and technology has important effects on learning as well as on professional development (Mishra & Koehler, 2006). They suggest ". . . a curricular system that would honour the complex, multi-dimensional relationships by treating all three components in an epistemologically and conceptually integrated manner" and they propose an approach which is called "Learning technology by design" (Mishra & Koehler, 2006, p. 1020).

In Greece, the educational changes of 2003 led to the "Cross-thematic Curriculum for Compulsory Education, CCTF", which has been implemented in compulsory education since 2006. One of its general principles is "to prepare pupils to explore new information and communications technologies" (Official Government Gazette, 2003, p. 1). In its effort to implement this new educational policy the Pedagogical Institute has developed textbooks and educational software (E.S.) for all teaching subjects. The educational software produced is not solely for the teaching of mathematics but is also for consolidation and supplementation and has been designed so as to complement and at the same time make use of the teaching materials for the teaching of mathematics in primary education (Chionidou, Zibidis, Doukakis, 2007).

The Educational Software of the Pedagogical Institute for Mathematics (E.S.P.I.M.) consists of three independent E.S., one for every second grade. Except for the educational software for the first two grades, the other two software applications are based on micro-worlds. According to Kynigos (2007, p. 90), "Micro-worlds are computational environments embedding a coherent set of scientific concepts and relations designed so that with an appropriate set of tasks and pedagogy, students can engage in exploration and construction activity rich in the generation of meaning."

Therefore, from a constructivist viewpoint, E.S.P.I.M. integration into 4th year undergraduate student teaching practice is a crucial factor for teachers' future "establishment" and improvement in maths classroom practices. It is this factor that the researchers of this project have begun to investigate. During the first phase of the research project the following questions were investigated: a) student learning styles, b) student attitudes towards ICT, c) student self-efficacy towards ICT and d) student attitudes towards Mathematics Educational Software.

This paper presents the results concerning student learning styles, their attitudes towards ICT and their efficiency in its usage. Furthermore, the correlation and statistically significant differences in student learning styles, attitudes and their self-efficacy towards ICT will be illustrated.

Finally, a reference will be made to the approach towards TPCK development among undergraduate students as well as to the research questions that emerged from the first stage.

Learning Styles

A learning style is described as a set of intellectual and emotional characteristics as well as of psychological factors used as indicators of a student's perception, inter-relatedness with and response to the learning environment (Keefe, 1979). The more we understand and know about a student's personal stance towards learning, the more we can contribute towards his/her success.

Several research studies have attempted to categorise students according to their learning styles with positive results not only for the understanding of these styles but also for their improvement. Dunn and Dunn (1978) presented a comprehensive model that incorporates the study of environmental, emotional, sociological, physical and psychological factors. Kolb (1984) defined four learning styles (accommodation, assimilation, converging, and diverging) and four learning modes (concrete experience, reflective observation, abstract conceptualization, and active experimentation).

Since then quite a few models investigating learning styles have been developed, all of which come to the same conclusion: the more we know about student learning styles, the more aware we are of the differences in class. This way, the educator/teacher can systematically design/prepare his/her lessons so as to achieve learning by combining his/her students' learning styles (Mangina & Mowlds, 2007).

Moreover, it is argued by several researchers that learning styles must be in accord with teaching styles (Charkins et al., 1985; Griggs & Dunn, 1984).

In Table I, Felder and Silverman (1988) present the dimensions of teaching and learning styles. In this model there are 25 learning styles. It is impossible for the teacher to adapt his/her teaching to all 32 different styles; yet his/her goal is to have an overview of his/her class and to adapt his/her teaching as required.

Table 1: Dimensions of Teaching and Learning Styles

Preferred learning	Style	Corresponding teaching	Style
Sensory/intuitive	Perception	Concrete/abstract	Content
Visual/auditory	Input	Visual/verbal	Presentation
Inductive/deductive	Organization	Inductive/deductive	Organization
Active/reflective	Processing	Active/passive	Student participation
Sequential/global	Understanding	Sequential/global	Perspective

(Source: Felder & Silverman, 1988)

In general, students prefer to receive and process information in different ways: by seeing and hearing, reflecting and acting, reasoning logically and intuitively, analyzing and visualizing. Yet criticism of this categorisation is valid, as e-learning environments have proven to enhance the teaching and learning, especially for groups from different cultural backgrounds (Mangina & Mowlds, 2007).

Furthermore, what is crucial is not just to be aware of student learning styles, but rather to identify and study those methods that will contribute to the improvement of these styles, based on our knowledge of their learning styles.

In this paper, the investigation of student learning styles does not aim at their identification alone, but more so to those actions that will follow and will have a strong pedagogical impact on the cycle of learning as well as the development to TPCK.

Attitudes Towards ICT

Investigating learning styles is of great importance for the development of TPCK and the incorporation of E.S.P.I.M. into the teaching practice of fourth year undergraduate students. Yet the success of this endeavour is directly correlated to the involvement and attitude of the student. It is argued that unless ICT conforms with the students' beliefs and attitudes, it will not be incorporated in their teaching and learning (Yuen, Law, & Chan, 1999).

Another factor is attitudes towards ICT (Huang & Liaw, 2005). Attitudes depend on a variety of issues such as the usefulness of ICT and confidence in using it (Rovai & Childress, 2002), training and knowledge of ICT (Tsitouridou & Vryzas, 2003; Yuen, Law & Chan, 1999), and anxiety and confidence (Roussos, 2007).

Regardless of ICT availability in schools what is of primary importance is the teachers' positive attitude towards ICT, so as to include it in the school curriculum. According to researchers, teacher attitude towards ICT is a predictor for future computer use in the classroom (Khine, 2001; Myers & Halpin, 2002). In Greece, Roussos (2007) designed the Greek computer attitudes scale. Using questions from other scales as well as introducing new scales, he based his model on three subscales: confidence, affection, and cognitive. Furthermore, in a study of 184 pre-service teachers, Khine (2001) found a significant relationship between computer attitude and its use in university laboratories. Kumar and Kumar (2003) report that teachers themselves believe that their experience in using ICT will positively affect their attitude towards ICT. Teo (2008) examined a sample of 139 pre-service teachers for their computer attitudes with four factors: affect (liking), perceived usefulness, perceived control, and behavioural intention to use the computer. It seems, therefore, that the study of undergraduate student attitudes towards ICT plays an important role in its incorporation into the teaching practice. However, as has already been mentioned, student efficacy in using ICT constitutes a factor in the formulation of their attitude and eventually in the incorporation of ICT in the classroom. It seems, therefore, that their attitude and self-efficacy together constitute a force that needs strengthening if ICT is to be incorporated in their teaching (Mishra & Koehler, 2006).

ICT Self-efficacy

In order to have a complete student-teacher profile, the ICT self-efficacy of the undergraduate students formed the third parameter of the investigation. According to Bandura (1997), who first discussed the notion of self-efficacy, "perceived self-efficacy refers to beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). As suggested by Bandura, self-efficacy is specific to a particular set of behaviours and comprises two components, efficacy expectations and outcome expectations which respectively relate to belief in personal capacity to affect a behaviour and belief that the behaviour will result in a particular outcome (Huey-Wen Chou & Tsung-Bin Wang, 2000). Apparently, the study of ICT self-efficacy constitutes an important factor in the teachers' decision to use ICT in class (Hill, Smith, & Mann, 1987). Furthermore, ICT performance seems to be related to ICT self-efficacy (Harrison, et al., 1997). A Greek instrument including several sub-scales for self-efficacy in relation to particular aspects of computer use has been developed and validated with students, teachers and individual persons (Kassotaki & Roussos, 2006). This research tool was used in this research study.

Data collection methods, research results as well as the emergence of the next set of research questions are presented in the following paragraphs.

Methods

The research sample consists of students at the Department of Primary Education, at the University of Aegean in Greece; all students have signed up for the courses Problem-solving in Mathematics and Second Stage Practicum. All in all, 325 students have registered in the fall semester of the 2008–2009 academic year. Out of these students, 234 completed the three research tools; in other words, 72%. Questionnaires were completed during the first meeting with the teacher and were anonymous. Unlimited time was allowed for each session, with most pre-service teachers finishing all the scales within 40 minutes.

Instruments

Four separate instruments were used to obtain the data. Furthermore, participant demographics were obtained related to their gender, high-school preference for a specific category of departments in universities (sciences, technological, theoretical), age and semester of current studies.

The first instrument was Index of Learning Styles, (Felder & Silverman, 1988). ILS is a self-scoring 44 item questionnaire for assessing preferences for four dimensions of the Felder and Silverman (1988) model. Students may have a mild, moderate or strong preference for each dimension. These four dimensions are active and reflective learners; sensing and intuitive learners; visual and verbal learners; and sequential and global learners. Platsidou and Zagora (2006) translated the tool in Greek, which was used to this study.

The second instrument was Greek Computer Attitude Scale (GCAS) (Roussos, 2007). GCAS is a scale devised to measure attitudes toward computers in the Greek population. The scale is presented as a list of 30 items, with three subscales: confidence, affection, and cognitive (Roussos, 2007). An answer scale of 1–5 was given to the participants; 1 stood for “I completely disagree,” on the left-hand side of the scale and 5, on the other side of the scale, stood for “I completely agree.” The 30 items of the GCAS are summed to provide a total score representing the participant’s overall attitude toward computers (ranging from 30 to 150), whereas scores from items on each subscale are summed to provide individual scores on each attitude construct.

The third tool was Greek Computer Self-Efficacy Scale (GCSES) (Kassotaki & Roussos, 2006). GCSES is a list of 29 items with two subscales: computer knowledge and computer usage and devised to measure self-efficacy towards computers in the Greek population (Kassotaki & Roussos, 2006). The 29 items of the GCSES are summed to provide a total score representing the participant's overall self-efficacy toward computers (ranging from 29 to 145). An answer scale of 1–5 was given to the participants; 1 stood for "None at all" on the left-hand side of the scale and 5, on the other side, stood for "Great."

The last tool was Greek Mathematics Educational Software Attitude Scale (GMESAS). GMESAS is a list of 29 items and is devised to measure attitudes toward Educational Software in Mathematics in the Greek population. The 29 items of the GMESAS are summed to provide a total score representing the participant's overall attitude toward Mathematics Educational Software (ranging from 29 to 145). An answer scale of 1-5 was given to the participants; 1 stood for "I completely disagree" on the left-hand side of the scale while 5 stood for "I completely agree."

In order to validate the tools and methodology, a pilot study was conducted before all students were asked to complete the questionnaires; all four research tools were used.

The fourth research tool was tailor made for this research study and once it has been further developed through principal component analysis (PCA), the relevant results will be presented. In the following paragraphs, the results concerning the first three research tools as well as the demographics are presented and discussed.

Results

Statistical Package for Social Science (SPSS) was used to analyze the data and answers given to the negative items in the scales were inverted at grading. Simple *t*-tests were used when it was essential, correlation techniques and ANOVA test of statistical significance were used to determine "whether any differences among two or more means are greater than would be expected by chance" (Walsh, 1990, p. 124). In the following paragraphs, the results concerning student learning styles, attitudes toward ICT and student self-efficacy are presented.

Demographics

The last section of the instruments contained several demographics questions addressing gender, age, semester of studies. Of the 234 survey responses, 83.8% of the undergraduate students were female. Of the 234 students, 220 (94% of the) participants were between 19 and 22 years old. The majority of the students

(66.2%) had attended the theoretical module at school, while 18.8% and 15% originated from the sciences and technological module respectively. Table 2 presents a profile of the students in the study using a cross-tabulation with the Index of Learning Styles categories.

Table 12: Characteristics of the Sample

	Index of Learning Styles (ILS)							
	Active	Reflective	Sensing	Intuitive	Visual	Verbal	Sequen-tial	Global
	N	N	N	N	N	N	N	N
By Gender								
Male	22	16	28	10	34	4	22	16
Female	113	83	169	27	136	60	131	65
Total	135	99	197	37	170	64	153	81
By Direction (Science: Sc, Technological: Te, Theoretical: Th)								
Sc	27	17	41	3	38	6	23	21
Te	24	11	27	8	29	6	15	20
Th	84	71	129	26	103	52	115	40
Total	135	99	197	37	170	64	153	81

Descriptive Analysis of the Index of Learning Styles

The results from the students (as provided in Table 2) showed that the students had a preference of active learning, which means that they learn by doing things and enjoy working in groups, whereas 42% is learning by thinking things through and they work better alone or with a familiar partner. The second dichotomy divides students into sensing or intuitive learners. Most of the students tend to like learning facts. They are concrete thinkers and quite practical. Only 16% were intuitive learners, that means they discover possibilities and relationships, they think in an abstract manner, they are innovative and work faster. Thirdly, a majority of the students (73%) are visual, in that they prefer representations of presented material, such as pictures, diagrams and flow charts. They remember what they see. Verbal learners (27%), on the other hand, prefer written and spoken information. Finally, the last dichotomy consists of sequential and global learners. Sequential learners (65% for those students) have a linear thinking process, they prefer to gain understanding in steps. They follow logical stepwise paths to find solutions. The 35% were global learners, learn in large jumps, they absorb material randomly without seeing connections then suddenly gain the understanding. They solve complex problems quickly once they have grasped the big picture.

Computer Attitudes of Pre-service School Teachers

The GCAS was subjected to multifactorial principal component analysis with varimax rotation for item analysis. The Kaiser-Meyer-Olkin measure of sampling adequacy was used to assess the adequacy of the correlation matrices for factor analysis (KMO = 0.912). Bartlett's test of sphericity ($X^2 = 4079.67$, df = 435, p <.001) reject the hypothesis that the correlation matrix is an identity matrix. The principal components analysis of the 30 variables has as a result of 3 factors with eigenvalues greater than one. The three factors explain nearly 52% the variability in the original 30 variables. The reliability was examined with Cronbach Alpha. The three factors have reliability between 0.917 and 0.866. The Varimax rotation is used to orthogonally transform the factor subspace and to interpret the physical meaning of each factor without altering the results.

The three factors, which are the same with Roussos (2007) results, are:

- Affection group: participants with computer anxiety and feelings such as unease, threat, irritation, and incompetence with respect to computers.

- Confidence group: participants who are confident with computers; some of these items concerned degree of engagement with computing.

- Cognitive group: participants' perceptions about computing and computers.

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Descriptive analysis of the Greek Computer Self-Efficacy Scale

The Greek Computer Self-Efficacy Scale counts student self-efficacy towards ICT on a scale of 29 (no knowledge) to 145 (very good knowledge). For the purpose of this analysis, answers were grouped into four scoring groups (little, average, good, very good knowledge). The results (as illustrated in Table 3) showed that 85% of students assess their ICT knowledge as 'good' or 'very good'.

Table 3: Greek Computer Self-Efficacy Scale

Scores	Frequency	Percent
29 - 57	2	0.9
58 - 86	33	14.1
87 - 115	88	37.6
116 - 145	111	47.4

Correlation analysis

A Pearson correlation was used to determine correlations among learning styles, computer attitude and self-efficacy. The correlation analysis did not suggest a strong correlation between learning styles and factors that emerged from the analysis of both the ICT attitudes scale and the self-efficacy in ICT usage scale. It is worth noting that an average negative correlation between the visual/verbal learning styles and self-efficacy ($r = -0.27$, $df = 228$, $p < 0.001$), an average negative correlation between visual/verbal learning styles and factor 2 (confidence) ($r = -0.28$, $df = 228$, $p < 0.001$), as well as an average positive correlation between visual/verbal learning styles and factor 1 (affection) ($r = 0.25$, $df = 228$, $p = 0.025$) were found. Finally, an average positive correlation is observed between the sensing/intuitive learning styles and factor 1 (affection) ($r = 0.29$, $df = 228$, $p = 0.004$).

The Differences of Undergraduate Teachers' Attitudes towards ICT in Relation to Their Learning Styles

A *t*-test was used to compare the mean value among the groups of learning styles, computer attitudes towards ICT and computer self-efficacy.

The mean value score of a visual learning style ($M = 0.16$, $SD = 1.01$) was found to be statistically significant ($t = 4.35$, $df = 232$, $p < .001$) compared with that of a verbal learning style ($M = -0.45$, $SD = 0.79$) with regard to factor 2 (confidence).

Moreover, the mean value score of males ($M = 0.4$, $SD = 0.98$) was found to be statistically significant ($t = 2.64$, $df = 228$, $p = .001$) compared with that of females ($M = -0.74$, $SD = 0.98$) with regard to factor 2 (confidence).

Finally, a one-way ANOVA was used to identify whether the group means of each school module differed with regard to learning style. The analysis shows a significant difference between the visual and verbal learning style group ($F_{2, 231} = 4.62$, $p = 0.011$). A Bonferroni adjustment is used to indicate that the significant difference is between the means of students from the science and theoretical modules. Moreover, there is a significant difference between the sequential and global learning style group ($F_{2, 231} = 8.76$, $p < 0.001$). A Bonferroni adjustment indicates that the significant difference is between the means of students from the theoretical group as opposed to the other two groups.

Discussion

The analysis results show that the least common/frequent student learning styles are the intuitive (16%), the verbal (27%) and the global style (35%). It seems that undergraduate students like learning facts, following proven methods of exploration and problem solving, are good at memorization and are careful and practical learners who like real world connections. Moreover, most of the students are visual, which means that they learn best from what they can visualise, and, therefore, like charts, graphs, pictures, films, and demonstrations. Finally, they are sequential, which means that they like the information presented in linear steps while at the same time they need some help in putting the “larger” picture together.

With regard to their ICT self-efficacy, it seems that students have already acquired the necessary knowledge of ICT usage before entering university or during their university studies and are, as a result, comfortable with using them. Consequently, it seems that using and familiarizing oneself with ICT are a given among students today as compared to students of the past. Perhaps this explains the lack of a significant correlation between learning styles and student attitudes towards ICT.

The statistically significant differences observed in ICT confidence between the visual and verbal style strongly suggest that feeling confident in using ICT positively correlates to a visual learning style. Furthermore, despite the fact that women have a stronger ICT self-efficacy in comparison to that of men, it is the latter who appear more ICT confident.

All in all, the descriptive data seem to be supported by the current literature (Ross & Lukow, 2004; Tripp & Moore, 2007; Young, Sanders & Hausler, 2008). In any case, the insignificant differences between learning styles and student attitudes towards ICT are worth noting.

It is obvious that research limitations (the fact that students might have taken advantage of ICT in other courses they chose to follow during their studies as well as the fact that they were selected from one university department) do not permit a generalisation of the findings to other student populations or other universities.

Conclusion

The investigation of student learning styles in this research study had two major aims: first, to allow students to experience and learn through this experience about the various learning styles so that they can be aware and capable of converting this awareness into practice in their own classrooms as future teachers; second, to develop their TPCK so they can incorporate ICT in their own teaching. According to Mishra and Koehler (2006), acquisition and development of TPCK presuppose a dynamic and complex knowledge on the part of the teacher.

TPCK development in students follows the Mishra and Koehler (2006) model, its defining feature being the active participation of the students in the entire process. Through learning by doing, the actual teaching using two different approaches, the first one using paper and pencil, whereas the second one making use of educational software and other computer tools, an attempt is made to engage the students in a rich teaching environment.

In addition, after the end of each lesson, students complete a feedback sheet as well as a second sheet that examines their attitudes towards the lesson and the usage of alternative teaching tools. Apart from the webpage and email communication, the lesson has been enriched with a forum, a blog as well as communication via sms. All of the above opportunities for student involvement with ICT as well as their projects will lead to the design of educational scenarios; whether or not these contribute to the acquisition and development of TPCK will be investigated. Furthermore, group discussions as well as the qualitative analysis of both the interviews and the discussions contribute to the group dynamics (Mishra & Koehler, 2006).

Whether or not a learning environment rich in technological tools and student support in the design of authentic educational scenarios, where ICT usage is embedded, allows students to draw the necessary connections between on the one hand, technology and mathematics, but also technology and pedagogy, so as to incorporate technology in their teaching, is one of the goals of this research programme.

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USING WEB BLOGS AS A TOOL TO ENCOURAGE PRE-CLASS READING, POST-CLASS REFLECTIONS AND COLLABORATION IN HIGHER EDUCATION

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Abstract

This paper reports on our students' experiments using blogs to encourage them to do pre-class reading assignment and reflections after class. The sample in the study included 5 EFL (English as Foreign Language) graduate students in a course of teaching methods and 90 Software Engineering students in an undergraduate Information Technology program. Results indicated that there was a positive attitude towards the use of blogs for pre-class preparation and post class reflections. However, for the experience to be successful it is important to consider the class size, students' educational level, and the type of reading assignment.

Introduction

Class discussion is a vital element in higher education. However, for discussion to be effective, students must do pre-class readings. This allows them to have a stand before class and enables them to engage in the discussion. To encourage students to do pre-class readings, we used blogs. Using blogs for courses, as an enhancement to the traditional online class, is becoming more and more popular. A blog is defined as "A website in which the entries are made in journal style and displayed in a reverse chronological order" (Wikipedia, 2006). It is also defined as "Personal web pages written in chronological diary form and maintained through blogging software" (Wagner, 2003). Visitors to the blog can read, comment, and link to the blog postings. From an educational perspective the availability and ease of use of blogging software makes using blogs a practical tool for use in higher education.

Our research set to answer the following questions:

- Does students' use of blogs encourage them to prepare for class and do pre-class readings?
- Does students' use of blogs encourage them to reflect on class activities and post their reflections online?
- Does students' use of blogs to enhance in collaborating with their peers?

The remainder of the paper is organized as follows. We will first review the literature on educational uses of blogs. Then, we will present our methodology in conducting this study. After that we present the results of our study, and a discussion of the findings. The final section summarizes our work and draws some conclusions and future directions.

Blogs in Education

According to the Australian scholars Williams and Jacobs (2004), blogs are technological tools with a potential for teaching and learning.

One of the important aspects of blogs is that they are readily accessible and easy to use by teachers and students, only a computer and a link to the Internet is required. Blogs can play an essential role in both teaching and learning. Even though there is a shortage of published materials of blogs in education, it is considered as an interesting tool in which the student can document both the learning activities and results (Dempsey, et al., 2003). Blogs have unlimited advantages for helping the educational sector. However, the evaluation of blogs depends mainly on the following:

- the person writing the blog.
- who reads it and
- the goals and objectives of the blog.

For our study, the blog is written by the instructor and commented on by students, read by both students and the instructor, and designed for supporting students in preparing for the class discussion.

The literature (Saeed et al., 2008; Wang et al., 2008) reports on the usefulness of blogs in supporting collaboration among students. By using blogs, teachers can arrange a collaborative learning environment where students can peer edit and comment on other students posting (Dieu, 2004). Students can see their work as well as other students' work and are able to collaborate on the learning activities. Other benefits of blogs in education according to (Campel, 2004):

- Students that have no personal websites may interact with others using blogs or cyberspace community.
- Students can practice their writing skills on the web and will be careful if they know someone will comment on their work.
- Students can converse and discuss with their teachers.
- Instructors can provide course details on the blog.
- Instructors can review and check students' work.
- Students have an opportunity to collaborate and interact with the wider community of students and teachers on the Web.

By the same token, other scholars stated the following advantages:

- When used for warm-up activities, blogs help instructors guide the classroom activities, as teachers can adjust and the organization and content in accordance with the students' current knowledge (Juang, 2008).

- Blogs enables the students to learn construction of social and cognitive knowledge according to (Du & Wagner, 2005).

- Blogs supports class interaction and discussions as well as enhance class presentations (Chang et al., 2008).

- Blogs empowers students to become more analytic as well as critical (Oravec, 2002).

- Students have the opportunity to write on the blog and document their work. Documenting saves the work during the course period and reflects their developments (Johnson, 2004).

- Students can discuss with the others on the course topic/s and reflect their views with others on the blog (Wu, 2005).

- Students are able to link their blog to other resources of learning to gain knowledge. They may link their blog to other blogs or any other related media to the subject (Wu, 2005).

- Blogs use an automatic dating system which helps tracks assignment submission. This dating system helps in searching and locating postings on a certain date (Wu, 2005).

Blogs in Language learning

Using blogs helps students in navigating the English websites according to (Campell, 2004), which increases

- their English language knowledge by chatting and interacting with other bloggers/students or even teachers.
- their abiltity to read more articles online which builds their language capabilities.

Wu (2005) of Taiwanis ChungHua University, department of Foreign Languages and Literature, highlighted the effectiveness of using blogs in English writing as EFL (English as foreign language). In his report, he stated that students are posting more than eight articles online during one semester. The majority of the students are happy with that method of teaching the English language. Similarly Bernstein (2004) described in his blog posted online titled: Do blogs improve writing? that writing frequently online improves the students skills of writing. The scholar suggested that EFL student/s should use blogs as well a dictionary or an Internet to see their vocabularies and express their thoughts and feelings obviously. As an EFL learner, students writing frequently online and expressing their thoughts improves the writing style in English language. As per the above survey, (91%) of the students interviewed told that, they look the dictionary or the Internet and sometimes ask friends when they aren't aware of how to express their thoughts in English language writing. In this study, there are two advantages that can be pinpointed for the purpose of active participation in blogs between students and their peers:

First: Posting articles, assignment works or even general knowledge topics and inquiries, frequent visits, commenting on these posted data on the blog, receiving comments from other colleagues. All these will increase the rate of collaboration between the learners using EFL writing class.

Second: Students will get involved to write good English due to its importance in cyberspace community as an international language where the student will work hard to write an understandable and correct English language to post on his/her website.

The study presented in this paper builds upon previous studies in the literature. It reports on the students' experience using blogs for pre-class readings and post-class reflections.

Methodology

Our sample study included five ESL graduate students in a one semester course of teaching methods, and 90 Software Engineering students in an undergraduate Information Technology program. We used the blogging tool wordpress (Wordpress, 2009). We created two blogs, one for the ESL course [1], and one for the Software Engineering (SW Eng) course [2].

Students were asked to read an assignment posted on the blog by the instructor. The assignment was a pre-class reading on a selected topic. Students were asked to post any questions or comments they have with regards to the reading assignment on the blog. The students then had a discussion in class on the topic of the reading assignment. Afterwards, they were asked to post their reflections on the blog about their class experience.

To evaluate students' experience on using the blogs, a survey was conducted to measure students' attitudes towards using the blog and its effectiveness as a tool for encouraging pre-class readings and post class reflections (one minute paper).

Results

All students in the ESL program and 35 students from the Software Engineering course responded to the survey. We asked them if they have used blogs before, and if so how did they use them. The results are shown in Table 1.

Table 1: Statistics for Students' Blog Experience

Have you used blogs prior to this class?	**Percentage**	
	SW Eng.	**ESL**
No	34%	20%
Yes, for commenting on someone else's blog	20%	80%
Yes, for writing on my personal blog	46%	0%

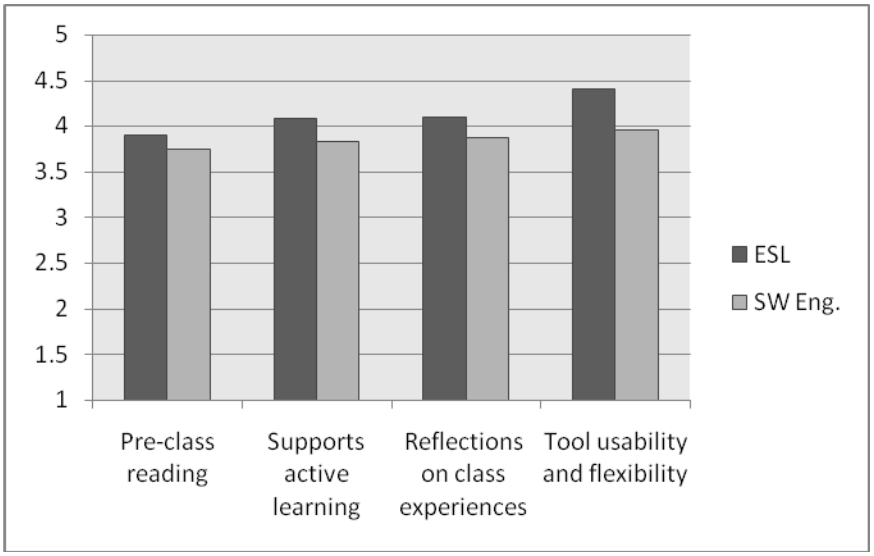
We presented a series of statements, and asked students to rate their agreement level on these statements (5–1, where 5 indicates strongly agree, and 1 indicates strongly disagree).

The survey included 19 statements grouped into four main categories:

- How helpful was the blog for supporting pre-class reading assignments.
- How helpful was the blog in supporting active learning (discussions and peer interactions).
- How helpful was the blog in supporting reflection on class experiences.
- The usability and flexibility of the tool.

The average of the responses for each group of questions is displayed in Figure 1.

Figure 1: Students' Perceptions on Blog Experience



In an open question, students were asked if they had any comments, or suggestions for improving the blog experience. The responses for the Software Engineering students and the ESL students are shown in Table 2 and Table 3, respectively.

Table 2: Students Comments on the Blog Activity (SW Eng.)

Software Engineering Students
If you really want the students to use the blog, you have to give a part of the grade. It's not the best option, but it's the only way to get the interaction started.
We didn't have enough time to actually enjoy working on the blog.
The pre-class blog discussion didn't work for me at all. I think you should figure out another way of discussion because the class discussion at the first time was much helpful. Maybe it should be like a chat that all experts contribute in.. or anything else
The idea of a bog is great, it allows one to say his/her opinion whenever the feel like it. However, I think class discussion is much more interesting than blog discussion
In my opinion, the blog discussion was less useful than the class discussion. Also I think more instructor presence is required on the blog.
The part that we were required to read was extremely difficult; therefore most students were only asking questions on the blog. The discussion was not apparent.
the blog is nice & good idea but still no yet. . . because the discussions face-to-face is more interactive ...

We also analyzed the number of comments on the blogs. The average number of posts per student was 2 comments/student for the ESL blog and 1 comment per a student for the Software Engineering blog.

Table 3: Students Comments on the Blog Activity (ESL)

ESL Students
Some students, like me, do not like face to face confrontation. They prefer to express points of view on line.
I like reading others points of view and having flexibility in time when doing my home work.
In terms of explaining an idea to a friend , I like to meet her face to face to make sure she got it
Blogs does not encourage shay students, bur help when teacher discuss with students their comments on line.
I have more time to think and re think, write and rewrite my ideas and organize them.
I think blogs increase the sense of community in the class, because it helps students and teachers to know more about each other's through communication and feedback sessions.
This experience inspired me. I love to create my own blog for my ESL students in the future. Thank you

Discussion

The results show that a majority of students have prior experience with blogs, and therefore the technology was familiar. An interesting finding from this study shows that the ESL students and the Software Engineering students had similar perceptions towards the blog activity as can be seen in Figure 1. The higher average rating by the ESL students might be due to the small sample size.

Looking at the agreement level shown in Figure 1, we can see that students generally agree that the blog activity helped in encouraging students to do pre-class reading assignments. It was also helpful supporting discussions and peer interactions. They also agreed that the blog supported reflection on class experiences. With regards to the flexibility and usability of the tool, it was the most agreed upon from both classes.

Although student perceptions seem positive, the comments the Software Engineering students provided in the survey, shown in Table 2, indicate that they are not completely satisfied with the experience.

They indicated that there was a considerable lack of interaction and communication between students on the blog. This is confirmed by our observations on the blog, most of the student contributions were questions. There are very rare occasions where one finds a student answering or engaging in discussion. This might be due to several factors: the timing of the activity, and the difficulty level of the reading assignment. The blog activity was introduced later in the course where students had exams, reports, and projects to hand in. With regards to the reading assignment, students complained during the lecture, and in their comments that the assignment was difficult to understand, and therefore they only asked questions waiting for someone to answer them.

Another issue which was raised by the students was that they did not feel the instructor presence on the blog. This is a very important and critical factor to engage students in the discussion. However, with large classes, this is not always possible.

Comparing blog observations for the ESL course with the Software Engineering course, we can see some differences. Students in the ESL class have shown reflective interaction and peer support in the discussion on the blog. This may be due to the following reasons: the class size, the maturity level of the students, the nature of the reading assignment, and the discipline. The ESL class was very small compared to the Software Engineering class. This may describe why the discussions were apparent. In small classes it easier for the instructor and peers to engage in discussion. The ESL students were graduate students in an English Language learning course, while the Software Engineering students were undergraduates in Information Technology. The reading assignment given to the Software Engineering students was a new topic, which has not been introduced to the students before and included a number of complex concepts.

The reading assignment for the ESL students was part of their reading materials in the course. The reading materials itself consists of several articles on the use of CALL (Computer Assisted Language Learning) in education and some other topics on ESL. Most of the articles were downloaded to the blog for students to read and discuss. It is important to mention that the ESL graduate students were in their third semester of the program. They are more familiar with large assignments of reading long articles, and complicated research studies. Another factor, and due to the small number of students, the instructor was mostly available to handle the discussion and comment to students postings.

In general, the results indicate that the blog activity was successful in encouraging students to do readings before class and helped them prepare for the discussion in class. However, for the experience to be successful it is important to consider the class size, the level of students, the reading assignment, and the timing of the assignment.

Conclusion

This paper described using blogs to encourage pre-class reading assignments and enhance learning and discussion during class.

It shows that blogs are an effective tool that can be used to encourage students to do pre-class readings and post-class reflections. The research was also valuable in evaluating students' general attitudes towards the use of blogs in higher education. However, for blogs to be effective, the following must be considered:

- The instructor presence should be more apparent.
- The timing of the activity should be suitable.
- The difficulty level of the reading assignment should be suitable for students to enable them to read and understand on their own.
- The suitability of the reading assignment for discussion.
- Class size, for large classes it is important that there is sufficient moderation so that the experience would be valuable.

This study provides a basis for our future research. We plan to introduce blog activities in future courses, taking into account the lessons we learned in this experience.

Endnotes

[1] ESL Blog at http:// http://esldeploma.wordpress.com
[2] Software Engineering Activities Blog at http://sweng.wordpress.com

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WINNING STRATEGIES: TECHNOLOGY + TEACHERS = TRANSFORMATION

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Abstract

This paper discusses the experiences of Australia's most densely populated state, Victoria, in developing a holistic approach to the implementation of ICTs across the State's Government schools. It considers the national context in which these reforms are being undertaken and the progress made. It shares lessons learned in developing three interrelated areas of ICT provision in the Victorian education system, namely: professional capability; curriculum reform and resources; and infrastructure, access and school design. By implementing such a holistic approach the pedagogy of teaching is rapidly changing in Victorian schools enabling a more targeted and individual approach to learning.

Introduction

Information and communication technologies (ICTs) are revolutionising the world of work and home and are contributing significantly to a transformation in education. This paper addresses the potential and the reality about the use of ICTs to enhance teaching and learning in the Victorian Government school system.

ICT presents both extraordinary opportunities and challenges for education. Digital technologies have the potential to change the way in which schools are organised, teachers teach, students learn and parents relate to their children's schooling.

In Victoria, exciting ICT innovations are occurring across a wide spectrum. Significant progress is being made in effectively using ICTs to support a curriculum that provides students with the knowledge and behaviours needed to prosper in a world that is being transformed by technology. Over the past ten years in particular, Victoria has invested heavily in digital infrastructure, content and leadership to enhance teaching and develop students' digital skills and overall learning potential.

Through this investment, Victoria's aspirations for ICTs in education have been well established. The most effective technologies for the Victorian education system are those that can contribute to successful learning outcomes for students by:

- catering for diverse learning styles and student needs
- helping teachers to make use of the available data and resources to design the best possible programs for individual learners
- animating the instructional process and the learning environment
- bridging the distance for students in remote locations
- re-engaging learners of all ages at all stages of their working life
- improving assessment and evaluation
- building partnerships with parents and the wider community, and
- improving the efficiency of school administration.

Through the State's investment in ICT, significant lessons have also been learned about the impact of ICTs and the ongoing challenges of providing universally accessible and high quality infrastructure, building teacher capability and ensuring the potential of digital technologies is fully realised across the whole education system.

The Australian Context

Australia has a population of 20.34 million in an area of 7.70 million square kilometres. The population density ranges from 0.2 people per square kilometre in the Northern Territory to 138.2 people per km^2 in the Australian Capital Territory. The majority of the population lives in coastal locations with the minority spread unevenly across the vast landmass. These geographic factors, coupled with the structure of a relatively immature telecommunications sector, have meant that broadband rollout has been significantly behind partner countries such as Singapore due to the high cost of laying infrastructure across vast distances.

Australian Bureau of Statistics data for 2007-08 shows that for households:

• Access to a computer	Australia	75%
• Internet access	Australia	67%
• Broadband access	Australia	52%

These statistics will be significantly enhanced by the recent Federal Government announcement of an Aus$43B broadband rollout supplying high speed optic fibre to homes across the nation over the next 8 years.

This is a major announcement for education as there is significant disadvantage for many Australian students due to living in geographically remote and/or rural locations. Isolation, the tyranny of distance, is a real issue for both teachers and their students and is being addressed through collaborative technologies and online curriculum provision.

The Australian education system is federated — there are eight states and territories in Australia and each one has its own approach to curriculum, staffing, resourcing and governance of state schools. Victoria is the second most populated state in Australia (see Figure 1).

Victoria's school system performs well on international comparisons and has made significant improvements in the last few years, which positions it well for international success.

The 2008 *Blueprint for Education and Early Childhood Development* (Department of Education and Early Childhood Development [DEECD], 2008) sets out the Victorian Government's five-year agenda for learning and development from birth to adulthood. It is the next generation of reform to improve outcomes for children and young people across Victoria. The Blueprint recognises the changing nature of learning in the 21st century and the need for children to develop the knowledge, skills and learning strategies they need to deal with the vast amounts of information and range of technologies now available to them. Importantly, the Blueprint recognised that Victoria, with its highly diverse cultural population, has many pockets of education disability.

Figure 1: A Snapshot of Victoria

Population: 5.25 million
Gross State Product: AU$228 billion
36% of Gross State Product spent on education & training
Multicultural: over 230 countries of birth and 200 languages spoken
State capital: Melbourne. Population: 3.7 million, 71% of Victorian population
School System
Schools: Government schools: 1587
Non-government schools: 706
Students: Enrolled in government schools: 538 116
Enrolled in non-government schools: 303 936
Staff in Government Schools: Teaching Staff: 40 447
Non teaching staff: 11 483
(Source: Department of Education and Early Childhood Development [DEECD], 2008)

Victoria's Approach

In Victoria, the ICT story has progressed from an initial focus on infrastructure, access to computers and network design in the early 1990's to embracing the role that ICTs can play in delivering returns in professional capability and curriculum reform in 2009. These strategies recognise the need to balance the vision for a technology supported future with the reality of the learning curve for each new technology. Professional learning for teachers is integral to the change process.

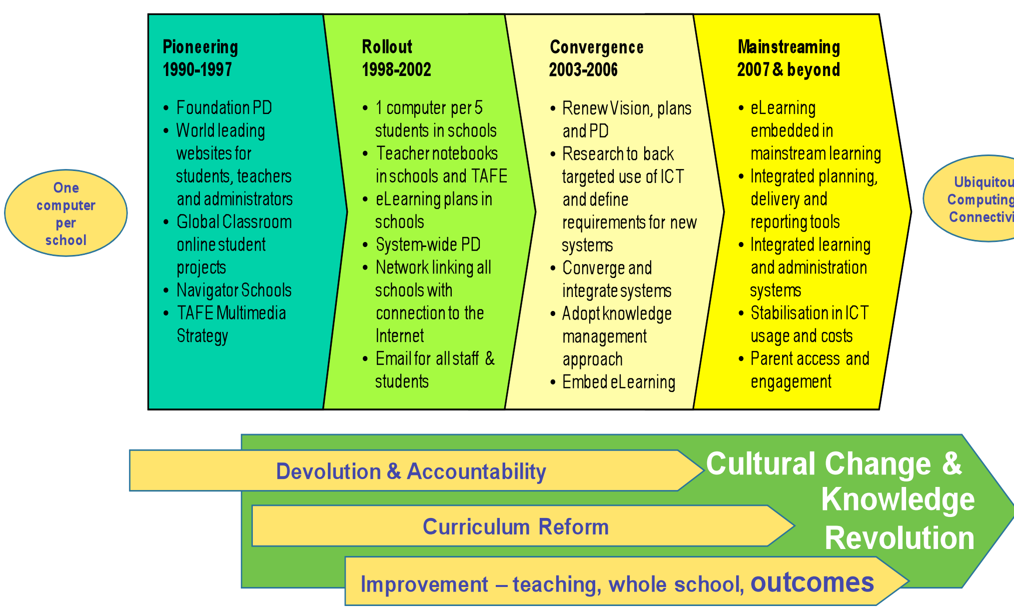
The Victorian story has developed from a simple desire to skill up the teacher workforce in the use of ICT to new individualised approaches to learning. ICT has enabled a shift from the traditional model of teacher led instruction of classes of students, to team teaching of students within ability groups. Individualised learning programs for students with exceptional capacity as well as students who are achieving below expectations are greatly enhanced with ICT. As such, the universal goal of equality of opportunity for all young people is much closer to becoming a reality.

Victoria's journey, from provision of laptops and e-mail accounts to all teachers in 1999, to electronic reporting and individualised lesson plans, through to the vision of parental engagement in the learning process via online learning environments has managed to counteract the cultural, socio-economic factors that have traditionally disadvantaged some young people.

Three strategies are explored in Figure 2 and illustrate recent developments in Australia and Victoria and demonstrate how progress is being made for a holistic response to the demands for 21st century learning. These strategies are:

- Professional capability
- Curriculum reform and resources; and
- Infrastructure, access and school design

Figure 2: Three Strategies



Professional Capability

In the technological revolution, each new generation is vastly superior in using, adapting and manipulating ICT than the previous generation. In education this means that students' mode of learning and capacity to use ICT is superior to teachers' knowledge of the pedagogy of learning with ICT. The Victorian Government's ICT strategy has focused strongly on developing professional development strategies which bridge this gap and enhance the expertise and knowledge of existing teachers (see Figure 3). This has been crucial in changing the way schools operate and the way students learn.

Innovators need to be supported in developing new practices and utilising new technologies, but it is important that professional development is targeted to the capability level of all teachers.

Benchmarking teacher capability. Victoria has developed an online tool that supports teachers to develop their confidence and capability to integrate ICT into their teaching practice (DEECD, 2009). It consists of an online survey, a bank of curriculum resources, an online journal and planning tools.

This is supported by a wide range of professional development programs available to Victorian teachers, through locally produced programs and partnerships with commercial providers. All of these centre around the fact that from 2000 each teacher in the State system has a highly subsidised notebook computer provided by the Government.

Figure 3: Examples of Partnerships for Building Professional Capability

Microsoft Partners in Learning
In 2009 this project will involve 9 Victorian schools working with Microsoft. The Catalyst schools will investigate ways of transforming classroom practice for improved student learning outcomes through the effective use of ICT. This will include developing a range of curriculum resources and tools to support other schools in their implementation of ICT into their teacher classroom practice (DEECD, 2009).

Intel ® Teach Program
Introduced in Victoria in 2003, the Intel Teach suite of programs has proved a popular and effective way to support teachers to integrate Information and Communication Technology (ICT) across the curriculum. Over 6000 Victorian teachers have been trained in Intel professional learning programs (DEECD, 2009).

The Creating eLearning Leaders (CeLL) (DEECD, 2009) initiative found that for effective integration of ICT in learning and teaching in schools:

- Leadership is critical
- Teachers are more likely to use ICT in the classroom when a whole school system is in place
- Sustained use of ICT in the classroom requires that teachers are appropriately skilled and have access to support for their immediate teaching needs
- More teachers will adopt ICT in their teaching approaches when they have access to ideas, activities and materials they can share and use
- eLearning can support schools to develop a more personalised approach to teaching and learning
- Getting *beyond engagement*, to the use of ICT to improve learning is hard work that takes time and effort.

It could be well argued that teachers are, more than ever, critical enablers of student learning with technology. Although students are routine adopters and users of new technologies, national curriculum testing has shown that they do not have depth of understanding of the applications and lack the skills to interpret knowledge they again through the use of ICTs.

Curriculum Reform and Resources

Over the past two years, ICT has been increasingly recognised in curriculum standards. The Victorian Curriculum and Assessment Authority specifically highlight the ICT domain as an interdisciplinary domain which includes:

- ICT for visualising thinking
- ICT for creating
- ICT for communicating.

Specifying the area in its own right has given ICT unprecedented prominence and a licence for innovators to change what, how, when and where they teach with multimedia technologies in particular. This is supported by a collaborative national effort in the development of quality online learning resources.

Victoria has taken a national leadership role in the use of new digital content formats and Web 2.0 technologies through the $8 million *Knowledgebank: Next Generation* (KB:NG) project. The project is establishing a content repository and portal for teachers across the country that:

- provides examples of leading practice in ICT including curriculum plans, digital stories, a showcase of student work and practitioner-led action research using Web 2.0 applications;

- provides easy access to online professional learning and access to other teachers through collaborative networks;

- brings together Web 2.0 content into a repository where a search will return 100 high quality, targeted resources for teachers rather than 1,000,000 as would be expected from a Google search; and

- develops policy around cybersafety, content procurement, copyright, intellectual property rights management and technology infrastructure.

The online content developed from world famous cultural institutions including the National Gallery, the Melbourne Zoo, The National Science Museum and international partners will be showcased through KB:NG. This content is improving every year, in line with the development of the local multimedia industry and, importantly, in line with the expectations of students.

Infrastructure, Access and School Design

The evolution of technology infrastructure has moved from an early focus on administration, to providing better classroom tools, to the present design of contemporary learning environments in which teachers and students access up to date ICT infrastructure to support varied styles of learning and teaching in newly designed learning spaces.

National infrastructure policies continue to centre on improving access to computers and ICT equipment and providing scalable, secure and robust infrastructure including broadband. Bandwidth provision for all government services, including schools, has been the single largest issue in a country with sparse population density and huge distances.

Victoria has invested more than $3 billion in ICT infrastructure since 1999 including: technical support for all schools; computers in schools; heavily subsidised notebooks for every teacher and an optical fibre broadband network linking all schools.

Many initiatives have focused on being strategic about leveraging past investments. Outcomes include:

- driving down the cost of computers and telecommunications infrastructure;
- making all Victorian government schools wireless in 2005 to break down the barrier for end-to-end access to teaching resources;
- better management of the Internet Service Provider industry;
- introducing a "white list" of quality education internet sites to maintain security around the internet resources accessed in schools.

A central focus of current infrastructure development in Victoria is the Ultranet, an online learning and teaching environment that will enable system-wide improvement in curriculum planning, access to learning resources, student assessment, reporting and communication with parents about individual student progress and needs.

Central to the value that Ultranet offers is the capacity for evidence based planning and more targeted delivery of personalised learning programs for each student. ICTs drive a more formative assessment approach for student learning and shift the focus to a changed relationship between teacher and student. Demonstrative of this approach has been the undertaking of the 2009 Netbook trials which encourage out of school learning (see Figure 4).

Figure 4: 2009 Netbook Trials

The Netbook Project has provided 10,000 students in 340 Victorian Government schools with a mini-notebook ("netbook"). The Government is contributing to the purchase of these netbooks and more than 28 educational software programs, so that they are available to families at a fraction of the cost of their commercial retail price. Netbooks are promoting better learning in and out of school by encouraging:

- anywhere, anytime access to learning
- independent, self initiated learning
- more family involvement in education
- collaboration between students in different schools, states & countries.

School Design. The iterative relationship between educational design and architectural design, coupled with new ways of engaging school communities, is enabling the vision for technology rich learning spaces. Over the next two years Victorian Government schools are benefiting from investment of nearly $AU4 billion from State and Federal Governments for new school buildings that feature ubiquitous technology in learning areas.

In terms of innovative design, the past five years in Victoria has seen 162 secondary schools participate in a $162 million project to design new learning spaces for students in the traditionally hard to engage middle years of their schooling (12 to 16 year olds). The new models have informed the capital investment program for all schools, producing innovative design templates for new buildings, which take schools from industrial models of classroom design to a more contemporary learning environment (DEECD, 2009).

This contemporary environment sees a concept of personalised learning at the core. Key concepts are innovative, flexible space and furniture, and ubiquitous technology — that is, access for students to whatever technology is required, as and when it is required.

Australia’s Approach: A Digital Education Revolution

To respond to the challenge of distance and varied performance across Australia, the Federal Government has nominated education as their top priority with an agenda for a *Digital Education Revolution (DER)* as a lead initiative. The aim of the DER is to stimulate sustainable change to teaching and learning in Australian schools that will prepare students for further education, training and jobs of the future and to live and work in a digital world (Department of Education, Employment and Workplace Relations [DEEWR], 2008).

The Australian Government is committing more than AU$2 billion over two years to provide:

- new or upgraded ICT for all secondary students in Years 9–12
- high speed fibre broadband connections to all Australian schools
- online curriculum content to support the national curriculum
- teacher access to training in the use of ICT
- web portals which will enable parents to participate in their child's education.

Moving Forward: Challenges and Opportunities

Ongoing challenges remain for the Victorian education system across all three of the areas outlined above. Victoria is currently working on policy program options to address these challenges:

Professional capacity:

- The absence of a readily available, recognisable and tangible picture of successful e-learning for teachers — models, competencies and pedagogies.
- Policy (e.g. copyright and intellectual property) which has lagged behind technology.
- Familiarity with new technologies is difficult in an aging workforce.

Curriculum reform and resources:

- The speed of change and lag between technology development and development of effective teaching and learning practice.
- Issues and perceptions about cyber safety, real and imagined.
- Access to high quality, targeted resources from across the world.
- Ensuring the curriculum is flexible enough to incorporate new ICTs as they develop and are embraced by students and teachers, while ensuring the key focus remains on how the available technologies are best used to improve student learning.

Infrastructure access and school design:

- Ongoing management of the centralised learning management system (*Ultranet)* as it is rolled out across the state.
- Home access to digital learning resources for students and families.
- Increasingly sophisticated technical support requirements.
- Bandwidth management to ensure that key systems are not compromised..

Developing New Metrics

Although international education benchmarks continue to focus on baseline literacy and numeracy measures, Victoria is participating in international research to identify the student capabilities that are developed through the use of new technologies. Some challenges that are being addressed include:

- How do we measure and demonstrate success when the targets keep changing? New metrics are needed to measure the success of initiatives that focus on the use of data as information, access to high quality resources, use of Web 2.0 technologies, etc.

- What are the new cost models, for example, supporting distance education students; 24/7 access to learning spaces; and high quality professional learning?

- What is Web 3.0? How do jurisdictions plan for the next wave of reform through technology? How do we balance cyber safety and innovation to undertake a genuine transformation in classroom practice?

Opportunities for Innovation

Innovative practitioners are leading practice in adoption of technologies with educational value, specifying future directions to the industry, and joining up processes, technologies and communities. Education systems need to encourage experimentation, take risks, but systematically identify "what works" so as to take the best practices to scale across the system.

The value of practitioner-led innovation in developing new practices, tools and resources for the benefit of the whole system cannot be underestimated. The Victorian Department of Education and Early Childhood Development is supporting school-led, disciplined innovation projects that address some of the key issues in ICT integration in teaching and learning. These projects include the establishment of a Virtual Learning Network for rural and isolated students and the development of a Digital Literacy Curriculum and Assessment Support Tool to provide teachers with materials and tools to teach the skills of digital literacy in a variety of curriculum areas as well as assess students' digital literacy competencies.

Conclusion

In a very short period of time ICTs have become a pervasive part of society, which is naturally reflected in our students. The way we communicate, access and process information about our world has fundamentally changed — as has the skill set required of our students for the workforce of 2010 let alone the more distant future.

In a very real way, technology has changed the way we think about the world - potentially less linear and more complex. We have moved gradually from a supply model of ICT infrastructure provision to a demand model which is focusing more on the individual needs of students and teachers.

There are tantalising views of what we can achieve through technology happening in our most innovative schools today — building whole communities of learners including teachers, students, siblings and parents, who can learn anytime, anywhere, at any stage of their life. The most exciting part about being in education in 2009 is that we know we are still only on the start of the change curve that technology will bring to our lives and our profession. No one has all the answers but the technology itself is enabling us to collaborate globally to work towards solutions, build preferred futures for technology enabled learning and address the real challenge of moving students beyond the superficial use of communications technologies to higher levels of analysis and evaluation of information about their world.

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INTRODUCING PRESERVICE TEACHERS TO FREE AND OPEN SOURCE SOFTWARE: FINDINGS FROM A CASE STUDY

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Abstract

Research suggests that one of the barriers to Information and Communication Technology (ICT) use in classrooms is teachers' lack of ICT skills and competencies. While for quite a long time ICT literacy meant familiarization with proprietary software, the growing importance of Free and Open Source Software (FOSS) has considerably changed the ICT landscape. The present paper examines undergraduate students' perspectives on FOSS after attending an introductory ICT course in which only such software was used. One hundred and one students from a preschool education department participated in the study. Two questionnaires were used for data collection. Data analysis indicated that (a) the students had no knowledge about FOSS concepts and applications and (b) GNU/Linux was considered more feature-rich and interesting compared to Microsoft Windows while Mozilla Firefox was also perceived as more feature-rich compared to Microsoft Internet Explorer. The paper is concluded with a discussion of the findings and implications for teacher training.

Teachers and ICT

Nowadays, most countries promote the use of ICT in education in an attempt to improve the quality of student learning. Consequently, ICT is a standard component of curricula in the western world. For at least three decades now, schools are being equipped with computers, educational software is being purchased, and teachers are being trained in ICT and how to use it in their practices. Regardless of the investment on infrastructure, teachers are not likely to use technology unless they have the knowledge, skills and attitudes to do so. Therefore, an important component of teacher training is related to the development of ICT competencies. The issue of technology skills for teachers needs to be addressed because research shows that teachers' lack of ICT knowledge and skills is one of the obstacles for the incorporation of ICT in their teaching (Hakkarainen et al., 2001; NCES, 2000; Pelgrum, 2001; Williams et al., 2000).

One might assume that even though practicing teachers lack technology skills, the young generation of prospective teachers are more prepared in terms of ICT. This is because students who are in their early 20s today grew up in a technologically rich environment, had more exposure to ICT and are digital natives. Empirical evidence lends support to this notion. Teachers' skills and confidence in using technology appears to increase over the years (Condie et al., 2007) and teachers who are new in the profession (e.g. have 5–6 years of experience) are more confident in using computers compared to teachers who entered the profession a long time ago (Rusell et al., 2003). On the other hand, research also suggests that even though young teachers possess more technology skills, there is a discrepancy between expected and actual technology skills (Albee, 2003). Thus, the level of technological preparedness of new teachers should not be taken for granted.

The issue of ICT literacy, skills, and competencies is important because it is a precondition for using ICT in educational practices. While research clearly suggests that technology training per se is not a sufficient condition (Wild, 1996), it is a necessary condition for without it the chances of teachers using ICT in their practices are minimal. Thus, the issue of preservice teachers' technology skills and preparedness needs to be explicitly addressed. In this paper we examine FOSS as a component of ICT-related teacher training.

FOSS and the Mature of ICT Literacy

The growing importance of FOSS, both in terms of software features and in terms of the underlying production model, has significantly changed the ICT landscape. FOSS is important for a number of reasons.

First, software-related freedoms. There are four kinds of freedom which characterize FOSS. These freedoms, which are defined in the licenses through which the software is distributed, grant users the freedom to run, copy, distribute, study, change, and improve the software (http://www.fsf.org; McGowan, 2005). Thus, the user can obtain the software without cost, has an unlimited number of licenses, may use the software for any purpose, may study and improve it as well as redistribute the improvements to the community so that others can also benefit. In the case of Proprietary Software (PS), these freedoms are simply inconceivable.

Second, features and qualities. As Chopra and Dexter (2008) note, a growing collection of powerful free software (e.g. Apache, BIND, Sendmail, GNU/Linux) have demonstrated their superiority to proprietary commercial software. More specifically, FOSS offers a number of advantages over PS including but not limited to reliability, security, performance, stability, cost, escape from vendor lock-up, scalability etc.

Third, market share, popularity, and adoption. FOSS' market share is on the rise both regarding operating system and applications software. In addition to the success in the corporate sector, many governments, local authorities, institutions, and organizations also embrace FOSS. For example, the European Union heavily endorses the use of FOSS over PS in its attempt to become the most competitive knowledge economy by 2010. Moreover, a recent EU-funded study recommended avoiding PS in the educational systems of its member states (Ghosh, 2006).

Fourth, the production model. While on the surface FOSS is about software, in reality it involves much more than software. FOSS may initially has emerged as a model for software development, but it has gradually evolved into a phenomenon with far reaching effects (Lessig, 2005; O'Reilly, 2005; Raymond, 2001). FOSS is important because the collaborative ideas and principles which underlie its development can be applied to any collaboration which focuses on any kind of work or content (Schweik, 2007). For example, the contemporary Web 2.0 developments are based on principles and practices which originated with FOSS.

FOSS and Education

While, as a rule, ICT literacy entailed familiarization with PS, over the past few years FOSS has emerged as an important alternative in many respects. This has a bearing both on what ICT literacy involves and on the training of teachers. Teacher education departments aim to prepare teachers to use ICT in their practices. Given the growing impact of FOSS outlined above, the content of this training is a very fundamental issue.

It has been noted that PS has the potential to define the curriculum of e.g. Computer Science (CS) departments. Chopra and Dexter (2008) note that in such departments scientists often spend considerable time developing and teaching classes to train new users of commercial software. At the same time theoretical computer science loses its status in undergraduate curricula because it has little or no application in the workplace. Chopra and Dexter (2008) conclude that this need to train students in the successful commercial software programs available renders CS a vocational rather than scientific training.

One cannot fail to notice that once the pressure of PS is so high on CS curricula, the corresponding pressure exerted on social science departments, such as education departments, is even higher. This is because in education departments the emphasis on theoretical constructs is, by default, very limited while the emphasis on the development of software skills is enormous. As a consequence, most courses in education departments are skills courses. Of course, it comes as no surprise that these skills are almost exclusively related to PS. To a certain extent, this tendency to use PS was justified because of its relative dominance and market share position. However, over the past few years and in addition to its dominance in certain niches of the server market, FOSS has become an important contender on the desktop as well. Considering that the importance of FOSS is growing, we argue that it is time to reexamine the content of ICT training in teacher training institutions.

Even though one can find several examples of studies reporting FOSS use in undergraduate courses (e.g. Carrington & Kim, 2003; Hernández-Leo et al., 2007; Raj & Kazemian, 2006), these primarily involve technical departments. It should be noted that introducing FOSS to technically sophisticated students with a CS background is less of a challenge compared to its introduction to education students. To the best of our knowledge, the issue of FOSS uptake has not been systematically explored with preservice education students, especially preschool and elementary school students.

Focus of the Study

The present paper draws on data from a larger research project on the use of FOSS in the ICT preparation of preservice preschool teachers. The paper examines students' familiarization with FOSS concepts and applications as well as their perceptions of 3 FOSS programs after attending an introductory ICT course in which FOSS was exclusively used. The study aimed to address the following research questions:

- What is students’ familiarity with FOSS concepts and applications?
- What are students'’perceptions of selected FOSS programs compared to PS ones in terms of features, ease to learn, ease to use, and general interest?

Method

Participants

One hundred one (101) students from a preschool education department participated in the study. This cohort of students, who were all female, had enrolled in an introductory, semester-long, ICT course which was compulsory for first year students that the author taught in his parent institution.

Course

The course aimed to introduce core ICT concepts as well as to render students skilled users of both operating system and applications software. Regarding the former, Ubuntu was the GNU/Linux distribution of choice considering that it is one of the most user-friendly distributions available. Regarding the latter, the course covered word processing and presentations (Writer and Impress from the OpenOffice.org suite respectively), web and mail clients (Mozilla Firefox &

Thunderbird), utilities (7Zip, InfraRecorder), and media player (VLC). The course involved weekly lectures and labs. It should be noted that because of the novelty of FOSS for students, lab attendance was compulsory.

Instruments & Measures

To the best of our knowledge, there exists no questionnaire which is suited for measuring familiarity with and attitudes to FOSS concepts and programs. Consequently, two questionnaires were specifically developed for the purposes of the study. The first instrument measured students' familiarity with common PS and FOSS applications as well as knowledge of main FOSS concepts. This instrument contained several questions on how skilled the students were with four general types of software: (a) operating system, (b) office, (c) Internet, and (d) multimedia. To measure familiarity with operating system software, 25 items on common tasks (ranging form simple ones such as copying files to more advanced ones such as customized software install) were used. The office category included questions about common software programs for FOSS and PS (e.g. Writer for FOSS, Word for PS). The Internet category included questions about FOSS and PS clients (e.g. Mozilla Firefox for FOSS, Microsoft Internet Explorer for PS). The multimedia category included questions about FOSS and PS programs which were related to graphics, audio, and video creation and processing (e.g. GIMP for FOSS, Adobe Photoshop for PS). A 5-point Likert scale ranging from unfamiliar (= 1) to very familiar (= 5) was used for all questions.

The second instrument measured students' views about various aspects of FOSS. This instrument included several items on FOSS programs. For the purposes of the present study, the dependent variables were 12 statements about 3 FOSS applications: GNU/Linux, Firefox, and OpenOffice.org. We focused mostly on those three applications because they were the ones which were thoroughly introduced in the context of the course. In each of the statements the students were asked to compare a FOSS program with its PS equivalent in terms of four dimensions: (a) features, (b) ease to learn, (c) ease to use, and (d) general interest. We chose to examine these four dimensions because they were deemed important. More specifically, the issue of features is critical for if students consider that the software lacks certain features (either because they are used to features that PS programs offer or simply because they tend to expect certain features), they will have very little incentive to use it. Regarding ease to learn, if students think that a program has a steep learning curve they will be less likely to turn to it in the future. The same holds for ease of use: if students find a program hard to use (compared to what they have been conditioned to use or what they expect) the program might not be a very appealing alternative to PS programs. Finally, the issue of general interest provides a general measure of how appealing the software is: the more interesting the program the more likely the students are to use it in the future. The scale used for all 12 statements was a 3-point one, ranging from less (= 1) to more (= 3).

Procedure

The first questionnaire was administered at the beginning of the course. Depending on their reported familiarity with FOSS and PS applications, the students were assigned to four homogeneous competence groups ranging from novices to more advanced users. Next, the students attended a 13-week course which on a weekly basis included one 3-hour lecture on ICT concepts (e.g. data representation, computer architecture, algorithms, networks) and one 3-hr lab session. The lectures and labs were held on different days. Finally, the second questionnaire was administered at the end of the course.

Analysis

Regarding the first question, composite scores were computed for operating system, office, Internet, and multimedia programs for both FOSS and PS. Means and standard deviations were computed for each composite variable and the Wilcoxon signed ranks test was used to detect any differences in familiarity between FOSS and PS applications. To examine the levels of familiarity with FOSS concepts as well as the importance attributed by the students to the four fundamental FOSS freedoms, means and standard deviations were computed. Regarding the second question, student responses on the 12 statements were initially recoded into two categories, one for less or same and another for more. The chi-square test was subsequently used to compare the frequencies obtained so as to determine whether students systematically favored FOSS applications over PS ones in the dimensions examined.

Results

Familiarization with software applications

Operating system software. Students reported familiarization with the GNU/Linux operating system was virtually non existent: $M = 1.07$, $SD = 0.48$ while they reported that their familiarization with the proprietary Microsoft Windows operating system was moderate: $M = 2.8$, $SD = 1.28$. While only 12.9% of the students stated that they were completely unfamiliar with Microsoft Windows, 97.6% of the students reported that they were unfamiliar with GNU/Linux. The Wilcoxon signed ranks test confirmed the obvious, i.e. that the students were more familiar with the PS operating system at a statistically significant level ($z = -7.0406$, $p = .000$).

Office software. The students were asked to rate their familiarity with the component applications of both OpenOffice.org and Microsoft Office suites. The students reported that their familiarity with OpenOffice.org was minimal (M = 1.16, SD = 0.45). On the other hand, students' reported familiarity level with Microsoft Office was moderate (M = 2.57, SD = .20). Eighty-five percent of the students stated that they had no knowledge about any of the OpenOffice.org suite applications (Writer, Calc, Impress, Base) while only 18.8% of the students reported being unfamiliar with any of the Microsoft Office suite applications. As expected, the Wilcoxon signed ranks test indicated that students were systematically more familiar with the Microsoft Office suite (z = -7.195, p = 0,000).

Internet software. The students reported virtually no knowledge about FOSS Internet applications (Firefox, Thunderbird, etc.) (M = 1.35, SD = 0.68) while their knowledge of PS Internet applications was low (M = 2.1, SD = 0.87). Again, this difference was found to be statistically significant in favor of PS (z =-6.580, p = .000).

Multimedia software. This was the only software category where the students reported having very little knowledge about the component applications (e.g. GIMP, Adobe Photoshop, VirtualDub, Adobe Premier, etc.). More specifically, as far as the FOSS applications are concerned, students' reported familiarity was very low (M = 1.22, SD = 0.41. Regarding PS applications, the students also reported low levels of familiarization (M = 1.27, SD = 0.49). A comparison of the two using the Wilcoxon signed ranks test indicated no significant differences (z = -1.00, p = .454).

Familiarization with FOSS concepts

Students' familiarization with the main FOSS concepts is presented in Table 1. As can be seen from the table, the students were essentially unfamiliar with FOSS concepts. It should be noted that more than 95% of the students reported having no knowledge whatsoever about what FOSS stands for. On the other hand, the examination of the importance that the students attributed to using the software for any purpose, adapting the software to one's needs, zero cost, and legal licenses indicated that the students were not much concerned with these issues. It should be emphasized that these four features constitute the four main freedoms which characterize FOSS. While some students did state that they were concerned e.g. about possessing a legal license for the software they use, as a group this cohort of students did not seem to be very concerned about the main FOSS freedoms.

Table 1: Students' reported familiarization with main FOSS concepts and importance attributed to the fundamental freedoms

	Variable	M	SD
Familiarization[a]	Software License	1.23	0.81
	Free Software (FS)	1.16	0.75
	Open Source Software (OSS)	1.09	0.50
	Free & Open Source Software (FOSS)	1.08	0.44
	FOSS Cost	1.05	0.30
	How to obtain FOSS	1.11	0.49
Importance[b]	use software for any purpose	2.93	1.00
	adapt software to one's needs	3.05	1.12
	software cost	3.02	1.16
	legal licence	2.96	1.15

a. 5-point Likert scale (1 = unfamiliar, 5 = very familiar)
b. 5-point Likert scale (1 = unimportant, 5 = very important)

Comparisons between FOSS & PS

Students' perceptions of 3 FOSS programs as compared to the corresponding PS programs are presented in Table 2.

Office suites. As Table 2 indicates, no statistically significant differences emerged between OpenOffice.org (OO) and Microsoft Office (MSO) in any of the four dimensions compared. While more students found OO to have more features compared to MSO (31 vs. 22) this difference was not statistically significant. On the other hand, none of the students found OO to be more interesting compared to MSO (55 vs. 0). Even though the inferential statistic could not be computed, it is obvious that the difference is statistically significant.

Web clients. When it comes to browser comparison, the analysis indicated that the students considered that Mozilla's web client had more features compared to MSIE. On the other hand, they did not find Firefox to be easier to learn or use compared to MSIE. Interestingly enough, Firefox was rated as being more interesting than MSIE but the chi-square value was not statistically significant (although it approached significance: $p = .052$).

Operating systems. The most noticeable differences were found in comparing the two operating systems: GNU/Linux and Microsoft Windows (MSW). Regarding features, the students found GNU/Linux to be more feature-rich compared to MSW. What is more, the results indicated that the GNU/Linux operating system captivated student interest significantly more than MSW. On the other hand, no statistically significant differences emerged with respect to the ease of learning GNU/Linux compared to MSW. Finally, the students found GNU/Linux to be more difficult to use compared to MSW.

Table 2: Students' perceptions of FOSS vs. PS programs

SW Category	Measure	Less-same	More	Chi-Square	df	p
Open Office.org vs. Microsoft Office	Features	22	31	1.528	1	0.272
	Ease to learn	29	20	1.653	1	0.253
	Ease to use	26	17	1.884	1	0.222
	Interest	55	0	n.a.		
Mozilla Firefox vs. Microsoft Internet Explorer	Features	15	37	9.308	1	0.003
	Ease to learn	22	29	0.961	1	0.401
	Ease to use	19	30	2.469	1	0.152
	Interest	22	38	4.267	1	0.052
GNU/Linux vs. Microsoft Windows	Features	10	43	20.547	1	0.000
	Ease to learn	26	17	1.884	1	0.222
	Ease to use	31	16	4.787	1	0.040
	Interest	14	42	14.000	1	0.000

Discussion

This paper examined preservice teachers' (a) familiarity with FOSS concepts and programs and (b) perceptions of FOSS programs as compared to PS ones. With respect to the first research question, data analysis indicated that the students were largely unfamiliar with both FOSS concepts and programs. Moreover, the students were systematically more familiar with PS programs compared to FOSS ones: the students' self-reported familiarity with PS programs outperformed the corresponding one with FOSS programs — with the exception of multimedia creation and processing. Needless to say this finding comes as no surprise considering how widespread PS is. In addition to being largely ignorant about the main FOSS concepts, the students did not appear to value the fundamental FOSS freedoms very much.

With respect to the second question, the analysis did not show any significant differences between the two office suites compared. It is interesting to note, however, that all students found Microsoft Office to be more interesting than OpenOffice.org. This finding is understandable because the version of OpenOffice.org used in the course, i.e. 2.0, was not as polished as Microsoft Office in terms of the interface. Students' perceptions of the browser comparison indicated that they were enthusiastic about Firefox which they found to be more feature-rich compared to Microsoft Internet Explorer. The students were excited by tabbed-browsing, bookmark management, and most importantly, browser-plug-ins. Regarding students' perceptions about the operating system comparison, the analysis indicated that the students found GNU/Linux to be more interesting and feature-rich compared to Microsoft Windows. The students were enthusiastic about Live-CDs, different GUIs, multiple desktops, and software repositories-package management system among others. On the other hand, the students found GNU/Linux to be easier to use compared to Microsoft Windows. While the students did not find GNU/Linux to be a geek-only operating system, they still appeared to be concerned about the ease of use. Thus, the students did recognize the potential of GNU/Linux but considered that Microsoft Windows was easier to use.

The findings of the present study suggest that while the students were utterly unfamiliar with FOSS concepts and programs, their ratings of FOSS programs in comparison with PS ones for the most part favored FOSS programs. The students appreciated the features of GNU/Linux and Mozilla Firefox, and expressed much interest in GNU/Linux. At the same time, they found Microsoft Office more interesting than OpenOffice.org and Microsoft Windows easier to use than GNU/Linux. Overall, students' responses to FOSS programs as a result of the course introduction greatly exceeded our expectations. The findings are very promising because FOSS — and especially GNU/Linux — is surrounded by several myths, e.g. it is notoriously difficult to install, master, and use effectively. Using students' responses as a criterion, the present study indicated that the introduction to FOSS in the context of an introductory ICT course may lead to successful outcomes. Consequently, FOSS might be effectively used to foster prospective preschool teachers' ICT literacy skills.

In conclusion, given the growing importance of FOSS both in terms of software quality and in terms of a new model of social practice (e.g. wikinomics) we argue that the training of student teachers in the use of FOSS is imperative. As the present study suggested, a systematic approach to FOSS might yield positive experiences and enrich students' ICT skills and perspectives. Especially when it comes to preservice teachers, teacher ICT training should expand to include FOSS.

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KNOWING ABOUT ICT IN EDUCATION: REDEFINING DIGITAL COMPETENCE FOR TEACHERS?

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Abstract

This paper concerns Teacher Professional Development (TPD) and ICT. It is sometimes assumed that teachers' use of ICT should promote a digital literacy, and that teachers' knowledge could be described as a digital competence. This assumption disregards that digital competence often refers to the policies of life-long learning (European Union, 2006). This paper aims to discuss digital competence in the context of ICT in Swedish schools as it appears in national and international surveys. It is argued that teachers' digital competence has to be framed differently in order to give a relevant picture of the situation in Swedish schools.

Introduction

In the last decade, there has been an increased attention in research as well as practice given to teachers' use of ICT. The Information Society has, at least in the Western parts of the world, meant a boost in the information and communication systems in society. The increased use of the Internet, and the communication oriented software sometimes referred to as Web 2.0, has brought about changes that affect different groups in different ways. In the above mentioned tension between the industrialised West and the developing countries, this has been described as a digital divide (Carr-Shellman, 2006). But also between generations in the west, a divide in the use of ICT has been said to exist. Young people's use of ICT is different from that of older people — they are more open to its use and less hesitant (Fors, 2007). This divide is also affecting schools (Krumsvik, 2008). Teachers, then, need to develop their own use of ICT, and to integrate ICT in education in a way relevant to schools (Rosado & Belisle, 2006). Teachers seem to be in need of professional development for this purpose. But what should that professional development aim at?

ICT Knowledge in the Information Society

The kind of knowledge needed to live in the information society has been debated, but often it has been described as information literacy. Gilster (1997) defined "digital literacy" as:

> the ability to understand and use information in multiple formats from a wide variety of sources when it is presented via computers. The concept

> of literacy goes beyond simply being able to read; it has always meant the ability to read with meaning, and to understand. It is the fundamental act of cognition. (pp. 1–2)

Rosado and Belisle (2006) acknowledge Glister's definition, and analyse ten different frameworks for digital literacy. They conclude that teachers face a challenge to change their understanding of their activities to a constructivist approach and to have a socio-cultural understanding. Today students seek the other experiences in academic settings. Students' use of knowledge is more pragmatic, functional and utilitarian nowadays. Schools, they say, are not the only place for knowledge experiences.

Digital Literacy for Digital Competence

Lately, following the EU policies on lifelong learning, digital literacy has also been described and related to digital competence. In Norway, Søby (2003) described the kind of knowledge needed for teachers by linking digital literacy to digital competence. Søby also linked those Norwegian ambitions to the EU work of defining digital literacy. Olsson and Edman-Stålbrandt (2008) connect the EU striving for digital literacy to digital competence and point to new definitions of digital literacy. In November 2008 the International Conference on Digital Literacy sponsored by the European Commission at Brunel University had as a strand the definition of digital competence and its assessment in which the challenge of today's society, due to complexity and globalization, was related to digital competence.

Krumsvik (2008) outlines a framework for teachers' complex digital competence. This can be seen as an attempt to capture what he sees as an increasingly digital reality in today's Norwegian schools. Krumsvik also points out some of the many possibilities, challenges and dilemmas that have arisen in the digital world of young people.

In a policy brief concerned with digital competence for lifelong learning (Ala-Mutka, Punie, & Redecker, 2008), there is a description of how teacher training in all fields should include advanced digital competence for teachers and their teaching. The brief also concludes that students should be both allowed and encouraged to use ICT for their learning, for information searching and for creation tasks. The intention is that students learn to use and be creative with digital tools and media in context, within different subject fields, and thereby taking into account the subject-specific considerations. The brief says that ICT for learning has the potential to put learners at the centre. If being engaged actively in the learning process, by for instance promoting discovery and experiential learning, this will bring forward at the same time other skills related to advanced digital competence, such as online collaboration with confident and critical use of the digital tools.

In April 2008 a joint seminar between the two different areas of cooperation in the EU Education and Training 2010 Work Programme, Teachers and Trainers and Key Competencies and Curriculum Development was held. Uzerli and Kerger (2007) describe the continuous professional development of teachers within the EU and the connections to the key competencies of lifelong learning, among which digital competence is one. For this reason, they also point to the need for teachers to develop new competencies, for instance in the subjects field. All in all, there seems to be a need for teachers to develop new approaches to teaching and learning, in which ICT is an integrated part.

Professional Development in Sweden Related to ICT Use

In Sweden the development of such a competence has, over time, been promoted by the Swedish Government and other actors (such as the Knowledge Foundation) through different kinds of national initiatives and programs. For more than 10 years, the knowledge Foundation has supported and developed the use of ICT in schools. Beginning in the 1990s with the lighthouse projects (Jedeskog & Nissen, 2004), and today in the 2005 initiative for integrating ICT in teacher education. The major government programme being the ITiS-programme of the Swedish Government in early 2000. These programmes all promoted the use of ICT to improve teaching and learning in schools.

In contrast to most of the writings referred to above, in which there are normative tendencies to define the content needed by teachers based on policy or by inferred demands from a knowledge or information society, Mishra and Koehler (2006) suggest a model of teachers' technological, pedagogical content knowledge that is empirically based and situates teacher's use of ICT in their practice. This framework, the TPCK-model, seems to be a model suitable for analytic purposes, Mishra and Koehler mentions it as a framework for research. As such, this paper will try to contrast it with the EU framework for lifelong learning and the key digital competence.

Aim

The aim of this paper is to discuss a possible conception of a digital competence for teachers through the framework of the European Key Competencies for Lifelong Learning and the TPCK-model of Mishra & Koehler (2006) by relating to teachers' use of ICT in Swedish schools as it appears in national and international surveys.

Digital Competence within a Framework of Lifelong Learning

In December 2006 the European Union launched its recommendations on key competencies for lifelong learning (European Union, 2006). The recommendation is considered to be a reference tool for the Member States, to ensure the full integration of the key competences into their strategies and infrastructures, in the context of lifelong learning.

Competences are defined as a combination of knowledge, skills and attitudes that are appropriate to the context. Key competencies are those which all individuals need, reasons given are for personal fulfillment and development; active citizenship; social inclusion; and employment. The Framework sets out eight key competences: communication in the mother tongue; communication in foreign languages; mathematical competence and basic competences in science and technology; digital competence; learning to learn; social and civic competences; sense of initiative and entrepreneurship; and cultural awareness and expression.

Each of the key competences are considered equally important. Each can contribute to a successful life in a knowledge society. Since many of the competences are said to overlap and interlock, they need to be given as part of the whole. For example, competence in the basic skills of language, literacy, numeracy, and in information and communication technologies (ICT) are said to be essential for learning, and the competence defined as learning to learn supports all learning activities.

In the recommendation, digital competence is defined as:

> Digital competence involves the confident and critical use of Information Society Technology (IST) for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet. (European Union, 2006)

Digital competence is said to require a sound understanding and knowledge of the nature, role and opportunities of IST in everyday contexts. In this is included word processing, using spreadsheets, using databases, information storage and management, and also an understanding of the opportunities and potential risks of the Internet and communication via electronic media, for work, leisure, information sharing and collaborative networking, learning and research. It is also said that individuals should understand how support for creativity and innovation can be found in the use of IST, and have an awareness of issues of validity and reliability of available information, as well as of the legal and ethical principles involved in using IST.

The skills needed and stated include abilities to search, collect and process information, in a critical and systematic way, assessing relevance and distinguishing the real from the virtual. Individuals should also have skills to use IT as a tool to produce, present and understand complex information and to access, search and use internet-based services, as well as to be able use IST to support critical thinking, creativity, and innovation.

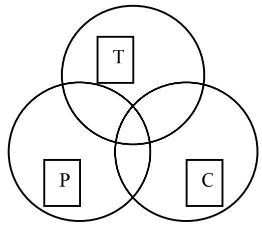
A critical and reflective attitude is said to be needed towards the sources of available information as well as a responsible use of the interactive media. Support for a digital competence is said to include an interest in engaging in communities and networks for cultural, social and/or professional purposes.

Pedagogical Technological Content Knowledge

A different framework for understanding teachers' use of technology is offered by Mishra and Koehler (2006). They argue that part of the problem of understanding why teachers' use of technology is falling behind has been a tendency to only look at the technology and not how it is used. They say that merely introducing technology to the educational process is not enough. Their primary focus lies on studying how technology is used. Their framework is based on an understanding of teaching as a highly complex activity that draws on many kinds of knowledge

In their framework they highlight the relationships between content (subject matter that is to be learned and taught), pedagogy (the process and practice or methods of teaching and learning), and technology (both commonplace, like chalkboards, and advanced, such as digital computers). The framework emphasizes the connections and interactions, between and among content, pedagogy, and technology. In their model, knowledge about content (C), pedagogy (P), and technology (T) are central for developing good teaching, but rather than treating these as separate bodies of knowledge, the emphasis is on the complex interplay of these three bodies of knowledge. In Figure 1, the intersections between the different knowledge domains are illustrated.

Figure 1: The Intersections of Technology, Pedagogy and Content



After Mishra & Koehler, 2006

In other words, to have a digital competence as a teacher, the teacher must know more than just how to use technology. The teacher needs to know how to use technology for pedagogical purposes in relation to a specific content matter. Having a digital competence would reflect the intersection between these knowledge domains, the intersecting area of all three circles in Figure 1. Thus, this model of technology integration in teaching and learning implies that developing good content requires interweaving three sources of knowledge: technology, pedagogy, and content. Mishra and Koehler (2006) argue that there is no single technological solution that applies for every teacher, every course, or every view of teaching. Developing a nuanced understanding of the complex relationships between technology, content, and pedagogy is needed.

The Use of ICT in Swedish Schools — Some Survey Results

According to the European Commission (European Commission Information Society and Media, 2006), all Swedish schools used computers for teaching, and had Internet access in 2006. Broadband connection was the most common, 89% of schools, and about 95% lower and upper secondary schools had a broadband Internet connection, while the figure for primary schools were lower, 86%. Sweden ranked at number 3 of the 27 countries in Europe according to the survey. ICT was integrated into teaching subjects in more than 90% of the schools. According to the teachers, only 11% of teachers in Sweden did not use computers in class. The majority of the teachers (54%) used computers in less than 10% of all lessons. Lack of computers in their schools was reported as the most important barrier for increased use. The majority of Swedish teachers, though, were satisfied with the access they had at their schools to technology, but they state they have problems to find adequate learning materials (62%), as well as argue that the existing materials are of poor quality (54%).

The first inter-Nordic study concentrated on the impact of ICT on education. E-learning Nordic 2006 Impact of ICT on Education involved four of the Nordic countries (Finland, Sweden, Norway and Denmark). In this study, more than 8000 people (teachers, pupils, headmasters and parents in primary and secondary schools) participated. The aim was to discover and document the perceived impact of ICT on education. The study had three key areas: the pupils and their performance, the teaching and learning processes, and finally knowledge sharing, communication and home-school cooperation. One of the major findings was that pupils and teachers as well as parents believed that ICT had a positive impact on improving pupils' performance, especially subject related performance, and on basic skills such as reading and writing. ICT was also thought to support differentiation for both academically strong and weak pupils. In general, ICT was assessed as having a positive impact on teaching and learning, but its revolutionary impact on teaching and learning processes in schools was also expected to be greater (E-learning Nordic 2006, 2006).

The Knowledge Foundation has continually investigated pupils', teachers' and school leaders' attitudes toward ICT and the use in schools. In 2006 they conducted the latest investigation, which shows that a great majority of pupils, and many teachers, appreciate using ICT in school assignments. In upper secondary schools, 7 of 10 pupils use computers during lectures at least once a week or more. Of the teachers, more than half use computers during their lectures at least once a week or more. Eight of 10 teachers' use computers daily outside of the lectures. Computer use among the school principals is high. In relation to their work, more than 4 of 10 headmasters use computers for more than 20 hours a week. Teachers have enough knowledge of IT according to a majority of the pupils, but only half of the teachers themselves assess their knowledge on IT as good enough. Also showed is that the communication supported by IT has increased greatly. Communication via e-mail between teachers and pupils is reported by 7 of 10 teachers. Communication with the parents via e-mail is reported by 6 of 10 teachers. In upper secondary schools, the pupils use IT to a very high degree to communicate with each other on questions related to school assignments, for instance via MSN/Messenger and SMS (KK-stiftelsen, 2006).

Discussion

In relation to the EU framework on digital competence, there seems to be possibilities to find aspects of the defining features of a digital competence in the use of ICT reported in the surveys.

For instance, using e-mail to communicate with pupils and parents could be said to reflect a sound understanding and knowledge of the nature, role and opportunities of IST in everyday contexts; that is for information sharing and communication. Teachers are also reported to believe that pupils perform better on basic skills, reading and writing using computers.

In relation to the TPCK-framework of Mishra & Koehler, there seems to be other aspects of the use reported in the surveys that might be discussed.

For instance, the reports of teachers stating that they are having trouble in finding adequate learning materials and that materials are of poor use could point to a pedagogical-technological knowledge included in the TPCK-model. Further, that the majority of the teachers' use computers in less than 10% of their classes' could be a sign of weak knowledge of the content-related use of ICT. This interpretation might be supported by the reports that teachers' use of ICT is higher outside of the classroom. They have the technological knowledge, but lack the knowledge of how to use ICT for pedagogical purposes. The TPCK-model might point towards this kind of knowledge.

In relation to each other, the digital competence framework is clearly formulated outside of the context of the educational system. The framework points towards a more common, or de-contextualized, use of ICT. In the TPCK-model, the use of ICT is much more contextualized within a pedagogical practice, and the basic skills and ICT competencies of the digital competence framework might be part of the technological aspect of that model. What the model then implies is that the technological knowledge and the digital competence need other kinds of knowledge structures to become useful in pedagogical settings.

Conclusion

What then can be concluded from this analysis? What seems obvious is that the digital competence framework will provide a way of relating teachers' use of ICT, both in and outside of classrooms, to the basic skills in using ICT for more simple aspects of tasks such as word processing, information seeking and communicating. But when it comes to the informed choices needed in complex pedagogical settings, there seems to be little guidance in the digital competence framework. It seems that this is not a framework that can be used in that specific manner.

What can be concluded about the TPCK-framework is that it might have an analytic potential in building an understanding of the lack of ICT use in certain areas. In the framework, what is described as complex relations between deep knowledge of content and pedagogy in relation to deep knowledge of technology is what is needed to develop a sound use of ICT in the teaching and learning.

There seems to be somewhat of an overlap in the definition of these complex relations to the kind of use that still seems to be lacking in schools. That is, teachers' informed use of ICT both related to pedagogy and related to content.

So, perhaps there is a need to redefine the framework for digital competence when it comes to teachers and teaching. Including the kind of knowledge that is captured in the TPCK-framework seems as a decent way to start.

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PRESEARCHING THE PAST TO RETOOL IN THE PRESENT FOR ACCESS TO THE FUTURE

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Abstract

Computers in Education, a course accredited by the National Council for Accreditation of Teacher Education (NCATE), USA, is the co-requisite of a field experience, Technology in Education. The courses exemplify the integration of technology to teach content, while preparing the next generation of educators. The challenges and opportunities associated with the design of age-appropriate, interdisciplinary curricula, teaching methodology, and advanced computer skills will be discussed during this paper session.

Introduction

Medgar Evers College is one of the premier four-year institutions of the City University of New York. The Education Department offers Associate Degrees and Bachelor's Degrees in Childhood Education, Childhood Special Education, and Early Childhood Special Education, all of which are programs accredited by the National Council of Accrediation of Teacher Education (NCATE), in the United States of America. One of the courses, EDUC 350, provides an opportunity for students to design instructional units by integrating technology to teach content. Authors share research on emerging technologies and their impact on the elementary classroom.

The Education Department of Medgar Evers College is built on a philosophy of culturally responsive teaching, and engages in the preparation of teacher candidates to that end. Candidates are prepared to incorporate teaching strategies to support learning of multi-ethnic and socieconomically diverse populations of students. Candidates nurture a knowledge and respect for the backgrounds of students within immigrant communities of New York City, and design instructional materials that respond to the needs of their future students.

The Web Quest, an interactive, interdisciplinary instructional unit incorporating web-based resouces is one example of instructional design. Three pre-service teacher candidates will discuss their experiences with the development of an authentic, student-centered, interdisciplinary unit. They will guide the audience through web quests in the fields of astronomy, using NASA websites; mathematics, incorporating financial literacy; and marine biology integrating technology-driven research. The audience will experience the web quest from multiple perspectives.

Technology and Teachers

An exploration of relevant literature revealed some findings. While Harvey (2005) wrote about the effectiveness of learning objects as reusable instructional materials, extensive discussions of emerging technological tools have been the focus of many publications by scientists (Alexander, 2006; Duncan, 2003; Harvey, 2005; McCord 2003) who documented the use of institutional repositories which systematically organize digital content for learning. Duncan (2003) stated that teachers and students determine the effectiveness of technology's use and presented this idea at an e-Learn International Conference in Edinburgh on Digital Repositories. In contrast to Duncan's perspective, Escalada, Graborn, and Zollman (1996) examined the earlier development of interactive digital video when teaching physics.

Fishman (2007) voiced the concerns of educators around the issue of student achievement. According to Fishman, schools face discipline problems with students who react to being "forced to attend schools and experience a curriculum developed for a mechanical era they do not comprehend" (2007, p. 1), so he proposed the implementation of curricula based upon video game technology to engage students. Fishman's idea to use video game technology to implement curricula was supported by statements made in the August 24, 2007 issue of *eSchoolNews*. Here it was suggested the image of technology integration must be updated to address the true core teaching skills needed to prepare students for the world they will face. The article in *eSchoolNews* expressed the concept that in addition to teaching core skills "such as reading, math, science and world languages, themes such as global awareness, financial, economic, business, and entrepreneurial literacy and civic literacy are necessary components of the curriculum with a focus on creativity, critical thinking, problem-solving, communication, information and media literacy, self-direction, leadership and responsibility" (p. 2).

Klopfer, Squire, and Jenkins (2002) discussed the use of Personal Digital Assistants (PDAs) in the instructional setting. These researchers emphasized the mobility, allowing adaptation to different contexts; social and web-based connectivity; and individuality of these tools, and they depicted their application for future environmental engineers to conduct research. Previously, Escalada et al. (1996) demonstrated the use of interactive video simulations in the physics laboratory environment. Ip, Linser, and Naidu (2001) described four crucial roles in web-based role play: "goal-based learning, role-play, online web-based communication and collaboration and the traditional lectures and tutorials" (p. 3).

Daggett (2003) discussed school reform and instructional technology skills of students that were necessary in their preparation for future employment. Daggett, who assumed the perspective of school counselors who guide students in their pursuit of a competitive role in the 21st century marketplace, said "In many cases, what individuals can do and the skills they can apply have become much more important than where they went to school, what their grades were, or how many credits they accumulated in a field" (p. 239). Daggett referred to the National Adult Literacy Survey, which presented three forms of literacy: (a) prose literacy, the knowledge and skills needed to identify, understand, and use information from continuous text sources; (b) document literacy, the knowledge and skills required to locate and use information contained in functional materials such as job applications and payroll forms; and (c) quantitative literacy, the knowledge and skills required to apply arithmetic operations, either singly or sequentially, using numerals and quantitative data embedded in printed materials (p. 240). Daggett further discussed the implications for K–12 literacy instruction. According to Daggett, in order to compete internationally, education systems within the United States must strengthen literacy skills by teaching reading beyond sixth grade, information literacy, nanotechnology, and the "Semantic web" (p. 242).

Technology Integration and Teacher Preparation

Each of the bachelor's degree candidates in teacher education takes *Computers in Education* and *Technology in the Classroom* field experience as part of their pre-professional coursework. The students complete projects in preparation for the web quest requiring them to plan a standards-based, interdisciplinary, instructional unit and design a PowerPoint presentation; construct a table of educational theorists as a resource for teachers; and critique websites for educational value. They review the components of a web quest and carefully design each component. Students have an opportunity to present their web quests for peer review prior to presentation in an elementary classroom setting. They are called upon to submit a reflection of the entire experience after completing the field experience, which can become part of their portfolios used to demonstrate accomplishment of two unit standards within the department.

As a course within a program accredited by the National Council for Accreditation of Teacher Education (NCATE), student achievement data is reviewed at the end of each semester. Students receive feedback according to the standards documented in the rubric, and the success of the course has been assessed according to the standards. After a few semesters of teaching the course, findings revealed an increase in the number of students achieving exemplary standards in the design and implementation of their web quests.

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A STUDY ON DEVELOPMENT OF DIGITAL CONTENT OF HUMAN-RESOURCE-MANAGEMENT PROGRAMS AT TECHNICAL UNIVERSITIES AND COLLABORATIVE E-LEARNING PLATFORM UNDER THE PRINCIPLES OF CONSTRUCTIVISM

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Abstract

Constructivism, stressed and valued in the field of education, can enhance students' motivation in learning and their ability to cooperate. Students could also develop their own knowledge with constructive interaction. Because the Internet learning system has the huge function of connecting information and interacting, it can assist learners to approach the idea of learning constructively. The purpose of study is to orient constructivism to the Internet Learning System for students of Human Resource Management of Business Administration in technical universities with the expectation of promoting students' practical abilities for human resource management and team cooperation. A constructivism-oriented e-learning platform is used, with the researchers' aspiration being that students could have higher level of practical working proficiency after learning. A basic teamwork ability scale of students in technical universities, a learning achievement scale of human-resource-management programs, and a learning attitude scale of human-resource-management programs were made under the principles of constructivism, and the researchers verified the reliability and validity of the scales in hope that future researchers could use less time and have a better understanding of disparities between correspondent abilities, learning achievement, and learning attitudes of students before and after the programs.

Introduction

It was said in *Learning: The Treasure Within* (UNESCO, 1996) that people must undergo four dimensions of learning in order to accommodate themselves to possible changes of the society: learning to know, learning to do, learning to live, and learning to be. In an era of knowledge-based economy in the 21st century, qualified human resource has become the most cardinal asset of an enterprise, which contributes to the fact that human resource management is one of the essential elements of the entire organizational management. A well-designed and sophisticated human-resource-management system can help an organization build a long-term irreplaceable competitiveness (Patricia, 2005; Way & Johnson, 2005).

Constructivism-oriented instruction holds that panel discussion and interaction between students with their peer groups or with external members are vital for their understanding information (Susan & Thomas, 1992). In the meantime, oversimplification of erudition is avoided. Constructivism-oriented instruction plays up problem-solving and task accomplishment more than other valuable components of it such as intact real-world knowledge, assorted viewpoints, and crucial open learning environments (Alfred, 2004). In an e-learning environment, people are no longer merely provided with limited time frames or places; instead, they are given multitudinous communicating ways and sundry content formats.

In this regard, this research is aiming at establishing a set of constructivism-oriented digital content of human-resource-management programs which would be applicable for students of the Department of Business Administration in technical universities. Hence, the constructivism-oriented e-learning platform is utilized with researchers' aspiration that students could have higher practical working proficiency after teaching experiments and constructivist learning could be achieved (Wen et al., 2004). The purposes of this study are: 1) to develop digital content of human-resource-management programs and to produce scales of human-resource-management cognition, of effectiveness of psychomotor learning, of effectiveness of affective learning, and of collaborative learning attitudes; and 2) to set up a constructivism-oriented e-learning platform for collaborative learning, with interactivity, which is necessary for distant learning, and all the properties of constructivism as follows.

- Learners can be allowed to take part in the construction of the platform and, therefore, decide inclusion of certain information in accord with their own preferences in the content.

- There should be opportunities that students can communicate and directions to their interaction that they can have a deeper conversation.

- Students can have chance to solve problems during their learning activities.

Constructivism and E-Learning

With a foundation stone of psychology and philosophy of the 20th century, constructivism indicates that learning is a process to put cognition in order. New information should relate to perceived knowledge of learners (Woolfolk, 1993) and, based on this, their personal cognition structure will be innovated or renovated. While learning, a person is more than conceiving new information; he or she is having their knowledge under reconstruction. In spite of the belief of behaviorists that learners oftentimes mildly accept erudition, they are active information producers from the perspectives of constructivists. Constructivist teaching underlines the complete intact lore in the real world without oversimplifying it, introducing myriad notions and open learning environments, along with an even stronger emphasis on problem-solving and task accomplishment through teamwork. The properties and features of E-learning are valued highly by considerable teaching theorists and scholars. They are convinced that the quality of web-based learning to present and process information corresponds with that of the latest models of cognitive theories, while the knowledge structure of web-based learning resembles that of people, leading to effective learning of pupils. Under this circumstance, scholars recommend that network technologies be utilized to establish constructivist learning environments (Wilson & Jonassen, 1989).

Dorothy (2000) implied that there were three flavors to merge the theory of constructivist learning into the application of e-learning instruction: 1) Instruction was made up for the intention that students could take part in it and organize context which they themselves thought worthy of learning; 2) With Instruction, students ought to be provided with abundant opportunities to communicate with others. When observing interaction among students, educators had to give them vital directions when necessary, which would help them have discussion in depth; 3) Students should be assured chance to conquer predicaments on their own. With e-learning, learners could search for and acquire the learning sources that aroused their curiosity and stimulated their thirst for knowledge. On the other hand, since there was no restriction on places and time periods as to using the service, learners could undergo a colloquy or other interaction with each other, taking advantage of discussion to encounter consistency coordination between information and cognition.

To sum up, it is constructivist teaching that is currently placed in the spotlight in academic area. With constructivist teaching, students may learn more aggressively, cooperate more efficiently, and nourish their own intellect through interaction. Due to numerous available connections with information and interaction provided by an e-learning platform, students could enjoy constructivist learning.

The Standard of E-Learning Content: SCORM

For the time being, with information of learning websites getting more diverse and considerable, ascribing to the extensive development and application of e-learning, people have difficulties integrating and sharing contents constructed according to different standards and methods. Thus, bringing to life a universal switching standard and method of program management process is one of the core intents of e-learning standards so that contents can be communicable and reusable. In 1997, United States Department of Defense proposed Sharable Content Object Reference Model (SCORM), offering a set of general regulations of establishing and digitalizing contents. SCORM 2004 is a set of regulations mainly of coordinating all existing e-learning contents deemed the reference for a refined SCORM. Therefore, more and more educational institutes invent e-learning platforms congruent with the SCORM standard, having their eye on a significantly adjustable e-learning environment.

Design of Digital Contents: ADDIE Model

The invention of digital contents is a decisive variable in considering whether e-learning is feasible or not at all, whereas the development of contents is relevant to teaching design. Even though e-Learning introduces numerous information technologies, learning is the essence, while digital technology a subordinate instrument. In the field of e-learning, digital contents, for the most part, are still produced based on ADDIE model (Analysis→ Design→ Development→ Implementation→ Evaluation). In truth, this sort of systematic instructional design models are widely applied in academics and development of industrial contents. ADDIE is explained below.

Analysis

During this phase: Pre-Analysis, Learning Content Analysis, Learner Analysis, Learning Objective Analysis, Information Technology Analysis, Delivery Method Analysis, and Budget Analysis will be held.

Design

In the phase of design, there are Timeline, Task Distribution, Standard Establishment, Assessment Approach, Tool Design, Teaching Strategy Design, Interface Design, Procedure Plan, Teaching Management Plan, Storyboard Design, etc.

Development

This is still a preparation phase: Storyboard Design Completion, Storyboard Revision, Content Design Completion, Content Debugging, Content Management, and Content Evaluation.

Implementation

This is when the proposal is being executed with two steps: simultaneous and non-simultaneous steps, inclusive of Educator Training, Assistantship Training, Learner Training, Learning Service Support, Course Extension.

Evaluation

After implementation, people can undertake self-evaluation and estimate course satisfaction such as Learning Achievement Evaluation, Degree of Students' Satisfaction, and Amendment Proposal. What with tests(self-evaluation, online post-training quiz) to understand students' learning achievement, what with questionnaires to perceive how pleased learners are regarding the learning process, the organizers will realize benefits and drawbacks of this model and reform it for future classes accordingly.

Methods

The Methods of Developing Digital Content of Human-Resource-Management Programs Based on Constructivism

Development of scales of learning achievement and learning attitudes of human-resource-management programs. In order to grasp learning achievement of students after the experimental teaching, the researchers generated scales of learning achievement and learning attitudes of human-resource-management programs in technical universities. As soon as the first version of these scales were done, the professionals in the field of human resource management were requested for scrutinizing their suitability, and the scales were amended in accord with their opinions afterwards before the pre-testing scales were fully emended. With the students majoring in human-resource-management programs in technical universities filling up the pre-testing scales, the final scales were brought out after the data of the former were analyzed.

Development of constructivism-oriented digital contents of human-resource-management programs. On the basis of constructivism-orientedness, this study developed contents of human-resource-management programs, which would be utilized in experimental teaching. Employing ADDIE digital content design models — analysis, design, development models — to establish the context of the contents for the programs, this study invented a set of digital contents of human-resource-management programs congruent with SCORM 2004 digital learning standard.

The Methods of Establishing an E-Learning Platform

The platform was mainly developed by programming language PHP, facilitated by Java Servelet, while content package compatible with SCORM 1.2 was allowed to import or export it. Attested by learning environment standard pronounced by United States Department of Defense, the platform was deemed to reach the most supreme standard (e-Learning Center of CCU, 2008).

The following are the system information of it: a) main standard of server hardware: 1. Operating system: FreeBSD 6, Linux kernel 2.4; 2. Character set of the system: zh_TW.UTF-8；3. Database character set: utf8_general_ci；4.WWW server：Apache 2, lighttpd, CGI programming language, PHP 5, Smarty template engine 2.6；5.Database: Mysql-server 5; 6. Database package：PEAR-1.4(PEAR DB).

Results and Discussion

There are findings worth summarizing as follows after the past six-month research.

Production of a Learning Achievement Scale of Human-Resource-Management Programs in Technical Universities

The researchers, referring to correspondent books, designed both contents and teaching objectives and made a two-way specification table as a footstone in sight of cognitive abilities — knowledge, comprehension, application, analysis, synthesis, and evaluation, according to Bruner (see Table1) before developing pre-testing scales of the unit, Training and Development, of human-resource-management programs in technical universities. These pre-testing scales were mailed to the professionals for examination, who verified whether or not the questions were in tune with the purpose, the sentences in agreement with fluency, and the content in compliance with the teaching conditions practically. Then the pre-testing scales became viable by reason of these specialized detailed revision and amendment.

Table1: Two-Way Specification Table for Tests of Learning Achievement of Human-resource-management programs.

Number of Questions / Cognitive Levels	Knowledge		Comprehension		Application		Total	
	T/F	MCQ	T/F	MCQ	T/F	MCQ	T/F	MCQ
An Introduction to Human Resource Development	1	1		1		1	1	3
Training and Development		5	3	3		1	3	9
Training Ways	1	2		2		3	1	7
Total	2	8	3	6		5	5	19

* Multiple Choice Question, MCQ; True or False Question, T/F

There were four true or false questions, 17 multiple choice questions, with a value of 0.72 of the overall internal reliability in the official scale.

Production of the Learning Attitude Scale of Human-Resource-Management Programs in Technical Universities

Liking, Anxiety, Confidence, and Usefulness were the four dimensions of the learning attitude scale of human-resource-management programs, each of which had five questions, 20 in total. Likert 5-Point Scale was adopted in this scale, which consisted of both positively and negatively stated questions. For positive ones, “Strongly Disagree” scored one point, “Disagree” two, “Neither Agree or Disagree” three, “Agree” four, and “Strongly Agree” five; vice versa.

The students of Chienkuo Technology Universities and of Hsiuping Institute of Technology who had attended human-resource-management programs were respondents, and the valid data they provided, excluding those from pre-testing questionnaires without complete answers, comprised 218 effective samples, 73 male and 145 female, and were analyzed by SPSS for Windows 13.0.

An assumption test with KMO (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) and Sphericity test of Bartlett were conducted in advance of a factor analysis, which is applicable because, of this research, KMO 0.865 >0.5 indicated the high association between variables, and the value of doubling that of Bartlett’s Sphericity test, 4888.397, $p< .001$, showed that there were common factors of the correlation matrices of the variables. During the factor analysis, Orthogonal rotations were implemented with Varimax, and four factors with the eigenvalues more than one were picked. At the same time, questions 3, 10, 11, and 15 are casted aside because the factor loading of them failed to reach 0.4. There were 16 questions in the official scale, presented in Table 2.

Table 2: Factor Analysis Summary of Learning Attitude Scale of Human-Resource-Management Programs

Pre-testing Scale Question	Factor 1: the Degree of Usefulness	Factor 2: the Degree of Liking	Factor 3: the Degree of Anxiety	Factor 4: the Degree of Confidence
6	.622			
7	.865			
8	.842			
9	.787			
12		.691		
13		.692		
14		.850		
16		.574		
17			.619	
18			.837	
19			.757	
20			.492	
1		.		703
2				.744
4				.725
5				.541
Eigenvalue	5.175	2.471	1.364	1.245
Accumulated Interpretation Variance	32.34%	47.78%	56.31%	64.09%

After the factor analysis, a reliability analysis of Cronbach's Alpha was executed on the retained questions to investigate the consistency of the scales. In so doing, the researchers obtained summary scale reliability (Cronbach's alpha = 0.86); on the other hand, the sub-scales reliabilities: the degree of liking (Cronbach's alpha = 0.78); the degree of anxiety (Cronbach's alpha = 0.75); the degree of usefulness (Cronbach's alpha = 0.88); and the degree of confidence (Cronbach's alpha = 0.75). Thus, this scale was considered sufficiently reliable, since an index value more than 0.70 provided reliability, a reference from perspectives of DeVellis (1991) and Nunnally (1978) (Ming Lung Wu, 1999).

Construction and Test of Constructivism-Oriented E-Learning Platform of Human-Resource-Management Programs in Technical Universities

As soon as the system source codes were downloaded and installed on the server, with system settings completed, the digital programs were established altogether after the researchers constructed contents, assignment, tests, collaborative learning activities, and students' accounts of the programs (see Figures 1 and 2).

Figure 1: Mainpage of the E-Learning Platform

Figure 2: Homepage of the E-Learning Platform

Scrutinization by the Professionals and Amendment of Constructivism-Oriented Digital Content of Human-Resource-Management Programs in Technical Universities

After the data of the entire programs were settled on the e-learning platform, the professionals in the fields of human resource management and e-learning were invited to assess the programs, applying assessment scales of constructivism-oriented contents and those of design and development phases of ADDIE digital content design model. On top of that, their advice and suggestion were taken into account for amelioration until the digital contents were ultimately constructed.

Development of Constructivism-Oriented E-Learning Contents of Human-Resource-Management Programs in Technical Universities

With respect to the constructivism-oriented systematized teaching model, the content of constructivism-oriented human-resource-management programs which was invented one year ago was further developed and digitalized. The syllabus is shown in Table Four, consisting of six units: Unit One: An Introduction to Human Resource Development; Unit Two: Human Resource Training and Development; Unit Three: Human Resource Training Ways; Unit Four: Relating Project Study and Analysis; Unit Five: Educational Training Plan Making; and Unit Six: Online Test and Project Discussion.

Conclusion

A basic teamwork ability scale of students in technical universities, a learning achievement scale of human-resource-management programs, and a learning attitude scale of human-resource-management programs were made under the principle of constructivism-orientedness. Besides, the researchers verified the reliability and validity of them in hope that people could use less time and have a better understanding of disparities between correspondent abilities, learning achievement, and learning attitudes of students before and after the programs when exercising experimental teaching in the relating fields in years to come. Contributions concerning the construction of the e-learning platform in this study are as follows:

- The content established in this research would be available for future human-resource-management programs in technical universities since, after serious literature review, it was dissected and revised in detail by experts in the fields of both human resource management and Internet-based education. Furthermore, the e-learning platform matches with the SCORM 1.2 standard and, as a result, may be sufficiently applicable for future education given by teachers in the relating areas.

- Conditional online contents were constructed with Flash Action script, offering immense interactivity so that students could face and grapple with virtual problems. Constructivist learning, helping students comprehending virtual problems, would not only instruct them in specialized skills but foster students' habits of and confidence in figuring out answers when confronted with other problems.

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DO STUDENTS' FORMER ICT EXPERIENCES INFLUENCE PATTERNS OF PARTICIPATION IN ONLINE HIGHER EDUCATION? A CASE STUDY ON A SWEDISH LEADERSHIP AND COACHING PROGRAMME

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Abstract

This paper investigates if and how students' former ICT experiences influence patterns of participation in online higher education. The empirical setting is an online Swedish leadership and coaching programme. Data was collected through questionnaires and log-files. In total, 17 students were followed up. Previous ICT experience from online education seems not influence on how often students use the Learning Management System. Patterns of participation seem not to be related to their previous ICT experiences. The result is discussed in relation to some theories of participation.

Introduction

In Sweden, online higher education has grown rapidly. Not only has the number of students attending higher education in an online mode increased dramatically but also how education is carried out has transformed. Online higher education has over the last years turned into a highly interactive experience characterised by an integration of concept like collaboration and community-building (Hrastinski, 2007), accompanied by the implementation of Web 2.0 (O'Reilly, 2005) and social software (Beldarrain, 2006). Such changes seem also to have nourished other educational requirements. Nowadays, students are supposed to participate actively, produce and perform not and not be passive receivers of distributed ready-made material.

Another trend that seems to be present in online higher education in Sweden is related to the groups of students attending higher educational programmes. Often, student groups are more heterogenic than in on-campus education. In addition, from sometimes quite different walks of life (Olofsson & Lindberg, 2007). Such circumstances together with a changed perspective of learning and participation, emphasising the social dimensions (see for example Bonk & King, 1998; Lindberg & Olofsson (in press); Salmon, 2000), makes Swedish online higher education buffeted with possibilities, constraints and challenges.

Parallel to this, an increased research focus on the issue of design for learning (Lockyer, Bennett, Agostinho, & Harper, 2008) has emerged. This might be described in terms of finding effective and productive ways to create educational environments supporting the students in order to enhance their learning processes. This issue can be considered to important also when it comes to online education (Haythornthwaite & Kazmer, 2002). Here, learning facilitating built-in functions in Learning Management Systems (LMS) seems to be central from a technological point of view. From a pedagogical or educational point of view, more collaborative learning orientated aspects of design, providing possibilities for online communities to be formed, appear to be on the agenda (compare Andersson, 2008).

This paper focuses on one aspect that, in various ways, often has been discussed in research literature aimed at online education — the aspect of students' former experiences in relation to participation in higher education (see for example Kirkwood, 2006; Kirkwood & Price, 2005; Stokes, Cannavina, & Cannavina, 2004; Söderström, 2004). Questions that have been asked here are, for example, if students' former experiences shape the way they enter the educational context, if it affects their understanding of learning, communication activities, and if it affects their level of success? Through an interpretative influenced approach this paper focuses on the research questions if, and how, students' former ICT-experiences influence patterns of participation in online higher education.

The empirical setting, understood as a case (see for example Stake, 1995), is a Swedish leadership and coaching programme. The programme is said to provide a deepened understanding of leadership and coaching within sports environments. It is provided online with a few face-to-face meetings a year and distributed through the LMS called Moodle.

Below, we provide three different understandings of the concept of participation, functioning as a theoretical framework for interpretation (compare Vattimo, 1997; Gadamer, 1989). Thereafter, both the empirical setting and method are presented. This is followed by a presentation of the empirical findings. The article continues with a discussion of the results, in relation to the theoretical understandings of the concept of participation.

Three Theoretical Understandings of the Concept of Participation

The possibility to understand patterns of participation related to students' former ICT experiences seems to depend on within which theoretical perspective the concept of participation is understood (Jaldemark, Lindberg, & Olofsson, 2005a).

In order to interpret and understand the empirical data presented in the article we follow Butler (1951). In line with Butler, we argue that by revealing each theoretical perspective's assumptions about the world together with possibilities to build knowledge of and in the world in a systematic way we will be able to also describe what implication those assumptions have when it comes to understanding participation within each perspective. A transparent approach, for which we argue, also opens up for critique of and discussion on the perspective's own assumptions. The framework that emerges is inspired by the work of Jaldemark, Lindberg and Olofsson (2005b). The perspectives chosen are understood as three of the most influential in higher education and are as follows:

- Behaviourism (Skinner, 1974; Thorndike, 1914; Watson, 1925)
- Cognitivism (Bruner, Goodnow, & Austin, 1956; Piaget & Inhelder, 1969; Shaw & Bransford, 1977)
- Socio-cultural theory (Luria, 1928; Vygotsky, 1962 & 1978; Wertsch, 1998).

The perspectives will help us to discuss in what way the students' former ICT experiences can be understood and we ask the question if the students' ICT experiences are mirrored in their pattern of participation, and if so, in what way? Below, each perspective's most central assumptions are debriefed, for a more in-depth description and discussion of each perspective the references above can be consulted.

Behaviourism

Within this perspective, the world is understood as being material and only what can be observed exists. The material orientated world-view also contains the understanding of the human being as biologically constituted. The human being works through the stimulus-response analogy. Further, the human being *is* his or her behaviour. Through the analogy, the human being learns what behaviour is appropriate in a certain situation and through his or her behaviour the human being expresses his or her knowledge.

Cognitivism

Cognitivism communicates a world view that means one, in material terms, existing world. It consists of qualities and features which the human being with his or her senses is able to acknowledge. Within this perspective it is argued that the human being, though, only has an indirect connection and thereby representation to and of the world. The world of humans is a constructed world. With that follows an understanding of knowledge as actively constructed by the use of concepts, categories and mental schemes. The humans' thinking and understanding is always challenged with new information and using cognitive strategies, he or she will develop higher order thinking skills.

Socio-cultural Theory

Central within this perspective is the human activity. The world is understood as material and in which the human is part of and always under influence of his or her historical, cultural and social context or position. The human understands the world through actions, that is, by interaction between human and world which is mediated by cultural tools. Knowledge is historical, cultural and situated. Knowledge is understood as emerging first in a social context with others then appropriated by the human being.

In Table 1, the most central notion within each perspective is illustrated with focus on the embodied understanding of the world and how to build knowledge in and of the world.

Table 1: Central aspects present within each of the three perspectives with reference to understanding of the world and knowledge building in and of the world.

	Behaviourism	Cognitivism	Socio-cultural theory
World	*Material*	*Material*	*Material*
Knowledge	*Stimulus-response*	*Construction*	*Situated*

In the next step, we will relate those aspects present above to the concept of participation. In specific, relate them to three different issues of participation. That is in relation to *focus*, *dependence* and *demand*. In Table 2 it is shown that within a behaviouristic perspective participation focuses on behaviour. Such behaviour can be changed through reinforcement, which results in the use of general repertoires of behaviour. Within a cognitive perspective, focus for participation is thinking. Participation can be changed through mind-challenging activities and the use of cognitive strategies. Finally, within the socio-cultural perspective focus for participation is placed in a social context and can be changed through the use of cultural tools.

Table 2: The concept of participation framed within behaviourism, cognitivism and socio-cultural perspectives.

Participation	Behaviourism	Cognitivism	Socio-cultural theory
Focus	*Behaviour*	*Thinking*	*Social context*
Participation depends on	*Reinforcement*	*Challenging thinking*	*Activity*
Participation requires	*General repertoires of behaviour*	*Cognitive strategies*	*Cultural tools*

In the next section, the empirical setting is shortly described and thereafter the method is presented.

The Empirical Setting

The empirical setting, a Swedish leadership and coaching programme, is in this paper understood as a case (Stake, 1995; Yin, 2003). The programme claimed to provide a deepened understanding of leadership and coaching within sports environments. The programme lasted for three and a half years and proceeded with a delayed pace. The programme included for example scientific disciplines like sports education, sports psychology and business administration. The educational setting facilitated for integration of theory and practice. In addition, it embodied asynchronous and synchronous digital resources for communication and collaboration independently of where the students were. The programme was provided online with a few face-to-face meetings a year and distributed through the LMS, Moodle, including for example e-mail, chat, forums and wikis. Furthermore, a video-conference system was used as a complement for communicational purposes. The course stretched over five weeks. The course activity was organized around eight different tasks that the students were required to solve. In five tasks, the students were urged to discuss and share their reflections with peer students.

Method

This study is influenced by Merriam (1998) and the characteristics of case studies, namely: it is particularistic, descriptive and heuristic. This study focuses on a single unit, it aims at producing a thick description and it aims at improving the readers' understanding by enabling other forms of understanding. According to Merriam, interpretations cannot be avoided in any research. Interpretations can be made about anything (as in the statement from Vattimo (1997), that all facts are interpretations) and we will argue that our interpretational influenced approach is possible to use vis-à-vis the sports and leadership programme reported on here. Stake (1995) claims that even though the interpretations of the researcher are likely to be emphasised more than the interpretations of those being studied, the aim is to preserve the different and contradictory views of what has happened. The three different perspectives on participation described above are on a theoretical and analytical level understood as providing possibilities to present such different views.

The findings presented are based on 17 students participating in the online leadership and coaching programme. Data was collected in relation to the first course given in the programme and this was done via two questionnaires and log data from the LMS. The first week of the programme data about their previous experiences with ICT and learning, motives for following the programme etc. were collected. At the end of the first course, an evaluation was carried out. The evaluation focused on, for instance, how the course was carried out and how they worked with the LMS. The log file data concentrated on the students' viewing and posting activities.

Findings

In this section, some of the main findings from the study are presented. First, some background data focusing on former educational and computer related experiences are presented and thereafter more specific data about participation in the programme.

The Student Group

The student group investigated consisted of 9 males and 8 females. Ten had former experiences of higher education and 6 had former experience of taking part in online higher education. Only 1 of the students did not use the computer on a weekly basis. When it came to former experiences of using tools for computer-based communication, 9 students labelled themselves as experienced or highly experienced in relation to communication via for example MSN. In relation to experiences of participating in online chat sessions, 6 students claimed that they were experienced or highly experienced. In addition, 4 students said that they were experienced or highly experienced when it comes to communicate online using video conference systems. Further 5 students stated that they were experienced or highly experienced in relation to participating in online community activities. In relation to using some kind of LMS only four students expressed that they were experienced or highly experienced.

Factors that seem to have been influential for the majority of students when it came to reasons taking part in the programme were to increase the personal competence within the knowledge area studied and to cultivate and facilitate their spare time. In addition, for half of the student group the goal of earning a university degree was an important driving force for participating in the programme. The possibility to discuss the programme content with peer students seems to be less important in relation to their participation in the programme. The programme mostly being carried out online and with significant flexibility built in seems to be of great importance for the students. Finally, all but one student expressed that they were highly motivated to participate in the programme.

The Students' Views of the First Course on the Programme

All students agreed on that the LMS used in the programme was simple or really simple to use. Almost half of the students said that the course encouraged dialogue between the participants and around one third of the students seemed to agree that the way the course has been organized demanded rather much communication between participants. Twelve of the participants put forth that the teachers actively encouraged dialogue between the students.

To continue, almost all of the students put forth that the tasks in the course were meaningful and that they created motivation. Almost half of the students said that the tasks strongly encouraged them to collaborate but only four students meant that they to a high degree experienced an online community feeling together with their peers on the course. In addition, over half of the total group of students expressed that they neither had felt a strong or weak online community feeling. About one third of the students said that they had not at all collaborated with their peers when solving the tasks included in the course. Almost half of the students said that their peers did not encourage online communication and collaboration. All students but two participated in the on-campus meeting and nine put forth that the meeting strongly contributed to enhancing and facilitating the online discussion through the LMS. Most of the students used the LMS on a daily basis or 2–3 times per week. The weekly frequency of using the LMS is shown in Table 3.

Table 3: The Students' Weekly Use of the LMS

Frequency	Students
Daily	11
2–3 times/week	4
One time/week	1
A couple of times/month	
Total	16

When it came to online activities, the students said that they foremost had read other students' and teachers' postings, watched streamed lectures and listened to the online course radio. Just a few, three-four students, estimated that they had asked questions and initiated discussions. The results in Table 4 below indicate that the students' foremost used the LMS as a forum for information and seldom for communication with teachers and student peers.

The log data collected from the course seem to point in the same direction. They seem, as shown in Table 5, to confirm that informative aspects dominated the 17 students' online activities in the programme.

Table 4: Online Activities Estimated by the Students

Activity	Low extent	Neither high versus low	High extent
Read other students' postings	2	4	11
Read teachers' postings	2	2	13
Answered teachers' questions	4	8	5
Asked questions to teachers	10	5	2
Asked questions to students	13	3	1
Chat about course content	9	4	4
Chat about other things	12	3	2
Commented students' postings	7	6	4
Watched lecturers	2	2	13
Listened to online course radio	1	3	13

Table 5: Log-file Data over the Students' Online Activities during the Course

Activity	Frequency variation
View specific discussion	22-269
View specific forum	14-542
Add new discussion thread	1-7
Add posting	3-12
Update posting	0-11

The Students' Previous ICT experiences and Patterns of Activity.
In this section, questions about what kind of ICT experiences the students had are summarized and those students claiming that they were experienced in for example videoconferencing and online communities have been compared with students claiming little experiences of such activities. The results indicate that students claiming to be being ICT experienced compared with students claiming low ICT experience did not show differences in their individual opinion whether or not the online communication had been productive, creating close ties between the participants. Table 6, though, shows a small tendency that students claiming sufficient ICT experience expressed that they used the LMS more on a daily basis than those claiming less ICT experience.

Table 6: Experienced Versus Non-experienced Users Weekly Use of the LMS

Frequency	Low experience	High experience
Daily	5	6
2-3 times/week	3	1
One time/week	1	-
Total	9	7

If relating this result with the log-files, see Table 7, students claiming less ICT experience seem to have been more active when it comes to viewing forums and specific discussions online, not the students claiming to be ICT experienced.

Table 7: Experienced Versus Non-experienced Students Viewing Forums and Discussions Online

Frequency (log data)	Low experience	High experience
View discussion <100	3	5
View discussion >101	6	3
View forum <100	3	6
View forum >101	6	2

According to the log-files, see Table 8, students claiming themselves to be more ICT experienced did not initiate discussions or post answers in the forums more often than those expressing less ICT experience. In addition, 5 out of 8 students in the group expressing themselves as ICT experienced put forth that they to a high degree discussed both course and non-course related issues compared to the group expressing less ICT experience. Only 1 out of 9 students in the less ICT experienced group expressed an opinion in line with the ICT experienced group.

Table 8: Experienced Versus Non-experienced Students in Relation to Postings and Initiating Discussions

Frequency (log data)	Low experience	High experience
Postings 0-6	4	4
Postings 7-12	5	4
Initiating disc. 0-3	4	5
Initiating disc. 4-7	5	3

Discussion and Concluding Remarks

If considering that online higher education in Sweden growing rapidly, attracting students from different walks of life and with various experience of using ICT, the results can be understood as promising. The results were nevertheless somewhat surprising. The students seem to foremost use the LMS as a forum for information, read teachers' and other students' postings and watch online lectures. Further, they seem seldom to communicate with teachers and peers. In fact, we might conclude that previous ICT experience from online education and online communication or interaction do not appear to substantially influence students' patterns of participation in the programme. Interestingly, the teachers, as well as the tasks in the course encouraged collaboration and dialogue. In addition, the LMS used had built-in functions like discussion forums and wikis. Nevertheless, this did not create patterns of participation in a significant way differencing between ICT experienced and less ICT experienced students.

If consulting the perspective of behaviourism, cognitivism and social-cultural theory and the way participation is understood respectively, it seems possible to understand the structure in the programme, the tasks including in the course and the built-in functions in the LMS as being in line with a socio-cultural perspective. Focusing on knowledge as produced in a social context, dependent on activity and providing cultural tools like wikis and chats for collaborative knowledge building. If drawing attention to both the ICT experienced and less ICT experienced students' pattern of participation there seems to be a possibility for at least a two-folded understanding. If understood within a behaviouristic framework, the students learned how to act, or behave, in order to solve the tasks. Further, that the information given by the teachers functioned as stimuli on which the students responded. The feedback provided via the functions in the LMS then worked as re-enforcement and developed certain repertoires of behaviour among the students. If understood within a cognitive based framework the programme seemed to provide tasks that challenged the participants thinking and made them develop cognitive strategies in order to pass the course. The built-in functions in the LMS offered support for such processes but the social dimension did not really come through.

To conclude we will once again emphasize that depending on which perspective used, the understanding of the pattern of participation will be different. In addition, it can be the case that the students reported on in this paper came into the programme with a specific and embodied understanding of learning. Something that might possibly also mirror their participation. If so, it seems not to be enough that the course structure and the LMS used reflected a social and active perspective on learning. Even careful design of the LMS and certain social orientated built-in functions might not solve such problems. Instead, to create a specific pattern of participation, whether or not the students are ICT experienced, might require online collaborative activities that shed light on what the teachers want from the students and why, on which theoretical ideas the design of the online course rests and why the use of certain social software can enhance and cultivate both individual and joint learning processes.

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THE IMPACT OF THE WEB CULTURE ON EDUCATION

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Abstract

With the progress of the web, many new solutions are also developed to allow every individual to be able to participate. The active ones see the need to create solutions that are free and accessible. Web 2.0 technologies and its contemporaries like Google and YouTube permit open collaboration and sharing, providing free and accessible solutions, the campaign of copying or retrieving, absorbing or reusing solution materials. This has now become part of the web culture. The web culture gives leverage to young people and students of enjoying more freedom, having so much resources and having a comfort zone. This leads to a more preferred reality compared to the imperfect physical reality. What are the implications of web culture now to education?

Web Trends

Web 2.0

The advent of Web 2.0 brought radical changes to the way programmers develop their solutions and applications; academics have befriended the web as a reliable haven of research and reference materials, students have become the topmost producer and consumer of new media and businesses have started making a leap again because of social networks.

Web 2.0 introduced many new working principles in the Internet — self-service approach, collaboration, participation, decentralization, collective intelligence, rich user experience, the expanded open source idea, reusable applications and peer to peer networks (O'Reilly, 2008). Tim O'Reilly, the Web 2.0 guru, must have imagined the leap web will do but not a triple leap with a somersault perhaps. It was originally thought of as a business model but has now moved to all types of industries.

It is a promising idea whether as a business model or a web framework. It gave hope to end the digital divide evident in many places and spaces. Wikipedia, for instance, the most popular information collaboration site, has 2,695,205 articles and 75,000 active contributors (Singer, 2009). Facebook, a late entrant in social networking, founded in 2004 has more than 200million active users and more than 660,000 developers and entrepreneurs (Facebook, 2009).

Free and Open Source Software

When the idea of the open source software gave birth in the early 80s through the efforts of Richard Stallman (Wheeler, 2003), the user support was very low because there were few experts in the field of software development, there were limited development, and application tools and users do not care much about the computing environment.

It is in this new millennium that free software, open source software, shareware and other related ways of using, sharing and reusing gained strong campaign. It is because primarily the web allowed small and big players have leverage in the web enabling the progress of the free and open source software. The model was adopted and given the availability of electronic solutions that free and open source software gained upper hand from being the marginalized entity in the computing industry. Examples will be Mozilla Firefox and Apache web server. From 2006 to the present, Mozilla Firefox is the most preferred browser (W3schools.com, 2009) and Apache has consistently been the preferred web server system since 1996 and was confirmed by the April 2007 survey (Netcraft, 2007).

The Free Software Foundation claims that Free software “is a matter of the users' freedom to run, copy, distribute, study, change and improve the software” and it can be enjoyed by the user if he enjoys certain freedom such as — “to run the program, for any purpose; to study how the program works, and adapt it to one’s needs; access to the source code is a precondition for this; to redistribute copies so you can help your neighbor; to improve the program, and release your improvements (and modified versions in general) to the public, so that the whole community benefits” (Free Software Foundation, 2007).

Creative Commons Licenses

Led by the group of Lawrence Lessig who believes that intellectual property and copyright are both restrictive and that copyright curtails creativity (Wikipedia, 2009), Lessig advocates “free culture” and started the Creative Commons Licenses.

Creative Commons released its first set of free, public licenses in 2002. One of the fundamental license issued is attribution, a license that allows others to distribute, reuse or build upon the original work as long as due credit is given to the original author or creation be it for a commercial or personal use. (Creative Commons, n.d.) “Creative Commons’ content pool has at least 40–60 million items attributed to the anti-copyright/pro-piracy attitude as a contributing factor for the growth of Creative Commons in some developed economies” (Cheliotis, 2007).

Google and YouTube

The Google as the most popular engine now (Sullivan, 2006) has become a virtual, universal query facility of knowledge and data of all web visitors. YouTube on the other hand has turned to become the virtual expression of those who do not have opinion; the audition hub of the unnoticed artists and non-artists; and the free, ubiquitous gallery of various media or video works. In 2008, 78.3 million videos were uploaded with an average of 150,000 videos uploaded per day (Wesch, 2008). Top three countries in terms of uploads were USA (34.5%), UK (6.9%) and the Philippines (3.9%) (Wesch, 2008).

Emanating Web Practices

The Web 2.0 technologies like the blogs, the RSS, the free software, the torrents, the rich new media like the videos, mp3, podcasts and online news gave hope to address the need for solutions and resources of students and teachers. The present technology tools allow easy transformation of knowledge from a codified to an explicit form (Pineda, 2008). Academic institutions are not tied anymore with the lack of development tools, renewal of software licensing, limited instructional materials and the dependency on the limited number of experts in their schools to teach the technology. Everything a student and a teacher would need becomes self-service, as upheld by Web 2.0.

Students' Practices

Students have become more digitally literate, can basically perform multi-tasking and are commonly computing multi-skilled. This means they can produce a video, a song or music or publish online anytime they wish. These students are the so-called "millennial learners", those born after 1982 that have wide exposure to interactive media and information and communication technologies. (Dieterle et al., 2006) All the development tools and software they need are available in the web including rich media. The students will search and retrieve the resources or they create and share their works in the web.

What Educators are Doing

With good intentions and the desire not to curtail learning, educators have sought various ways to allow transformation of students and ensure learning will take place. Instructional technology systems, ICT and web equipment, learning management systems, teacher ICT capacity building, creation of computer laboratories and placement of web and other wifi infrastructure are taking place everywhere. Education has continued to ascertain its role in the development of the student and to prepare him or her for a meaningful role in the society.

Paradigm Shift of the View of Reality

Aristotle's theory says that to comprehend reality it must be categorized as a substance, quality, condition, action, determined by time and space and its reason for being. (Freedictionary.com, 2009). And these characteristics of reality will be applied to physical reality as "there are real things, facts or real events" (Dictionary.com).

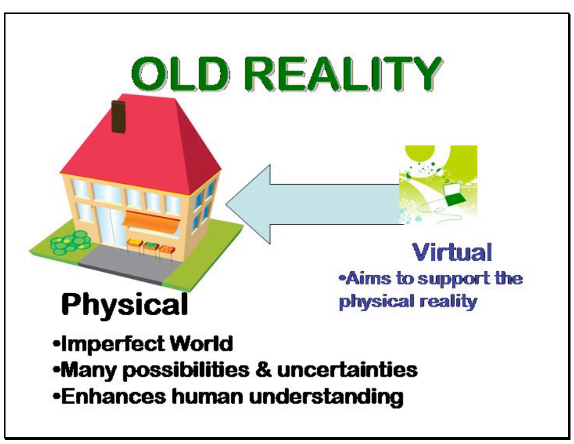
Physical reality may be resembled to a house. A person who needs to enter the house will have to knock first or will have to use a key to be able to enter the house. Inside the house there are places for specific activities- the bedroom, the kitchen, the living room or the dining room. And an individual who is inside the house takes a peek of what is outside through the window. It explains that there are certain ways to stay in the house. But at the same time, many things, even unexpected and unplanned events can happen inside the house.

Physical reality is also a very imperfect world with many uncertainties. It is the imperfect nature of the physical world that makes people explore or chart possibilities and enhance human understanding (Gardner, 1999).

Old Reality

Figure 1 illustrates the web being envisioned as a mechanism supporting the physical reality. The web became a virtual reality. "Virtual reality is best described as an illusion of reality created by a computer system" (Sharpened glossary, 2009). "Virtual means existing or resulting in essence or effect though not in actual fact, form, or name" (Sharpened glossary, 2009). And the web is aimed to support the physical reality in its goal to solve human problems and inefficiencies and to make the physical world a better place.

Figure 1: The Concept of Old Reality



Education played a major role to enhance better understanding of how to shape virtual reality and address distance barriers and communication. The web together with other technologies such as the e-mail, information systems, multimedia made a difference in the physical reality of human beings.

Present Reality

In this decade and the onset of the new millennium that a new revolution took place, the web revolution. The web revolution spun from the information age and made the world "flat" as Thomas Friedman phrased it. The "leveling of the playing field" takes place, small and big individuals have a chance to participate (Friedman, 2006). The web revolution became a very liberating take off point to so many ideas and technologies that everyone and every idea have to be connected in the web. There is e-learning, e-commerce, e-marketing, e-scriptures, e-governance, e-services, e-society and so on. Web revolution is one of humans' best accomplishments.

The web gave education a leverage to become more dynamic, more progressive and more encouraging. And with the group of Tim O'Reilly's introduction of Web 2.0 technologies (O'Reilly, 2008), the hope of bridging the issue of the digital divide have better chances. Collaboration and sharing in blogs and wikis empowered humans to contribute and participate to generate knowledge and information. The same principles of collaboration coupled by self-service ideas are also employed by torrents. As a member in a torrent shares something, she becomes a seed whereas if she gets only what she needs in most occasions, she is considered a leech (Kayne, 2009). It is a good model of participation. All of these led to creation, generation and distribution of web knowledge, information and resources.

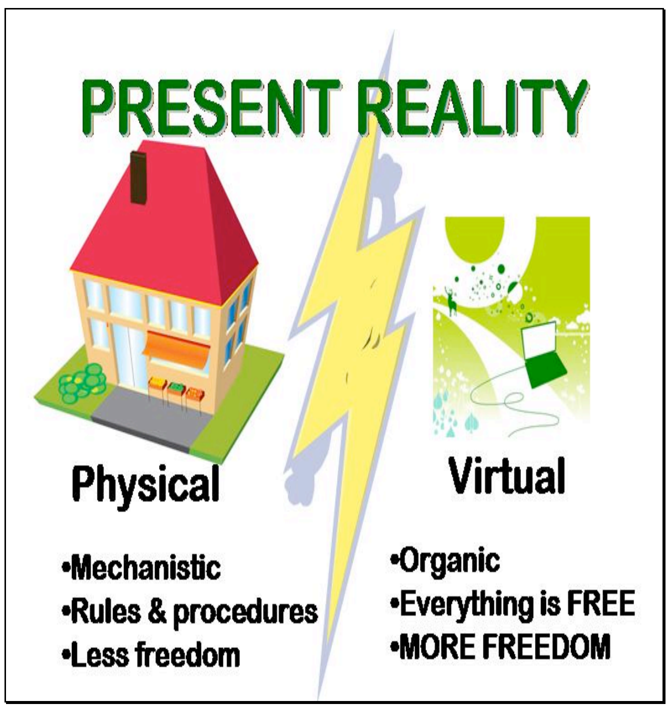
Table 1: Comparison of the Physical Reality and the Virtual Reality

Physical	Virtual
• Valued resources	• Free resources
• Old media	• New media
• Intellectual property/authorship	• Attribution/ Re-user & Re-creator
• Formal & leveled collaboration &/or cooperation	• Open collaboration, sharing & participation
• Accountability	• Little or no liability
• Creativity	• Lesser thinking & rethinking

Physical reality and virtual reality now coexists. In the virtual reality, there is abundance of free resources in the form of data, software, research materials, application tools and other information; new media resources like music, videos, podcasts and images; and other web services. In the physical reality, the similar resources are available for a price or good value. The old media are still very much limited to TV, news, and print.

Authorship and ownership of ideas are very much embraced in the physical world. On the other side, reuse, recreation and distribution of works are very common that practical attribution as recommended by Creative Commons has now become a de facto standard to many countries trying to protect and share their work especially for media files. Flickr for instance, a popular photo site claims to host 36 million Creative Commons' licensed photos and images (Cheliotis, 2007).

Figure 2: Physical Reality and Virtual Reality Coexists



The present reality now exhibits a more mechanistic world with less freedom and more rules and procedures (as shown in Figure 2). Virtual reality is having more freedom and everything is free — information, knowledge, self-service learning, new media and all the resources needed to learn and develop. Education becomes a facilitator of learning as learning becomes self-service.

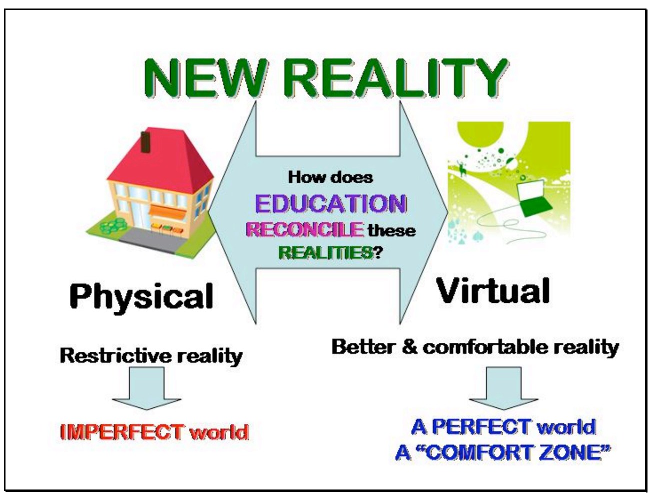
New Reality

We observe now two faces of reality — the physical and the virtual. It used to be just the physical reality. It may be perceived that the virtual reality is a deconstruction of the physical reality.

The present virtual reality experienced by everyone is very good. It is too good that it is becoming a better, comfortable and preferred reality for many people. This virtual world has become "a comfort zone" when just a few decades back, virtual world is just a pigment of film imagination.

Allan Kirby noted the Internet as a phenomenon of pseudo-modernism, where pseudo-modernism is an ideology that "makes the individual's action the necessary condition of the cultural product"; "a globalised market economics raised to the level of the sole and over-powering regulator of all social activity"(Kirby, 2006). And that "pseudo-modernism *takes the world away*, by creating a new weightless nowhere of silent autism" (Kirby, 2006). When Kirby made these statements he is referring to the web culture that is taking place now. And this pseudo-modernism state puts people in a trance that they are all swallowed by the web, a "comfort zone." (Refer to Figure 3.)

Figure 3: The New Reality



Issues faced by education. As virtual reality becomes an incidental deconstruction of the physical reality, education is now facing some issues. First, with physical and virtual realities coexisting what happens to people or young students when they view the virtual world as a better world, as a comfort zone and a preferred reality? A hypothetical case scenario like this can happen. College students and young, working people spending a minimum of four hours a day in the web where they engage in social networking, watching videos or news, or playing online games. First, online engagement is perceived to be physically safe and economical. Second, they do not have to be responsible by purchasing a newspaper, a music CD or video for personal consumption because they can get these items for free. And these are just some of the things that become the general opinion perpetuated by the comfortable “virtual reality”.

Second, how does education reconcile these physical and virtual as both physical and separate realities and not the virtual as an extension of the physical? And that the virtual is not an ideal simulation of the physical? Another hypothetical case scenario is this. A little boy is taught at home that lying and cheating are bad things and that he should always be honest. But when it comes to playing video games in the computer or the web, he can actually download quickly and for free a set of cheat codes for his games. Everyone is able to get hold of the cheat codes for free including his classmates. And no physical harm is done. Does this mean that it is alright to cheat and maybe lie virtually to get the cheat codes but not in the physical world?

Third, as these two realities coexist, how does education sustain enhancing humans’ capability to understand the world or these worlds, to address the problems of these realities independently? With the convenience of getting information in one’s fingertips, people and even young students are becoming less critical, less creative, less resourceful and maybe less responsible. Everything they need can be easily retrieved from the web. When they get the answers, will it be just a matter of selecting which reality should be addressed? And when they do not get the answers, will they know where and how to get the answers?

Scrutinizing the two realities. Emmanuel Levinas, a Lithuanian born with Jewish parents and who later became a French citizen, had made analysis of metaphysics as directed towards “elsewhere, the otherwise or the other.” He claimed that people are “entities living in a concrete world of experience but driven by the desire for the other” (Edgar & Sedgwick, 2002). People will have this metaphysical desire and satisfaction is derived from this desire. The metaphysical desire aims for “the other” and this other refers to goodness beyond anything that can complete it. The desire deepens and strives for goodness.

Driven by the great desire of the physical reality to solve its human problems and the desire for a more “free” world and the virtual reality becomes the “other.” The virtual reality is a metaphysical desire of the physical reality.

Figure 4: Illustration of Levinas' the Self and the Other

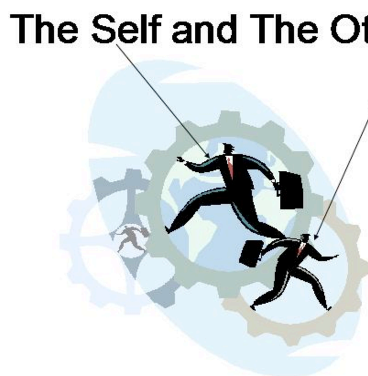


Figure 5: Another Illustration of Levinas' the Self and the Other

In Levinas' theory, to preserve the "other", the other cannot become an object of knowledge or experience within the totality of one's personal ego system. The person is "living from" which uses up the other in order to fulfill its own needs and desires (Robbins, 2000).

Conclusions

As this essay moves to its conclusions, the issues posted in the previous section will not be answered but a mindset will be used to guide educators in setting directions to address the issues.

The physical and the virtual realities are not two different entities. The virtual reality may be viewed as the desire state of the physical reality in the past. There might have been a subconscious, conscious or even an unconscious desire for such virtual state or condition.

The virtual reality becomes an object of knowledge or experience for the physical reality at some point. But that condition has progressed.

Such desired condition is different from the physical satisfaction experienced by most people like having a sumptuous dinner or a walk in the park. It is a "metaphysical desire" as Levinas would put it. (Edgar & Sedgwick, 2002) And the intention of this metaphysical desire is goodness.

So evidently, the human desires such as freedom, openness, sharing, social interactions, communication, ubiquity, and abundant resources are now present in the virtual world. All of these were made possible by technology, by the web and primarily, by the physical reality.

As the virtual reality now occupies space, it also enjoys freedom. But a relationship exists between the two. The physical is responsible to the virtual without mutual reciprocity. As the physical becomes responsible, it should benefit from the virtual as "a source of satisfaction and happiness" in Levinas' context. This means the benefits harnessed from the virtual world should address the inadequacies, the needs, the obstacles of the physical world. And these should result to the virtual becoming a source of euphoria, gratification, and content.

With this mindset, education will now be in a better disposition on how it should dispense its efforts and energies to guide the students, especially the young generation and the audacity to face the dynamism of web culture.

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ARE STUDENTS' ATTITUDES TOWARDS COLLABORATION MIRRORED IN ONLINE EDUCATION?

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Abstract

In this article, the aim is to explore the relation between students' attitudes towards collaboration and their actual online interaction. The article reports on a small case study based on a university course. Data was collected using a questionnaire and log file analysis. Seventeen students were studied. The students foremost use the LMS as a forum for information, for reading teachers' and other students' postings, and for watching streamed online lectures. The results show that students who perceive themselves as cooperative and group work oriented did not participate in higher extent than students with lower estimations of their group work orientation.

Introduction

In contemporary society, new flexible teaching methods have achieved prominence as a result of the increased digitalisation of education. For instance, Solimeno et al. (2008) suggests that the application of cooperative and collaborative teaching models in online education is related to new technologies that facilitate social interaction (Jaldemark, 2008). In relation to this technological progress, the field of learning and information and communication technology (ICT) is sustained by a related discourse about knowledge and learning. Participation, interaction and communication with other students are considered as a core factors for learning to take place (Säljö, 2001). Consequently, online education has changed from distributing information to communication between learners and between teachers and learners (e.g. Jaldemark, 2008; Solimeno, 2008; Williams et al., 2006). Collaborative learning strategies are also popular when designing educational settings since collaboration is considered to contribute to the sharing of arguments and opinions within a group, encouraging the kind of reflection that leads to a deeper learning of the subject (e.g., Head, 2003; Jonassen et al., 2003; Mörch & Dolonen, 2004).

However, previous research on online education shows that students differ in how much they participate in the online communication (Haythornthwaite et al., 2000; Olofsson, 2007; Olofsson & Lindberg, 2006; Svensson, 2002). Participation on the net is explained to depend of factors such as size of group, knowledge of other participants, student experience, clarity about task, ownership of task, need for and type of system and prior experience of CMC but also depending on personality based factors (Tolmie & Boyle, 2000). For instance, personality based factors that may prevent people to talk in face-to-face conversations partly disappear on the net (Stone, 1997). The absence of physical attributes can make it easier for less vocal students to communicate. Personality based factors could also be explained by Hrastinski's (2007) behavioural factors, which embrace student attitudes toward online participation.

In this paper, we focus on student attitudes to collaboration and how these are reflected in their online participation. Research show no unanimously results regarding if and how personality based factors affect online participation. Hrastinski (2007) stresses, for example, that there is no clear relationship between learning style and performance in online education. Similarly, Rovai (2003) claims, that there is no relationship between learning styles and online classroom communities. Contrary to these findings, Williams et al., 2006, show in their study that teamwork orientation is positively associated to student learning. Kanuka and Nocente (2003), on the other hand assert that it is necessary with further research to explore the relation between personality and the experience of online education.

This study highlights students' attitudes towards collaboration in educational settings and the online interaction patterns within a university course. In specific, we will concentrate on whether students that perceive themselves as cooperative and group work oriented also participate in higher extent than other students do.

Findings

The findings presented in this paper are based on a case study of 17 distance students in their first course of a leadership and coaching programme. Data was collected on three occasions and consisted of two questionnaires and course log data from the learning management system (Moodle). The first week of the programme a questionnaire collected data about, for instance, their previous experiences about ICT and learning, motives for following the programme, and also how they perceive themselves in relation to group work. At the end of the first course, an evaluation of the course was carried out among the students. The second questionnaire focused on, for instance, how the course was carried out and how they worked with the learning management system. The log file data concentrated on the students' viewing and posting activities during the course.

The course was managed with an open source learning management system (Moodle) and with delayed study pace. The educational setting was supposed to facilitate for integrating theory and practice together with peer students. The educational setting supported asynchronous and synchronous digital resources for communication and collaboration independently of where the students were. The course activity was organised around tasks where students in five of eight tasks were urged to discuss and share their reflections with peer students. The analysis of the students' opinions about their cooperativeness and online communication patterns is based on an index made from five questionnaire items (five graded scale):

- prefer to cooperate with others
- try to be active and participative in group work
- helping others developing their argument by discussions
- try to initiate discussions
- encourage others to participate in group work

Students who agreed highly on the five graded scale are regarded to have high cooperativeness. Nine students have high cooperativeness and 8 students were indexed as low based on their total score of these five items.

The Students

The students in the course consisted of 9 males and 8 females. Ten students had former experiences of higher education and 6 had former experience of being part of online higher education. When it came to former experience of using tools for computer-based communication in total 7 students can be regarded as experienced or highly experienced in relation to communication via for example MSN, desktop video conferencing, online chat sessions and participating in online community activities. A majority of the students' motives for participating in the coaching and leadership programme were to increase their personal competence, to cultivate and facilitate their spare time and to earning a university degree. The possibility to discuss the programme content with peer students seems to be less important in relation to their participation in the programme. Finally, it was estimated to be of great importance for the students that the programme mostly was carried out online and with significant flexibility.

Activity Patterns Online

All students agreed on that the LMS used in the programme was simple or really simple to use. Almost half of the students said that the course encouraged dialogue between the participants. One third of the students seemed to agree that the way the course has been organized demanded rather much communication between the participants. Twelve of the participants put forth that the teachers encouraged dialogue between the students.

The tasks in the course were regarded by almost all of the students to be meaningful and motivational. Almost half of the students said that the tasks strongly encouraged them to collaborate but only 4 out of 17 students meant that they to a high degree experienced an online community feeling together with their peers on the course. In addition, more than half of the total group of students expressed that they neither had felt a strong or weak online community feeling. About one third of the students said that they had not at all collaborated with their peers when solving the tasks included in the course. Almost half of the students said that their peers did not encourage online communication and collaboration. Most of the students used the LMS on a daily basis or two to three times a week. The weekly usage perceived by students is shown in Table 1 below.

Table 1: Perceived Weekly Usage of the LMS

Frequency	Students
Daily	11
2-3 times/week	4
One time/week	1
A couple of times/month	
Total	16

The students' estimates of what they had done in the LMS show that they foremost read other students' and teachers' postings, watched streamed lectures and listened to the course radio (Table 2.)

Table 2: Students' Estimations of Their Activity on the Net

Activity	Low extent	Neither high versus low	High extent
Read other students' postings	2	4	11
Read teachers' postings	2	2	13
Answered teachers' questions	4	8	5
Asked questions to teachers	10	5	2
Asked questions to students	13	3	1
Chatted about course content	9	4	4
Chatted about other things	12	3	2
Commented students' postings	7	6	4
Watched lectures	2	2	13
Listened to Internet course radio	1	3	13

The table illustrates that 3–4 students estimated that they had asked questions and initiated discussions. The dominant pattern is that students use the LMS as a forum for information and that they seem to rarely communicate with teachers and peers. Log data from the course confirms this picture. Table 3 below shows how the informative aspect dominates the 17 students' activities on the net.

Table 3 Log-file Data during the Course

Activity	Frequency variation
View specific discussion	22-269
View specific forum	14-542
Add new discussion thread	1-7
Add posting	3-12
Update posting	0-11

The patterns of the online activities reveal that the activity on the net foremost concerned viewing.

Cooperativeness and Online Activity Pattern

Table 4 shows that the students that perceive themselves as cooperative oriented do not use the online course platform more than other students.

Table 4: High and Low Cooperative Students' Weekly Usage of the LMS

Frequency	Low perceived cooperativeness	High perceived cooperativeness
Daily	6	5
2-3 times/week	1	3
One time/week	1	-
Total	8	8

Further, the results also show that there is no difference between high and low cooperative students' estimates of their activity on the net during the course (e.g. reading and posting activities or watching lectures). The only exception is that high cooperative students to a higher extent (5 out of 8) state that they chat about course content. This image of the online activity pattern is reinforced by viewing and posting activities from the log files.

Table 5: High and Low Cooperative Students' Viewing Frequency

Frequency (log data)	Low perceived cooperativeness	High perceived cooperativeness
View discussion <100	4	4
View discussion >101	5	4
View forum <100	5	4
View forum >101	4	4

Table 5 shows that viewing is more frequent than the posting activities (Table 6).

Table 6: High and Low Cooperative Students' Postings

Frequency (log data)	Low perceived cooperativeness	High perceived cooperativeness
Postings 0-6	3	5
Postings 7-12	6	3
Initiating disc. 0-3	3	6
Initiating disc. 4-7	6	2

However, Table 6 illustrates that the log data are contradictory. Table 6 shows that the students indexed as low cooperative oriented did more of the course postings and initiated more of the discussions.

Discussion

This study shows that there are not much discussions or peer exchange during the course. Furthermore, students who perceive themselves as cooperative and group work oriented did not participate in higher extent than students with lower estimations of their group work orientation. This conclusion both agrees with research on the relation between personality types and perceived satisfaction with web based instruction for professional development (Kanuka & Nocente, 2003), personality types and participation in networked learning environments (Ellis, 2003) and disagree with research that has shown that teamwork orientation is positively associated with student learning (Williams et al., 2006).

The overall results in this study show that students foremost use the LMS as a forum for information and they seldom communicate with teachers and peers. The overall pattern in this study makes clear that the reading activity is dominant. This could be interpreted in different ways. For instance, it might be as researchers claim, namely that students' face-to-face communicative competence must be augmented before full membership of an online educational course can be assured (e.g. Baym, 1998; Collins 2004). It is possible that the face–to-face communicative competence not necessarily leads to virtual communicative competence (Goffman, 1963). Feng et al. (2004) showed that "communication partners who talked in an empathic accurate and supportive way were most trusted by the participants" (p. 103). The fact that the students that perceived themselves as low cooperative oriented did most of the postings can be interpreted as signifying that there is no direct transfer from real to virtual.

Another possible interpretation of the results from this study is, as other studies also have shown, that participants can be looked upon as eavesdroppers not willing to put in the emotional energy to acquire and sustain the interaction in the online educational setting (e.g. Söderström et al., 2006). The motives for participating in the programme also show that the cooperative dimension, for instance, learning together with peer students is of low value. Instead individually related motives, such as to increase personal competence, to cultivate and facilitate spare time and to earn a university degree are in the forefront; perhaps reflecting an ego-related lifestyle (e.g. Beck & Beck–Gernsheim, 2002, p. 4). Other studies notify that topics related to socializing, may be a waste of time for the goal-directed students, which also could be the case here (e.g. Baym, 1998; Hrastinski, 2007). These motives can counteract any attempt to create communication. Campbell (1996) says about communication that "until there is mutual understanding of the action concerned, *successful interaction will not occur*" (p. 126). It is possible that students, in this phase of their education, have not yet learned to use the online learning environment to foster discussions about the course contents.

Finally, with respect to the small sample in the study, it can be concluded that other factors than their perceived group work orientation play a more important role for their participation in online education. A longitudinal study combining quantitative and qualitative data could enhance the understanding of how these factors operate in order to increase participation in online education.

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TOWARDS ACTIVE CITIZENSHIP USING ICT

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Abstract

The objective of this paper is to present the achieved results and the lessons learned from a Grundtvig II Learning Partnership entitled "Active Citizenship", that focus on the use of innovative application of ICT tools with the purpose to further active citizenship. We present the methodologies that we applied while teaching Informatics at the Second Chance School of Corfu, which evolved around three axes; active citizens are informed, open-minded and act locally while thinking globally. Our overall aim was not merely to teach our adult learners ICT skills, but to motivate them to embrace ICT as means to alter their daily attitude.

Introduction

The Second Chance Schools in Greece target to establish places where knowledge is produced through the direct and active involvement of learners in the learning process. They seek to cooperate with social organizations and follow pedagogical approaches that focus on the individual needs and interests of learners. Particular emphasis is placed on acquiring basic knowledge and skills in new technologies, while fostering social skills, which combined contribute to form an attitude of being an active citizen. To achieve these targets, the curriculum is flexible and allows teachers and learners to explore various social scenes where they can acquire knowledge (Ministry of Education - GSLL, 2008).

In the Second Chance School of Corfu we seek the involvement in various projects and partnerships in order to achieve the aforementioned objectives. Under these projects we apply teaching methods, which enable learners to participate in experiential activities, enabling observation, discussion, reflection and critical work in groups. One of the main objectives of these activities is to familiarise learners with the use and exploitation of new technologies and ICT tools; such use is not an end in itself and does not draw the attention on the ICT tools.

Our school following its policy to participate in various projects is the coordinator partner of the Grundtvig II Learning Partnership "Active Citizenship" that is carrying out under the umbrella of Lifelong Learning Programme (LLP) that has been established by the European Commission since 2007. LLP's priority is to reinforce the contribution of lifelong learning to active citizenship, intercultural dialogue and to support the development of innovative ICT-based content, pedagogical methods and practices.

In this paper we first present our partnership, whose main aim was to exchange experiences on methods for defining and promoting active citizenship and European awareness, and its objectives. We place emphasis on the specific objectives on which we focused at our school and how we achieved them through the innovative application and use of ICT tools. Next we present the applied methodologies and the exploited ICT tools, which evolved around three axes: active citizens are informed, open-minded and citizens that act locally while thinking globally. Our overall aim was not merely to teach our learners ICT skills, but to motivate them to embrace ICT as means to alter their daily attitude and to become active citizens. Finally we conclude by evaluating our experiences and reflecting on the lessons learned from the use of technology in education promoting active citizenship.

The “Active Citizenship” Partnership

Since the year 2000, the EU with the Grundtvig I action has offered a framework for European cooperation in the field of Lifelong Learning and Adult Education. The overarching priority of the Lifelong Learning Programme (LLP) has been to reinforce the contribution made by education and training to achieving the Lisbon goal of making the EU the most competitive knowledge-based economy, with sustainable economic development, more and better jobs, and greater social cohesion. Among the priorities of LLP have been the support of lifelong learning, the reinforcement of collaboration among parts of the education system and the support of the acquisition of key competences, such as ICT skills (European Commission – Directorate-General for Education and Culture, 2006).

The “Active Citizenship” Grundtvig II Learning Partnership was formed, among two Second Chance Schools in Greece and two Language Centres for foreigners in Sweden and Denmark, under the revised LLP umbrella in 2007, aiming to exchange experiences on methods for defining and promoting active citizenship constituents, such as cultural awareness and intercultural dialogue, environmental awareness, language and job training. Using collaborative methods and encouraging communication among educators and learners the partnership seeks to promote the exchange and dissemination of innovative practices in adult education and the development of new pedagogical methodologies through the use of ICT technologies and tools (Greek State Scholarships Foundation, 2006), (ACt, 2007).

Our partnership aims to develop new approaches and methods that will fight social exclusion and marginalization and at the same time will further intercultural awareness and dialogue; key component in this process is the strengthening of the learners' communication skills, thus we seek to promote their ability to acquire information and actively take part in social and cultural life and public debate using ICT tools. In order to achieve these, we have set a number of specific objectives, such as enabling intercultural dialogue and exchange of experiences between learners using ICT technologies, as well as strengthening their communication and presentation skills using ICT tools.

The profile of the Second Chance School of Corfu is that of a school for adult learners that have not finished compulsory education; the curriculum follows that of a typical high school, but particular emphasis is given on ICT skills. During this partnership we selected to work on strengthening learners' communication skills and ICT competencies, targeting to promote the notion of active citizenship. Following, we present a few definitions of active citizenship, how education for citizenship can be fulfilled, our perception for active citizenship and the methodologies that we applied.

Pursuing Active Citizenship by Learning ICT

According to the curriculum of our school the lesson of informatics is entitled "Computing Literacy" and targets to assist learners to become digitally literate. The scope of this lesson is fairly wide and open allowing us to adapt to learners' needs and capabilities. In the context of the "Active Citizenship" partnership we had the chance to teach ICT through an alternative perception; we did not merely teach learners ICT skills, but we motivated them to embrace ICT as means to alter their daily attitude and to become active citizens.

Active Citizenship in Adult Education

According to Cecchini (2003) learning for active citizenship means becoming aware of one's rights and responsibilities and developing the capability for participation in society. Schugurensky (2001) emphasises that adult education for active citizenship refers to the development of critical citizens who are not only able to participate in social life, but are also willing to.

An early classification on how to teach citizenship by Blyth (1984) identifies three forms: education about citizenship, which seeks to provide knowledge and understanding of history and structures of civil life; education through citizenship, which utilises active and participative experiences in the school and local community; and finally education for citizenship, which attempts to encompass the other two forms. Contemporary educational thinking stresses the need to enable the "education for citizenship" approach.

For the Council of Europe education for democratic citizenship should (i) equip people to play an active part in public life and to shape in a responsible way their own destiny and that of their society, (ii) aim to instil a culture of human rights which will ensure full respect for those rights and understanding of responsibilities that flow from them, and (iii) prepare people to live in a multicultural society and to deal with difference knowledgeably, sensibly, tolerantly and morally (Duerr et al., 2000). In order to achieve the aforementioned goals, education for active citizenship has to be a form of *literacy*, in order to develop knowledge, understanding and critical thinking, has to imply *action*, in order to be able and willing to use acquired knowledge and skills, and has to be based on *values*, like human rights, respect for diversity, responsibility. Learning for citizenship, therefore, includes cognitive (knowledge), pragmatic (action), and affective (values) aspects (Cecchini, 2003).

Based on the above we selected to evolve our work in this partnership around three axes. Active citizens are informed as they seek knowledge and critical awareness. They are open-minded as they respect values, like human rights, diversity, and they understand their culture, join to intercultural dialogue and can be members of multicultural societies. Finally they are citizens that act locally while thinking globally, as they develop skills and competencies of communication, participation and responsible action.

Our Foundation

The ICT tools and applications that we selected to exploit in order to educate learners for citizenship followed the three axes mentioned above and were based mainly on Selwyn (2003, 2007) and Duffy and Bruns (2006). Specifically according to Selwyn (2003) one of the applications of technology in teaching citizenship has always been the use of ICT as a source of citizenship information and as a means of taking part in citizenship discussion and debate. Selwyn (2003) also notes that the creation of learner-produced digital content that is tangible to the learners promotes both cultural awareness and intercultural dialogue. Moreover, Duffy and Bruns (2006) are in favour of the use of blogs and wikis as they favour dialogue and collaboration.

In the next sections we present the evolution of our work around the three axes and how we used ICT tools and applications aiming both to educate for citizenship and to digital literate our learners.

Active Citizens are Informed

The first axis around which our work evolved is strongly related to the cognitive aspect of learning for citizenship. Our main target was to contribute to the development of citizens who are well informed and are critically aware of the upcoming issues; our target was that learners would acquire the knowledge and self-awareness of becoming informed citizens. Informed citizens are the ones who have both the ability to find knowledge and information and to critically review and understand it.

Search Engines

According to Selwyn (2003) one of the applications of technology in teaching citizenship has always been the use of ICT as a source of citizenship information. As the World Wide Web, from here on called the Web, is probably the most important source of information we set as one of our targets to provide learners with the ability to seek information in the Web. In order to achieve our goal we set off by assisting learners to learn how to use major search engines, like Google, in order to seek information. We emphasised that they should cross examine their results, compare different angles of view on the given topic and rate the authenticity of their sources — e.g. a government agency versus a forum.

Blogs

We did not merely focus on the search engines and their use, though, but we also tried to exploit various online media, like blogs, encyclopaedias, etc. Through the creation of blogs we taught learners a skill and a way of expression that has become very popular with the advent of Web 2.0, but also we wanted learners to become aware of the process and accountability of publishing on a medium that is open to the public and to discussion. Particularly important was the fact that blogs technology favours dialogue (Duffy & Bruns, 2006), a citizenship virtue that we wanted to promote, based on written text, a medium that learners had not been accustomed to exploit. This is in line with the remark that Selwyn (2003) makes that the application of ICT is also identified as a means of taking part in citizenship discussion and debate, primarily through the development of ICT simulations of social situations with the aim of stimulating discussion amongst learners.

Wikis

The next step for active citizens, after the collection and examination of knowledge and the discussion that leads to conclusions, is to disseminate the result; for this the use of a wiki was selected. As Duffy and Bruns (2006) point out wikis can be used for students to add summaries of their thoughts, building collaborative results, especially due to the ability they offer to students to edit and comment on the content directly. Our work on the use of wikis was actually a three step process, beginning with studying wikis already in use, most notably Wikipedia (el.wikipedia.org), following with getting acquainted with structure and syntax of wiki software (MediaWiki), and finally by truly exploiting a wiki in order to publicise their opinions.

During the first step, our specific goals included not only getting to know Wikipedia and identifying it as a useful source of information, but also to understand that there are various user roles and to realise the open character that this brings along. Having realised that they could contribute to enrich the content of a wiki, learners became acquainted with the wiki language, they started contributing their content, they took on the role of checking the content for soundness, and they organised their content using links among logical concepts. Finally, in the third step, they could plan and organise a special purpose wiki working collaboratively and actively participate to a community.

Active Citizens are Open-Minded

The second axis around which our work evolved is strongly related to the affective aspect of learning for citizenship. We wanted learners to respect values, like human rights and diversity, to understand their culture, to join intercultural dialogue and be able to be members of multicultural societies.

Country Portfolios

In this axe we started by involving learners in the collaborative creation of a country's portfolio using ICT technologies like the Web and presentation software. The points that they wanted to focus were decided using brainstorming, the workload was then divided and altogether they produced a portfolio that reflected their perception of their country and culture. The portfolios that were created among all partner institutions were exchanged, compared and discussed.

Recipes Booklets

Next, having already had an initial communication among the institutions' learners, we used a common celebration date, the Christmas period, that reflects the local culture and at the same time the existence of similar traditions throughout Europe shows that this is an intercultural tradition. In order to help learners identify the cultural similarities among countries we involved them in an unofficial intercultural dialogue by asking them to prepare and exchange a small booklet of local Christmas recipes and traditions.

During this project learners exploited simple tools, like a word processor, a scanner and a simple image processing tool in order to prepare their recipes, and they had to collaborate in order to put together all the material that they produced. To take part in an intercultural dialogue with the other partnership institutions the booklets had to be translated in a common language; for this they initially used online translation tools, like Google translate, realised their limitations and worked on refining the result. The exchange of booklets spurred intercultural dialogue through the comparison of customs and the identification of similarities and differences.

Both the country portfolios and the recipes booklets have been especially appropriate for the application of ICT in the classroom (Selwyn, 2003) as they allowed the creation of learner-produced digital content that was tangible to the learners and promoted cultural awareness and intercultural dialogue. So far the content that the learners had created can be characterised as cultural products which did not focus on citizenship; that was our next target.

Producing a Video of a Theatrical Play

In cooperation with the arts class learners produced a theatrical play; specifically they selected the ancient comedy “Lysistrata” of Aristophanes that embraces various virtues of active citizenship. The story of “Lysistrata” speaks out about virtues like peace and women rights; it shows that people can even stop a war if they organise themselves and act as a team for the common benefit and it also addresses the contribution of women to society and policy making.

From the ICT point of view our target was to disseminate this play among all partnership institutions. Learners initially recorded the play using digital video-cameras and experienced the procedure of transferring material between electronic devices. Then they had the opportunity to create their own video in order to produce a DVD for the theatrical play; they used video and audio editing tools. As the main aim was to disseminate this DVD it was critical to be subtitled; so they translated the text and wrote subtitles for the DVD using the software developed by the Learning via Subtitling (LeViS) project (Papadakis & Papadimitriou, 2008).

Active Citizens Act Locally and Think Globally

The final axis around which our work evolved is strongly related to the pragmatic aspect of learning for citizenship. Our target was to encourage learners to take up action on issues that are important on their local community but at the same time have a greater significance that goes beyond the local perspective. For this we assisted them in participating in the discussion of controversial public issues by publishing their positions online, contacting local authorities and requesting official responses.

Contacting the Local Authorities

In order to initiate a discussion on a burning issue of the local community, the management of wastes, we presented learners a documentary on the mismanagement of electronic waste entitled “Digital Cemeteries” (Exandas, 2007). A discussion followed around what happens in the local community that led to deciding to contact the local authorities. Initially, learners were divided in small groups and each group attempted to collect relevant information from local municipalities via personal contact. When this failed, mainly due to lack of knowledge concerning this issue from the municipalities, they collaborated in order to officially contact them via e-mail and to demand information; the progress of this attempt was also published on the school website as a means to provoke reaction from the officials.

The outcome of this process was that learners realised that when they act as a united group they can achieve positive results and cannot be ignored. Although initially the local authorities did not respond to a citizen’s request, when this became a public demand they had to respond responsibly; some municipalities even requested our learners assistance and cooperation in raising awareness on this issue among public.

Creating a Leaflet on Recycling

The issue of waste management and recycling was a burning issue for the municipality that hosted our school. As a result of the previous action, the mayor accepted our learners’ proposal to support and fund the production of a leaflet on recycling. Learners used tools like the Web, word processor and image editing in order to design their leaflet. Particular effort was given to produce a professional looking result since this would be printed and handed out to citizens of the whole municipality; this was a strong motive to come up with an elegant result that would inspire citizens to follow this paradigm.

Since this was a leaflet on recycling and reduction of waste, learners proposed that it should be handed out in a manner that it would not end up to be just more garbage. For this they organised a campaign that they personally handed out the leaflets, encouraging recipients to study them, discuss on the issue and hand out more leaflets responsibly. This whole procedure helped them develop skills of participation and responsible action and also stimulated interest in engaging effectively in democratic processes of decision-making in their own communities (Selwyn, 2007).

Teaching Strategy

The learning procedure that we followed was dictated by the fact that our learners were adults, thus they wish to participate in the learning process and we should strive to structure it based on their experiences, perceptions and previous knowledge (Jarvis, 2004). We wished to develop a learning environment where we, as teachers, were not regarded as 'the fount of all knowledge', but instead knowledge and skills flourished through collaborative activities in a learning engagement among teachers and learners. Furthermore, we had to accept that there was a significant diversity in educational biographies and background of our learners, thus they should be encouraged to learn at their own pace, and possibly select the activities they would be involved more. Thus the activities that we designed in order to teach ICT skills built on the experiential learning approach (Kolb & Fry, 1975), which according to Rogers (1969) also has a quality of personal involvement and is self-initiated.

Regarding the values and attitudes relevant to being an active citizen that we wanted our learners to develop, the approach that we followed was in line with the transformative learning theory of Mezirow. According to Mezirow (1977, 1981, 2000) everyone has constructions of reality which are dependent on his socio-cultural world. These constructions of reality "perspectives" are transformed when they are in disjunction with an individual's new experience. The result of such a situation is the individual's reflection upon the experience, the transformation of his perspective and the plot of new strategy of living. The activities that we designed and applied aimed to face our learners with situations where they should reflect upon their perspectives, critical assess them and explore new ways of acting, thus transforming themselves from citizens to active citizens.

Teaching Methods

Our goal was twofold: to teach ICT skills and to develop an active citizen attitude. Therefore among the teaching methods that we selected some favored more the former cause and others the latter. We used various teacher-centred methods; the demonstration was suitable in order to introduce and present a new tool when teaching ICT skills, whereas the guided discussion was preferable whenever citizenship issues came up. Additionally we exploited student-centred group methods; brainstorming and debate were particularly suitable to teach citizenship but we adapted them by conducting the learners' dialogue via the blogs and the wiki thus we managed to exploit them to teach also ICT skills. For the most demanding activities we selected to follow the project teaching method, where learners worked in groups, they learn by doing and they could use the results in a practical manner.

Learning goals and objectives. According to Cecchini (2003) learning for citizenship includes cognitive (knowledge), pragmatic (action), and affective (values) aspects; the three axes around which we evolved our work attempted to address all the aforementioned aspects. One can identify the relevance between these aspects and the three domains of educational objectives that Bloom (1956) identifies; cognitive, affective and psychomotor. As Bloom proposes we attempted to follow a holistic form of education by setting goals relevant to the knowledge that our learners would acquire the skills they would develop and the attitudes they would embrace.

Table 1 lists the most representative learning objectives relevant to teaching ICT, based on Bloom's taxonomy. More specific learning objectives have been set for each learning activity; a more detailed description can be found on (Ringas & Christopoulou, 2009). Additionally, a number of learning objectives relevant to citizenship were set. Among them the most notable belong to the Affective domain. We encouraged our learners to adopt debate and discussion on their everyday lives, practice the use of new means of expression and become able to defend, adopt or drop opinions on citizenship. They were assisted to realise their culture and its values and to embrace an open attitude towards other cultures. They were motivated to engage in organising a campaign in their local community aiming to encourage others to become active citizenship and to press the authorities to take action.

Table 1: Selected ICT Learning Objectives

Cognitive (Knowledge)	**Psychomotor** (Skills)	**Affective** (Attitudes)
To acquaint with common ICT tools; like word processor, presentation software and image, audio and video processing tools To comprehend the structure of the Internet and the need for search engines To be aware that Web 2.0 content is rich but may not be credible To define multimedia applications and identify their components To comprehend the advantages of digital content, especially its ability to transfer it among devices	To practice typing and editing of texts To search and collect information from the Internet To publish content on the web via blogs and wikis To communicate via e-mail To digitise content and transfer it among devices To edit images, audio, video and to create multimedia applications	To embrace online resources as a means of information To become aware of the process and accountability of publishing on an open medium To participate in a group and to work collaboratively To adopt common ICT tools as a means to create complex products To adopt ICT tools in order to communicate and exchange opinions

Lessons Learned and Empirical Data

In retrospect, the involvement in this Grundtvig learning partnership has been fruitful and has offered us the opportunity to explore innovative methodologies of teaching ICT. In this section we discuss the experiences we gained and present the learning outcome based on the aforementioned goals. In general most of our activities were successful, especially due to learners' enthusiasm and involvement in both studying ICT and working on active citizenship. Our major finding is that the activities which were product oriented and were implemented as projects produced better learning outcomes. We reckon that a reason for this result is that such activities have a tangible goal that can be identified by learners and can be better assessed and evaluated.

Specifically during the activities on blogs and wikis we found out that learners feel more comfortable to publish their opinions and comment on them when they have already worked on a topic and are familiar with its various aspects. Learners did not face any difficulties publishing on the Web using blogs or wikis, however they did not become accustomed to writing on blogs as a daily routine; they exploited this medium only when significant issues emerged and discussion arose. On the other hand wikis had a different result; as soon as we solved an initial hesitation due to uncertainty on their writing skills by installing a plugin for language spell checking, learners were willing to use them and a community was formed.

The product-oriented activities, i.e. country portfolios, recipes booklets and leaflet on recycling, although they required more ICT skills, they were more successful possibly because their target was tangible and more conceivable. Learners felt more up to designing and creating the products that were meant to be exchanged among the partners; whereas when designing the leaflet that was for public use they asked for more assistance and guidance. Particularly in the case of the DVD for the theatrical play the required technical skills were more demanding and thus fewer were interested to be involved. It should be noted that although learners were acquainted with forms of multimedia content editing, like image and audio processing, they faced difficulties when they had to combine all these and use a more advanced video editing tool.

We believe that most of the learning objectives related to ICT which we had set were achieved. Regarding the goals on active citizenship, the objective to enable our learners to access and assess information has been clearly successful as well as the ones related to communication, discussion, acceptance of diversity, etc. Most important of all was the fact that learners were indeed involved in organising a campaign for a public issue and they motivated both local authorities and public.

Concluding we would like to note that the involvement in such programs allows for the adoption of innovative approaches that are desirable when teaching ICT as otherwise the lesson can be trivial focusing on the mere demonstration of ICT tools. Through such learning processes learners can change their attitudes towards ICT and adopt them to their everyday lives.

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WHOSE SPACE IS IT ANYWAY? AN EXPLORATORY STUDY OF STUDENTS' USE OF MYSPACE.COM FOR EDUCATIONAL PURPOSES

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Abstract

The immense popularity and voluminous usage of social networking tools and sites such as MySpace.com have not gone unnoticed by educators who wish to use such spaces for purposes of education. But it is not known if these networking sites are currently being used for educational purposes. Data for the study consisted of five 505 comments posted in the public or unprotected areas of 50 college-age users of MySpace.com. The study found that students rarely used the comment space for educational interactions. Only 4.75% or 1 out of every 20 of the messages was related to education.

Introduction

The "ARPANET," which has grown to become what we know as the "Internet," was first demonstrated in 1972 (Leiner et al., 1997). The still widely used communication tool known as "e-mail" also had its beginnings in the year 1972 (Segaller, 1998). The development of Internet and e-mail allowed many researchers and computer savvy professionals in geographically dispersed laboratories and universities to communicate and collaborate with each other. However, the general population was largely excluded from such capabilities until personal computers that could be connected to the Internet invaded households and the World Wide Web gained popularity among citizens of developed countries. The World Wide Web or the "Web" was born in 1990 (Berners-Lee, 1999). It was Berners-Lee (1999) who developed the "hypertext transfer protocol" which led to the birth of the World Wide Web. The Web emerged as a very popular tool a few short years after it became a reality and now millions of people use it everyday for various purposes, communicating and networking with each other constituting a sizeable part of such Web usage.

The Emergence of Web 2.0

According to McLean, Richards, and Wardman (2007),

> The term Web 2.0 does not refer to new technical standards, but to new ways of using the Internet as a platform for interactive applications. A distinguishing characteristic of Web 2.0 is the concept of online social networking — the use of Internet technologies to create value through mass user participation (p. 174).

Web-based services and resources such as MySpace.com provide storage space and interactive features on the Web for users to establish a presence and communicate and network with others. Educators have in the past adopted many emerging and established technological tools with the hope that such technologies will somehow transform education and improve student learning. It is therefore not surprising that educators now consider MySpace.com and other similar communications and networking services and technologies as having the potential for improving the education of modern youngsters enrolled in schools and colleges. For example, according to Andrews (2007),

> Some schools ban social networks for wasting classroom time or to protect students from weirdoes. But, as part of a wider trend toward less top-down teaching, other institutions are putting tools like MySpace, Bebo and Facebook on the curriculum — and teachers are saying: "Thanks for the add."

Purpose of the Study

Web 2.0 and social software are being increasingly viewed as having the potential to transform educational practices (Brown & Adler, 2008; Owen et al., 2006). MySpace is a Web 2.0 technology that offers communications and networking capabilities to its users. However, the extent to which college-aged students who already have MySpace.com accounts use them for educational purposes is not known. The reason for this is simple: little research has been conducted in this area. The purpose of this study is to explore if, how, and how much, students use their MySpace.com areas for educational purposes. Differences, if any, between males and females in their educational usage of MySpace.com will also be explored.

If the study shows that college-age students are already using social networking areas for educational conversations, then universities can enter these spaces with the confidence that, students will not hesitate using the spaces to pursue formal educational opportunities. If the study shows that students use social networking spaces to communicate little about formal education, then universities may have a tougher time trying to get students to use these spaces for educational interactions.

Background Information about MySpace.com

MySpace.com is a popular service on the Web that allows those who create an account, space or carve out a niche for themselves in cyberspace and use such a space to establish their presence and to network and communicate with others who have also created their own niches. As of December 2008, millions of people, including college students have a presence on MySpace.com. Within each person's private space, and within the common spaces that account holders share with others, users have a few options for communicating with each other. This study will focus on how college students use the publicly viewable comment area to interact with each other.

Methods

Sample and Data Collection

Twenty-five male and 25 females were selected randomly from a list of college-aged MySpace.com account holders. These 50 males and females constituted the sample for this exploratory study. The specific criteria used to select the sample of subjects included the following:

- users be in the 18–22 age range
- users be currently enrolled as a student in a college or university (listed within the MySpace.com accounts under Details)
- users be White Caucasian (listed within each myspace.com account under-Details).
- purpose for establishing accounts was for networking and friends (education is not one of the purposes for which people can establish MySpace.com accounts.)
- accounts were created by users living within the United States
- users are single rather than those who are either married or are in a relationship were selected for the study.

As Table 1 shows, the sample of subjects were distributed among seven interest areas of "video games," "sports," "Internet," "movies," "fun with friends," "shopping," and "read." These interest areas are selected by users when they create an account for themselves on MySpace.com. At the time the data was collected, there was no interest area labeled "Education."

Table 1: General Interests of Selected MySpace.com Users by Sex (n = 50)

Interest Area	Male	Female	Total
Video games	4 (80%)	1 (20%)	5
Sports	8 (53.33%)	7 (46.66%)	15
Internet	1 (50%)	1 (50%)	2
Movies	7 (58.33%)	4 (41.66%)	11
Fun with friends	1 (14.29%)	6 (85.74%)	7
Shopping	0 (0%)	4 (100%)	4
Read	4 (80%)	2 (20%)	6
Total	25	25	50

The messages posted in the 50 randomly selected MySpace.com account areas during spring 2008 that were publicly available, constituted the data for this study. As shown in Table 2, a total of 505 comments were posted in the publicly available comment areas during the data collection period.

Data Analysis

The comments posted by students in the selected MySpace.com areas were analyzed using qualitative techniques suggested by Bogdan and Biklen (2007). A total of 15 categories, including the category of ‘education’ emerged as a result of such analysis. The fifteen categories are shown in Table 2.

Descriptions for each of the 15 categories are provided in Table 3. Examples of comments posted by students are also provided in the table. The comments made by students that were categorized as ‘education’ comments are reproduced in Table 4.

Table 2: Comments Made by Friends of Selected Myspace.com Users by Sex

Category	Male	Female	Total*
Greetings	82 (51.57%)	77 (48.43%)	159 (31.49%)
Holiday Wishes	15 (45.45%)	18 (54.55%)	33 (6.53%)
Birthday Wishes	9 (34.62%)	17 (65.38%)	26 (5.15%)
Workout	6 (100.00%)	0 (0.00%)	6 (1.19%)
Thank you	13 (59.09%)	9 (40.91%)	22 (4.36%)
Visit a Website	10 (71.43%)	4 (28.57%)	14 (2.77%)
Hangout plans	43 (42.16%)	59 (57.84%)	102 (20.20%)
Sports	9 (81.82%)	2 (18.19%)	11 (2.18%)
Summer Plans	6 (60.00%)	4 (0.00%)	10 (1.98%)
Hobbies/Interests	9 (47.37%)	10 (52.63%)	19 (3.76%)
Job	17 (54.84%)	14 (45.16%)	31 (6.14%)
Reading	0 (0.00%)	2 (100.00%)	2 (0.40%)
Education	7 (29.17%)	17 (70.83%)	24 (4.75%)
Gossip	16 (34.78%)	30 (65.22%)	46 (9.11%)
Total	242	263	505

* percentages add to 100% going across

Table 3: Descriptions of the Derived Categories and a Sample Comment for Each Category

Category	Meaning	Sample Comment
Greetings	A friendly hello/hi/how are you	Hello, Hey man, whaz up?
Holiday Wishes	Wishing happiness during holidays	Happy Easter, Happy New Year, Happy Valentine's Day
Birthday Wishes	Wishing happiness for birthday	HAPPY 21ST BIRTHDAY!!!!
Workout	going to gym/exercise	Are you going to the gym tomorrow?? Let's meet tomorrow and w
Thank you	expression of gratitude	Thanks, Thank you
Visit a Website	ask friend to log onto a specific website to view for entertainment purposes	http://profile.myspace.com/index.cfm?fuseaction=user.viewprofile
Hang out plans	get together, visit a place	What are you doing tonight? Wanna hang out?
Sports	playing/watching sports	And italy is out of da euro cup!!!!!!!!! LETS GO GERANY!!

Summer Plans	Plans during the summer	Goin be at the beach all summer long!
Hobbies/Interest	activities or interest for pleasure	Goin shoppin tomorrow
Job	employment/work	Well yeah i have been working for a commercial company
Reading	reading for pleasure	The series is great. I'm reading Eclipse.
Education	comments about classes, courses, homework, studying	see table 3
Gossip	talk or rumor about a the personal affair of others	Did that chic take all your money and drop you off like a cheap dat scank!

Table 4: Education Related Comments made by Males and Females

Male	Female
1) Just say Hi!!! Do you like science?	1) I have a LARGE math test today at 4 and I need to teach myself everything about the course so far until then...so after that I shall give you a call!
2) hey you, yeah i know i haven't been around school at all, im actually in poland right now, i don't think i'll be going to st fransis anymore something crazy came up, but anyway we're gonna get those islanders next time LETS GO RANGERS :)	2) School is alright so far, most of my classes are fine, im not liking macroeonomics too much but o well.
3) yeah.....i actually cant wait for class to start back up again, i had to drop my classes because of work about half way through the semester....	3) Hahaha yea it has. Well I am at Rutgers now and so forth. Got a job as Rutgers EMS, going for a degree in Biotechnology and a minor in Religion and Biochem.
4) but i was spending so much time there that i wasnt spending enough time doinh homework lol. and i'm bummed cause i loved Anthro.sooooooooo much!	4) Sooo ill meet you at school at 8 k..haha and illl wake up on time this time i promise
5) alright call me soon just not when im in school	5) hey hey....wuts ups girl?? I finally picked my class, now you should take me and show me around the school cuz i got no clue where anything is :)
6) im at my scholarship thing	6)i knowww!! so hows colllege??
7)yea dude ive been good yea mang anytime you wanna chill!! im still in school but i get out really erlly!!	7) not working much..interning twice a week so its nice.
	8) sleeping in and hanging by the pool till class starts, in my slip on shoes.
	9)how studying?
	10) I know!! I'm just working and getting ready to start school again!!
	11) wats up with you? Gah we don't get to talk much since we don't have spanish together anymore. oo well ur lucky u don't have spanish...grr... anyways lots of love
	12)Hey ho-bag! lol Yea i think i will, lol i still don't know if i got detention or not, hmmmmm hope not grrrr
	13) yea i am going to school. i'm still

	doing that internship through the U of A at the Al-Marah arabian stables. i think i told you that once. hey are you going to the sabino musical this week?
	14) Eh summer class at Pima West for Trig. Just found out from people that m instructor is the worse teacher ever and I'm starting to feel the pain from him. Oh man I hope I don't get destroyed in this class :(
	15) And r u coming back to school next semester?
	16) Hey girl. Just stoppin through to show you some love. When are you coming to see me? I graduate next weekend.
	17) no there going to pay for lander, thank god i don't have that kind of money, lol yea well lander got the best what i'm trying to major in, so that did it for me. yep how bout u?? u still going to coastal?

Findings and Discussion

MySpace.com users did talk about education. However, such talk mostly focused on non-content related aspects of education. For example a student may have mentioned how difficult a particular class was, but did not go into details regarding the content taught in the course. Only 24 (4.75%) of the total number of 505 comments posted were related to education. Of the 24 total education comments posted, 7 (29.17%) were posted by males and 17 (70.83%) were comments posted by females.

The numbers of comments posted in the ‘greetings’ category far exceeded educational comments. Comments that were categorized as ‘gossip’ considerably exceeded those that were considered to be ‘educational’ in nature. Comments posted that were categorized as ‘reading’ were the lowest, with only two comments (0.40%), out of the total of 505 comments. Both comments related to reading were posted by females

In spite of educators’ enthusiasm about the potential that Web 2.0 and social software technologies have to offer education, students in this study do not seem to be using a popular site as MySpace.com for educational purposes. Students seem to be using their MySpace.com spaces for social and other non-educational networking purposes.

Our suggestions for further research include using larger samples of subjects. Further studies should also be conducted to determine how students use the password protected portions of their MySpace.com accounts. It will perhaps be hard to conduct such a study since not many students may be willing to grant access to protected areas of their MySpace.com accounts. However, it is worth trying.

Conclusion

In the physical world, there are places designated as universities and people are aware that these are the locations that they need to go to, in order to further their education. There are also places where people go to socialize, such as restaurants, movie theaters, clubs, parks and other areas used primarily for face-to-face socialization. Educators have not tried to invade these places to try and educate the people who frequent them. Imagine a university trying to offer a class in a bar or a club where the music is blaring loudly and people are imbibing alcoholic drinks and dancing.

Should educators try to invade social networking sites in cyber space and start using it for educational purposes even though these sites were not established solely for purposes of education? If large numbers of educational institutions start invading such spaces, will students develop and move away to other, more secure and less accessible cyber areas they can use for social networking purposes, without having to worry about educators trying to invade such spaces?

There are number of educators and educational institutions currently using Web 2.0 tools and technologies to offer virtual coursework to students. However, as Hoare (2007) states, results from ". . . the Learner Experience Project, has just revealed, amazingly, that students want to be left alone. Their message to the trendy academics is: "Get out of MySpace!" Hence the question and the title of this paper "Whose space is this anyway?" We would like to conclude by saying that since the use of Web 2.0 technologies for educational purposes is still in its infancy, much research is needed before educators can make informed policy decisions regarding the use of such technologies for purposes of educating future generations of students.

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ICT-INTEGRATION IN LEARNING ORGANISATIONS: POTENTIALS OF THE 'INTERMEDIATE SPACE' FOR VIRTUAL LEARNING ENVIRONMENTS

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Abstract

This paper explores the concept of 'intermediate space' as a method of understanding the role of learning spaces in the development of technology enhanced educational organisations. Sesink (2002) refers to the English psychoanalyst and paediatrician D. W. Winnicott (1971) and describes intermediate space as a transitional object or phenomena: the potential space, the area of joint cultural experience for learners where personal knowledge, development and social interaction promote a learners' initiative and individual learning. To facilitate such constructivist processes requires an encouraging and protected space — one which promotes active, individual and reflective knowledge construction (Jonassen, 1991). An understanding of the role of 'intermediate space' in educational organisations in both virtual and 'real' architectures can encourage the development of process-related media competences, e.g. the ability for self-organised learning.

Intermediate Room

With the concept of the intermediate space Sesink (2002) refers to the English psychoanalyst and paediatrician D. W. Winnicott (1971) who describes the intermediate area as a space which exists neither only in the imagination nor only in the physical reality. For Winnicott this third area facilitates the experimental meeting of individual imaginations and the real existing world. As an example, he refers to a child submerged in itself whilst playing, operating with real objects which are converted in the service of the child's creative imagination for other purposes; thus the child successively develops trust in its own creativity. For Winnicott, to create space for such an encounter, it requires both protection from external disturbances and room for individual knowledge construction through social interaction. A metaphorical use of the concept of space could be seen as relevant in pedagogical considerations in higher education: giving the learner space in order to facilitate the development of self-determination, autonomy and participation. For Klafki (1996) the goal is to provide breathing space for growth, independence and self-organisation of the learner. The metaphor of space is also regularly applied to the period of learning: the learner is to be given a space (of time) for learning; time, where one is relieved of other responsibilities, and can concentrate on one's personal learning process without distractions. Social interaction forms around an accepted abstraction of presence in communities based on both synchronous and asynchronous communication.

There is an ongoing debate as to what the terms space and place (Wahlstedt et al. 2008; Whitworth 2008) and presence (Tu 2000) mean when considering virtual learning environments. The construct of intermediate space has value within this debate as a method of conceptualising educational environments; such a construct has the potential to provide a framework within which emerging issues of space, place, presence and particularly the learner as a socially situated individual, can be considered. Rather than focusing on the technological attributes of a virtual environment or the organizational and political issues related to the design of such environments (though these issues are of importance), intermediate space allows for a detailed analysis of the many facets, drivers and influences of a given educational environment, thus leading to a more holistic approach to learning environments and the learner as a social being. It can be argued that understanding the changing nature of educational environments and the role of space for learner's self-organisation allows teaching staff to be more successful in encouraging learner interactions, connections and exploration of individual potentials and boundaries. Additionally, a deeper understanding of such spaces enables the organisation to consider how the architecture of learning environments can be constructed and developed in a form that encourages connectivity, community and self-organisation. This paper considers whether the nature of interaction within a particular attribute of virtual educational spaces i.e. asynchronous discussion boards, can be considered to be within an intermediate space in Winnicott's sense. To explore this, the paper focuses on the effect of virtual seminars on the self-organisation of student groups.

Methods

A comparative analysis of interaction within face-to-face and online learning environments was used to explore this area. The analysis used data from within a postgraduate Research Methods module in the school of Nursing, Midwifery and Social Work at The University of Manchester. Data was collected from two cohorts of students; in the first year there were three face-to-face tutorial group and two online seminar groups. Thirteen audio recordings of face-to-face seminars were made and all of the discussion boards were compiled and downloaded. In the second year there were three face-to-face and three online groups (analytic focus was placed on the online interaction so only the data from the online groups was retrieved). In addition, interviews were carried out with representative samples from both years of students, and quantitative data was obtained using WebStats software, which outlined the patterns of online interaction. All students and staff involved in the project gave full written consent and where exposed to the same instructions and learning resources. The analysis explores the ways in which topics are negotiated in online discussion environments by concentrating on one of the distinctive characteristics of face-to-face educational dialogue; namely, ‘introductory discussions’. The analysis here uses Sacks’s concept of false-firsts (Sacks 2000) to describe the ways in which preliminary issues are dealt with in face-to-face seminars, and proceeds to examine how these occur in online environments. It is demonstrated that this distinctive feature of traditional learning forums is negotiated in very different ways in online learning environments and that the nature of a virtual learning environment promotes a more direct and self-organised engagement with the subject matter.

A central impetus for the following discussion comes from observations of two key characteristics of face to face seminars: firstly, the dialogue in these traditional discussion environments is negotiated — the order, length, and frequency of the conversational turns of participants are negotiated *in situ* by the participants with reference to normative organisational practices (i.e. the intersubjective sense of how discussions ought to proceed in the context of the power relations, institutional politics, personality types and individual discussion preferences that constitute the peculiarities of particular discussion environment). It has been shown that one of the characteristics of the negotiated feature of this talk is that the topics under discussion are in constant flux, changing as each member of the discussion brings their own interpretation and discussion agenda to bear on the turn and topic negotiation process (Campbell et al., 2008).

Secondly, and related to this, particular organisational practices are often used by tutors to place formal restrictions on dialogue practices which place boundaries on when specific topics can be discussed. One common practice is to demarcate certain sections of talk that are used to deal with organisational matters — such as homework, passing on information, the absences of participants, or course organisation — thus leaving clear sections of dialogue that can be used to pursue the designated educational issues (Stokoe, 2000). The pragmatic feature of this practice is to limit the amounts of interruption to the talk. The ability to make such impositions arises through inter-subjective orientation to mutually recognisable appropriate actions; status positions or power positions confer the right or mandate to define the limits of discussions, but they only do so because people treat them as doing so by acting towards them in an appropriate manner.

In concentrating to organisational issues, we intend to draw a distinction between practical educational matters (such as the setting of homework, dealing with queries, chatting about work practices) and actual discussions of educational materials. It must be noted from the outset that to make clear distinctions between organisational and educational issues can be problematic as the two are both inexorably intertwined (Yonge & Stables, 1998) and contextually contingent (Stokoe, 2000). It should be recognised therefore that within seminar discussions, the status of particular issues as either relevant, academic, practical or whatever is a matter of interactive negotiation within the particular seminar in which a wide range of factors will play a part — including the culture of teaching within the institution and the power relations of the seminar.

Face-to-Face Seminar Dialogue and False First Topics

The term false-first has been used in Conversation Analysis to describe discrete sections of talk that precede topic relevant discussion sections. These false-firsts segments function as normative procedural approaches to coming round to particular context relevant talk (Sacks, 2000). Stokoe uses the term in relation to discourse within face-to-face university seminars to describe the opening sections of talk within face-to-face seminars in which peripheral issues are discussed. She suggests that within seminar dialogue participants often engage in such preliminary talk in order to deal with organisational issue such as discussing homework, passing on information, the absences of participants, or organising the session. An example of this kind of discussion is provided in Figure 1 in which a tutor from one of the face-to-face seminars negotiates with students over who is going to chair the seminar.

Figure 1: Face to Face Dialogue

1 (S1) Ri:ght. (.) Oh Ka:y (.) Who's chair toda:y?

2 Pause (5.5)

3 (T) You were and I took over last week [dint I]

3 (S2) [I
know]hah[ahaha]hahahahaha

4 (T) (Laughin) [Sorry] hahahahn 5
hnhnhnhn

6 Pause (2.5)

7 (T) I'll let you av another go hnhnhnhahahahahahahahaha

8 (S2) [oh chears] hmhm

9 Pause (1.5)

10 (S2) Well I'll star:t then

11 (T) Go on.

Some of the false-first topics that are dealt with in face-to-face seminars arise specifically because the seminar *is* face to face. For example, reporting on the presence or absence of students within a specific class is necessary because of the accountability of all parties to be present within the seminar at the specified time. Such an issue may be less likely to arise online because participants co-operate in the seminar at different times and places. However, other topics that usually function as false-first type issues may be potentially generic: discussions about how to organise activities or informal talk about the experience of doing work (how hard or difficult certain activities have been) constitute interactional work which, while perhaps not representing the key function of traditional seminars, nonetheless may be regarded as forming an important aspect of virtual discussion environments. Due to the flexibility asynchronous settings provide, learners attending online groups need to use other strategies to integrate (and bind) fellow group members. These could be coordinating the collaborative work or preliminary talk which is not dealing with organisational matters but rather provides social bindings; such strategies contribute to the coherence of the group and individual participants' motivation (Zentgraf et al., 2006). Such hypothesising illustrates that there are outstanding questions about the differences between the organisational relevancies within the two learning environments.

Examining the Dialogue in Postings

As we have seen, in face-to-face seminars topic relevant discussions are often postponed until certain business at hand matters have been dealt with. By looking at the preliminary postings within discussion boards we can gain a sense of whether a similar approach is used in online discussions. The data from the second year of the course demonstrate that, with very few exceptions, students' immediately engaged with work tasks with no preliminary remarks at all (only 6 out of 113 preliminary postings did not adhere to this pattern). Within the preliminary postings that did deal with other issues there were three issues that were raised. The first is demonstrated in Figure 2 where a student used the beginning part of the posting to voice concern about the process of participating in online discussions ("am I doing this right?") and to solicit for comments on the work ("constructive criticism most welcome!"). The contingent issue here then is how to use discussion boards appropriately. Although it was raised at other places within the discussion, this issue was not raised by any other student as a preliminary topic.

Figure 2: Am I Doing This Right?

> C12qual
>
> am I doing this right? I'm feeling a bit unsure and
>
> all at sea with this at the moment - constructive criticism
>
> most welcome! Exercise 1.2 – the theoretical perspectives adopted in the

A second issue to be raised in the preliminary postings is shown in Figures 2 and 3

Figure 3: Hard Work

> e12quant
>
> Phew!! That was hard work! I'm again very tentative about
> much of this. I'm not sure if I've understood/applied the
> terms correctly.

Finally, Figures 3, 4 and 5 show students talking about being the first to post to the board.

Figure 3: Beaten You All

c13qual Guess I've beaten you all to this one. I think this has been discussed in a round about way through the previous two activities but here is a little more to deal with some of the finer points - I hope! (…)

Figure 4: Friday Night

c41qual Hi all, I know this is really sad to post things on a Friday evening when I should be out enjoying myself in other pursuits other than academic!!! However, I'm not sure when I'll be able to post some of these activites in the next week to I'll be 'sad' for tonight!!!

Figure 5: First to Post

c51qual Hi everybody. I felt a sense of relief when I got to this stage of the programme but now I find myself posting first to this topic with feelings of anxiety because there seems to be a lot of stuff to take into account, which I'm not sure I fully understand - Well, here goes

These preliminary postings demonstrate that, in the case of these tutorials, there were no organisational issues that needed to be dealt with to prevent students from proceeding with the tasks at hand. Although there were subsidiary topics that were addressed by preliminary postings, these were not contingent matters, were not exclusively confined to preliminary postings, and concerned in the main emotions i.e. relief, anxiety etc. It could be argued that members of the seminar groups brought their personalities to bear through expression of emotion and individual perception however raising such matters in these postings did not prohibit the discussion of the prescribed topic of the seminar. In all of the above cases the students were able to integrate this subsidiary matter into their engagement with the set work.

Where tutors' posts occupied a preliminary position within a discussion board, they used their opening remarks to outline the purpose of the discussion board by providing instructions for the methods of participation. Where they occurred then, tutors postings in preliminary positions dealt with basic organisational issues of the seminar in a similar way to how opening dialogue might in face-to-face seminars. However, because of the pre-specification of this information (all instructions were part of the online unit within the VLE), even these comments were actually unnecessary to the progression of topic relevant discussions within the seminar.

Frequencies of Opening Postings

Each of the three groups in the second year of the course involved a far greater instance of preliminary postings by the students than by the tutors (Table 1). For example, only 3 of the 46 preliminary posts from group B came from a tutor. These figures demonstrate the minimal extent to which tutor were involved in acting as mediators of student discussions.

Table 1: Initial Postings in Year Two

Group	Number of Initial Postings	Number of Initial Postings by a tutor	Number of initial Postings by a student
A	39	1	38
B	46	3	43
C	28	3	25
All Groups	113	7	106

However, within the first year of the course, one of the groups displayed a discernibly different pattern of usage. In this group one of the tutors played a dominant role throughout the seminars, and provided nearly two thirds of all of the preliminary postings of the group (Table 2).

Table 2: Initial Postings in Year One

Group	Number of Initial Postings	Number of Initial Postings by a tutor	Number of initial Postings by a student
A	33	20	13
B	34	4	30
Both Groups	67	24	43

There is an increasingly popular view within the education community that creating independent learners who can function with minimal dependence on tutors is to be regarded as a key goal within pedagogic practice (Mezirow, 1983). This analysis displays the potentially facilitating nature of online asynchronous discussion boards as environments in which work can be self organized by students, and tasks addressed immediately by students, without engaging in preliminary discussions about other business, and in which there is no need for negotiations from tutors to make this come about. The analysis implies that asynchronous discussion forums may be particularly appropriate environments to pursue constructivist objectives.

The point then is not that there is necessarily one clear discernable pattern of organisation within virtual seminars, but merely that such learning environments can display patterns of organisation which are distinct from those generally found in traditional face-to-face learning environments. To the extent that online discussion groups entail integration of group-binding talk in immediate participation from students without preliminary tutor direction or instruction within the discussion group, asynchronous discussion environments appear to provide more autonomy and space for learner's self-organisation. Preliminary directions from the tutor are not dominating learner's interactions, they exist as part of the deliberate design of the online programme, which, in Winnicott's terms, could be seen as the good enough environment. Therefore from this analysis, online discussion environments can be said to provide an intermediate space where students can, independent of the tutor and the physical environment, engage as a group in the educational experience at hand.

Conclusion

Winnicott's intermediate space is a facilitating environment for self-organised learning processes. The intermediate space is a transitional phenomenon, which depends upon individuals' experiences in connecting and separating inner world and outer reality. Thus the intermediate space provides breathing space or free space for individual growth, creativity, autonomy and self-organisation of the learner. In the online discussions that are the focus of this paper, the virtual environment facilitates students' immediate engagement and exploration of the subject matter to hand. The postponing effect of preliminary talk experienced in face to face seminars is significantly reduced, whilst (social binding) emotional issues are integrated into posts on educational matters. This could be interpreted in the following way: online collaboration per se is more effective than face to face interaction, because the technical architecture focuses social interaction in an educational setting. Good enough (not perfect, but adequate) virtual environments create space for learner's autonomy, enable self-organisation, facilitate social interactions which accompany the discussion of educational materials and can reduce reliance on tutors as organisers or leaders. If social interaction is embedded within educational matters, this provides continued motivation and creates social bindings whereby learners are encouraged to communicate and reflect on the educational experience at hand as human beings with social needs. This encounter with both individual and object worlds (here: set work, fellow group members and the virtual environment) could be described as an intermediate space, a space, 'where cultural experience is located' (Winnicott, 1971, p. 118) and where online socialisation, information exchange and knowledge construction (Salmon, 2000), rather than being stages of interaction are formed reciprocal.

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THE WIKI FACTOR: HOW STUDENTS LEARN TO LOVE GROUP WORK

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Abstract

We explore the use of social software to enhance online collaboration of undergraduate students in higher education. This was implemented within Leapfrog Biology, an intensive 4-week online program developed for students who have not completed year 12 biology and who are entering first year medical studies. We used wikis to facilitate both the process and the product of collaboration. We consider the educational design of the online environment, the underlying pedagogy and student activity, and the ways in which the design influences student satisfaction, motivation and learning outcomes.

Introduction

The Internet was spawned by the desire of people (computer programmers) to communicate via computer. Software for e-mail, discussion boards, groupware and the like allowed users to interact and communicate online. However, it took the development of Web 2.0 technologies (O'Reilly, 2005), which enabled users to modify content online, for online collaboration to move towards a new definition for group work. Web 2.0 or 'social software', so called because of its facility for communication, interaction and activity, gives power in online collaboration directly to members of social groupings without the need for intermediary technical experts (Shirky, 2008).

In designing a biology bridging course we wanted students to have opportunities to collaborate. The social software of wikis provided a mechanism for students who were unable to meet face to face to engage in group project work, with a structure and a place to get to know each other and to work together online. Thus issues of collaborative skills, peer learning, and information and communication technology (ICT) skills as well as biology content were included in learning outcomes.

Background

At Monash University (Australia) medicine is offered as an undergraduate course; however, over 50% of students entering the course in first year have not completed biology as it is not a prerequisite. These students are at a disadvantage when they start medical studies and report feeling confused by terminology and concepts. In 2006 we implemented, for this group of students, an online biology bridging course called “Leapfrog Biology” so-called in reference to the popular beach game of leapfrog with the idea of getting over a hurdle. Leapfrog Biology was not compulsory but students who had not taken year 12 Biology were strongly advised to enrol. The content of the course is based on the Victorian year 12 curriculum. A pedagogy based on active learning was incorporated through student engagement in authentic activities (Honebein et al., 1993) to provide real-life contexts in relation to medical science.

The scheduling was dictated by the timing of student acceptance of offers four weeks prior to the start of first semester. At this time students are committed to employment and vacation activities, with many interstate and overseas students; and are unable to attend the campus. The course is run online to accommodate the circumstances of students.

Student Collaborative Learning

Collaborative group work provides a powerful context for student learning in higher education within a social constructivist paradigm, which based on ideas of Vygosky (1978), describes learning as a social process. The success of collaborative group work for learning is highly dependent on the context in which it is implemented (Bower & Richards, 2006). Collaborative group work based on a ‘community of practice’ provides an environment where a group of students engage in shared activity around a domain of knowledge (Wenger, 2002). Students communicate and work together on an activity designed to facilitate their construction of meaning and understanding around the domain of knowledge. In addition to their value for learning, proficiencies in communication and collaboration are life skills often included in statements of attributes of graduates in higher education (Barrie, 2004).

Implementing collaborative learning presents challenges, the most significant of which is that of student perception. Students often dislike group work which does not recognise different levels of contributions from individuals (Falchikov, 2005; Gatfield, 1999). Studies of attitudes of first year students to group work revealed an acceptance of its value for learning but concern and dissatisfaction over the issue of ‘passengers’, students who made little contribution but benefited from the work of the group (Bourner et al., 2001). Self- and peer assessment schemes have been used to address this issue with varying success. These schemes rely on student reporting on their contributions and those of other students in their group. As this reporting is subjective, Li (2001) used a 'normalisation factor' to account for bias and concluded that while well received by students, it was useful only as a reference for staff in distributing group marks. In considering self and peer assessment as a core attribute for professionals Raban and Litchfield (2007) devised an online scheme for such assessment. They questioned its value in assessing individual contributions but concluded that it was useful in terms of group dynamics and learning outcomes.

A further challenge is one of scheduling. Engaging undergraduate students in collaborative learning has become increasingly difficult due to large class and timetabling issues which limit opportunities for face-to-face interactions in small groups. The increasing familiarity with online communication and the use of social software provided opportunities for our course.

Social Software and Collaborative Learning

In discussing social software for learning Leslie and Landon (2008) describe characteristics which make it especially suited to online learning. In addition to its social aspect, these characteristics include the degree to which it taps into the user's motivation; helps build authentic online identity and authentic learning experiences; builds networks of affinity and the emergence of connected knowledge; and encourages peer production and review. These characteristics relate closely to those of a community of practice translated to the online environment. Hoadley and Kilner (2005) offer a model termed C4P where elements of content, conversation, connections, and (information) context respond to purpose of a community of practice. They link this with a distributed cognition framework drawing on the advantages of online technologies of representation, process and social context. Dron (2007) explores social software in education in terms of a shifting balance of control towards students.

In the higher education context the social software of wikis has been used in writing assignments and in group projects where students collate information (Parker & Chao, 2007). Students create a knowledge repository akin to arguably the most extensive wiki, Wikipedia (www.wikipedia.org). These applications draw on the value of online editing enabling production of a body of work. But a wiki is much more than a repository, a body of work, a product. Unlike other forms of group work the wiki itself contains a record of the collaborative process. It holds a record of discussion between group members as well as a record of its evolution. Shirky (2008) describes this aspect as stigmergic in nature drawing an analogy to the pattern ants leave from which the term is derived. By incorporating communication between students as an integral part of their activity the wiki reveals a more collaborative environment. The recording of collaborative process as well as product makes individual contributions to collaborative work transparent and brings a new level of validity to assessment. We have used wikis which record and preserve edit histories and discussions, to observe and assess contributions of individuals and assess the process as well as the product in online collaborative student projects. We have successfully used this approach in different contexts within interactive case-based programs for medical and biomedical students (Brack et al., 2007).

From studies of collaborative group work with postgraduate students Elgort et al. (2008) concluded that while students and teachers viewed wikis as a valuable way to collaborate, it is not the 'tool' itself that promotes collaboration. This echoes conclusions across the range of technologies used in education that the design of the environment and the context are the key to successful learning.

The prevalence of social software suggested that students would be familiar with and proficient in its use. Prensky (2001) views Generation Y as the "net generation" describing them as "digital natives." However, Kennedy, et al. (2008) found that first year medical students varied considerably in their use and preference for technologies. Thus scaffolding to support students with a wide range of information and communication technology (ICT) skills is needed.

Educational Design

Leapfrog Biology is an intensive 4-week online program which incorporates individual self-directed learning material and activities and collaborative online projects. The individual program was implemented through the university Learning Management System (LMS). Learning was scaffolded in an open structure designed to encourage higher order thinking. Learning materials were offered in three modules based on themes aligned with those of first-year medical studies: The Cellular Basis of Life; Human Genetics; and Infection, Disease and Immunity. For each module there were 14 to 20 activities (including multimedia, quizzes), complementary text and a self-assessment quiz. Collaborative group work included a debate and a competition between groups called "the Nobel Factor." Students commenced by engaging in a debate on the topic of Stem cells. Each group used the social software functionality of wikis to create a site exploring Nobel Prize winning discoveries in stem-cell research relating to the topics of the modules. The wiki facilitated networking and peer learning via discussion and enabled students to produce and refine a body of work through progressive editing.

A private wiki was set up for each group in 'Wikispaces' (www.wikispaces.com). Wikispaces was chosen because of its simplicity in terms of management, ease of use, rapidly responding 'helpdesk' and availability of private spaces. Students controlled membership of their wikis and could open them for all to read (i.e., make them public) at the end of the project. Editing was easy to master and discussion spaces were threaded. Wikis becoming available in existing LMSs offer an advantage of incorporation with other learning materials and functions but their identification tends to be with the course rather than the group owners.

From 2006 to 2008 the course was introduced and run completely online. Early online chat sessions supported students in setting up their wikis. In a 'Getting started' section students were introduced to the course, our role and expectations and given guidance in working in groups. In 2009 a two-hour face-to-face orientation session was introduced to brief students on expectations of the course, its resources and support.

Evaluation

In 2009 an extensive evaluation of student perceptions of several aspects of the course, was conducted by survey. In particular the survey analysed how students collaborated online and explored how the technology contributed to motivation, group dynamics and identity, and facilitated development of students' collaborative and problem solving skills. Analysis of page histories and discussion contributions provided evidence of how groups worked to create communities of practice.

Results

In 2009 there were 132 students enrolled in Leapfrog Biology. Informal survey indicated that no students had experience editing wikis, although they had used Wikipedia as a source of information. Most students accessed the course from their place of residence via broadband connection. A high proportion of students (42%) responded to the online evaluation survey, far above the average response of 25%.

Despite the non-compulsory nature of the course more than 60% of enrolled students substantively participated in the debate discussion and engaged in wiki (Table 1); 68% of students who signed up for wikis engaged with them. Reasons given for lack of engagement in group activities ranged from lack of Internet access over the period of the course to lack of time.

Table 1: Participation in Social Software Opportunities

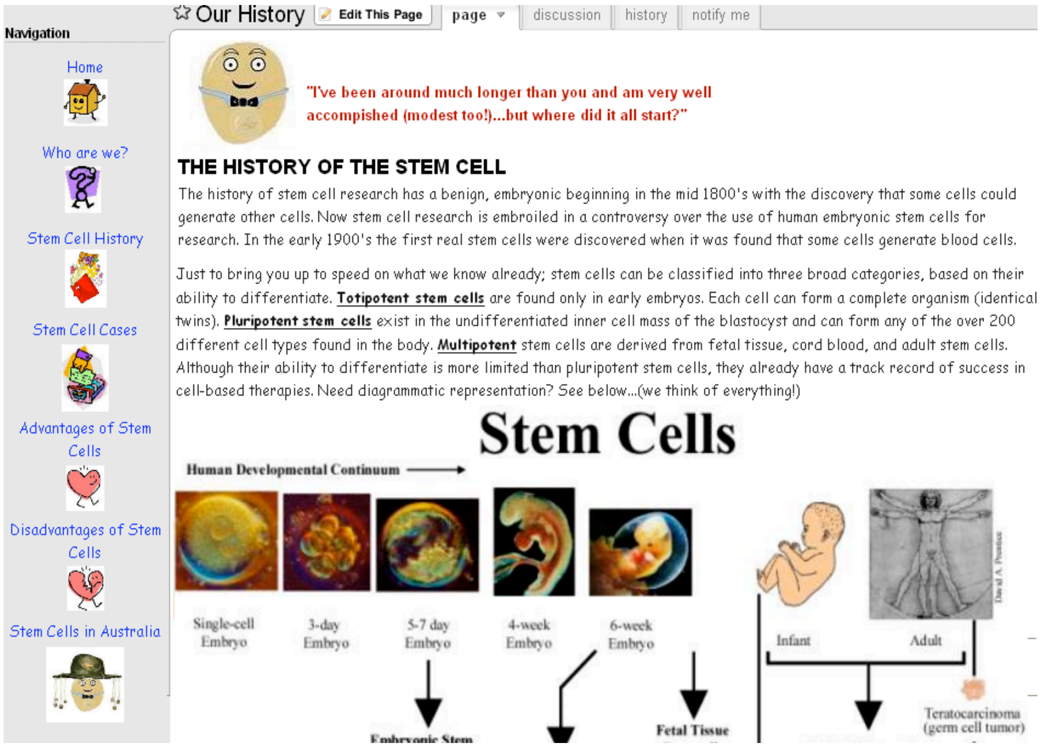
In 2009	**Number of students***	**% of enrolled**
Total engaging in debate discussion space	105	80
• social introduction only	22	17
• substantively	83	63
Signing up for wiki	120	91
Engaging in wiki	81	61
** 132 students enrolled for Leapfrog Biology in 2009*		

Considering that the course was run before the start of the semester, during University holidays, data in Table 1 show students had a high commitment to the course.

Considering the Product

The wikis produced by student groups for the Nobel Factor ranged from simple single page sites of text to complex multipage sites with text, images, video and sophisticated navigation. They defined terms in stem cell biology, explored the ethics of stem cell research and responded to specific questions raised in the context of the Leapfrog modules. Figure 1 shows the home page of the winning wiki. The menu (on the left) shows some of the links to areas of the site indicating the complexity of this project. Wiki functionality is indicated in the tabs across the top of the screen.

Figure 1: Home Page of the Winning Wiki



Student Attitudes to Group Work

Survey of students indicated that social software gave them opportunities for networking and support that they valued (Table 2).

Table 2: Student Responses to Selected Survey Items

Survey item	% of students agreeing
Initially the idea of learning online was daunting	41
By the end of the course I felt more confident about learning online	70
I valued opportunities to make contact online with teaching staff and other students.	63
The social software (wiki) was an effective way to collaborate online	64
The wiki provided a rewarding way of presenting a project online	73
It was important that my contribution to the project could be assessed by staff	56

While 41% of students were initially daunted by online learning, their confidence had markedly increased by the end of the course. Almost three quarter of students found using a wiki rewarding. As the course was not compulsory, the project was not graded; yet over half of the class found it important to have their contribution assessed by staff.

Student responses to “What did you enjoy most?” often related to the collaborative nature of the course as listed in the quotes below.

- “The ability to design a website and through this activity build on my knowledge of stem cells and their uses”
- “Meeting other people online”
- “The interaction with other students”
- “The collaboration of work with other students”
- “Working in group and building friendships with others before starting class”
- “Getting used to learn via the Internet”

Considering the Process

Scanning wiki discussions revealed the ways in which students collaborated, including issues of organisation, enthusiasm and satisfaction. Table 3 gives some examples of different styles of student collaboration.

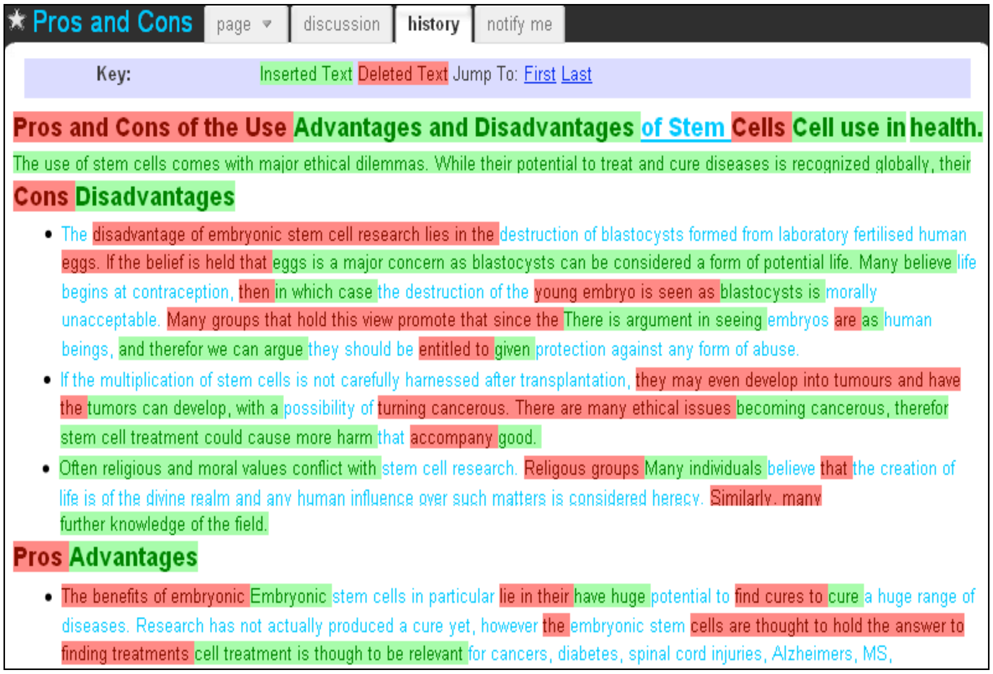
Discussion posts listed under ‘Enthusiasm’ and ‘Satisfaction’ indicate that students felt positively about their groups and group projects. Comments were unsolicited.

Table 3: Examples of Collaboration from Student Discussions

Aspect	**Examples:** direct quotes from student discussions
Organisation	We need to assign everyone a clear topic of research and decide our stance before we can start collating so that we don't waste time, get confused or duplicate our info. Don't forget to footnote !! What do u think if we choose one as leader and then every one say who want to do which part of research. This is just a list of what people seem to be doing/collated from all the other message boards. Just to see a summary but definitely not definitive. LK - Recent research done (2-3 in detail) + editing/layout (?) AE - Advantages RA - History + Definitions KN - Editing + benefits/dangers (?) LS - Disadvantages + Usage + Editing (?) RF - General Info/Home Page JM - Disadvantages BE - All round We can finish the final drafting maybe next Thursday? And start the editing/final corrections after that - finish Monday/Tuesday before camp? That way, we can all 'relax' sooner rather than later. I was just thinking whether we should just do a basic list/brainstorm/"points of debate" (etc) for the general points we have to cover (after everyone's up) so we know where we're heading? Maybe have a separate thread for each point? Does that sound okay?
Enthusiasm	I'm excited! Can't actually wait to meet you all in person! I had what I think is a super idea!! We could make the site in the perspective of a stem cell, like a day in the life of one stem cell and all its friends that get differenciated to other cells so we can go over anything!! EXCITING im getting really excited its looking great ! oh and i hear there will be more controversial articles re. stem cell research esp. in aust in the next week or so everyone look out.!
Satisfaction	So lovely to meet you! The research you've done so far is GREAT! our wiki is looking fantastic!!!!!! I'm so proud of everyone's work The whole wiki has worked brilliantly *I'm really feeling the love in this group...you guys are wonderful! I feel priveliged to have been able to work with you guys... Can't wait to meet each and every one of you!*

The collaborative process was further explored through wiki page histories. Figure 2 shows a comparison of two versions of a wiki page, indicating how one student edited work of others. From such comparisons the development of sites can be monitored.

Figure 2: Comparison of Versions of a Wiki Page



Learning Outcomes

The development of students' IT skills was evident in the structure and complexity of the wikis. From a position of no experience with the technology students rapidly grasped and mastered the abilities to edit and manipulate their wikis. Students' collaborative skills were also evident, both from the content of discussion and the rapidity of the development of the wikis. Consideration of the content of the wikis and its synthesis gave a measure of students' understanding of the biology of stem cells, suggesting they had developed a mature and sophisticated knowledge base. Furthermore, feedback from self-assessment quizzes in the modules showed a high average mark of 70%, indicating that students had mastered key concepts in biology.

Discussion

The extent and accuracy of information in wikis and the level of knowledge building evident in histories and discussion, indicated that the students gained an excellent understanding of biology through group work. The requirement for collaboration helped students develop skills in problem solving, communicating, planning and organising. The authenticity of the Nobel Factor project gave students the opportunity to develop their academic and ICT literacies. Some of the wikis produced for the Nobel Factor project in Leapfrog Biology were exemplars of good web design, well laid out, well researched, accurate and informative. This demonstrated that Leapfrog helped students gain familiarity with terminology and key concepts in biology. Each year we have used the winning wiki as a resource on stem cells for first-year medical students. The pride students take in their wiki and the commitment to their group comes through in their discussion posts. It is remarkable that students who have not yet met each other work collaboratively on a project which is not compulsory and contributes no marks to their first year studies.

The social constructivist basis for the educational design of the course was verified in particular through the competition, the Nobel Factor. The discussions of the wikis enabled students to share their excitement about their project wikis and enthusiasm within their group as well as to show their satisfaction with the group process and the wiki product. The last comment in Table 2 captures the mood of a particularly successful wiki in which 10 of the 11 members were active participants. Despite the large number of students they managed their group skilfully and productively and were awarded the Nobel Factor prize for 2009.

Social constructivism is also apparent in the way students collaborated in creating meaning through exploring the topic of stem cells. They researched aspects of stem cell biology and offered their results to the group. The pattern that emerged from scanning histories and comparing pages is one of contribution followed by consolidation. Students posted their responses to questions and issues, they then edited, merged and adapted the contributions with the synthesis of knowledge evident in considering the histories and discussions together. Wiki pages became far more than collated information with simple contributions of content from individuals. The combination of the discussion and page histories offers a unique opportunity to observe aspects of social constructivism in action.

Analyses of the process and the product of the Nobel Factor give clear evidence of the building and operating of online communities of practice, with shared activity around a domain of knowledge (stem cells) with construction of meaning. The project responds to the paired frameworks of learning in a community of practice (C4P: content, conversation, connections, (information) context and purpose) and of distributed cognition which encompasses authentic individual and systemic elements in relation to use of online technologies (Hoadley & Kilner, 2005).

Not only did the technology facilitate the activity of collaborating it engaged students engendering considerable enthusiasm for the collaborative process. It would be interesting to explore the ways in which students worked differently because of the online technology. Some of the comments made in the discussions displayed considerable freedom of expression, possibly due to an element of safety of physical remoteness.

Conclusion

"I'm really feeling the love in this group . . . you guys are wonderful! I feel priveliged to have been able to work with you guys . . . Can't wait to meet each and every one of you!"

This extravagant comment from one student illustrates the enthusiasm with which they embraced the Nobel Factor project and the collaboration it required.

The educational design of the course provided the context in which students used social software for learning within an online community of practice. The partnership between the technology and the educational design provided a safe and supportive environment where students could appreciate their individual learning through collaboration.

And at the end of the Nobel Factor, students 'loved' group work and appreciated the opportunity to leap the hurdle and acquire a sound background in biology as summarised by one student *"The course was wonderful!! Thank you for helping out the Biology "virgins", even though it meant sparing a lot of your time; it was much appreciated."*

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IMPLEMENTING EPORTFOLIOS: FIRST STEPS — LESSONS LEARNT

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Abstract

This paper reflects on the implementation of ePortfolio software for a year one undergraduate course. The process of choosing the appropriate software, the essential training needs and the results of a student survey are analysed and discussed. Key findings indicate a greater need for training both staff and students than was initially predicted. The common assumption that all students have an adequate level of computer literacy is challenged. Staff moving into the area of new technologies for the first time may have misconceptions that are difficult to identify.

Introduction

The ePortfolio described in this paper was introduced to undergraduate students as an integral part of the Personal Development and Planning (PDP) module. PDP runs throughout the four years but this paper is concerned with the initial introduction of this tool to year one undergraduates. The undergraduate program recruits 70 students and runs for four years, after which successful students graduate with a Bachelor of Arts degree at honours level with Qualified Teacher Status (QTS). The undergraduate course was completely rewritten, validated and delivered to year one students in the 2008–2009 academic year.

The main focus for the paper will be the choice and evaluation of the implementation of an ePortfolio for first year undergraduate students. However, some key aspects of how the undergraduate programmes have been adapted and the rationale for the choice of software will also be discussed.

Developing the PDP Module

The course introduced Personal Development Planning. The content of the module is generic in nature and includes a number of transferable skills. It is possible to define PDP as

> A structured and supported process undertaken by an individual to reflect upon their own learning, performance and/or achievement and to plan for their personal, educational and career development. (Guidelines for HE Progress Files, 2001)

This definition implies that the module requires the learner to be in control of their own learning and is autonomous and is learner-centred in nature. The group formed to develop the PDP was a multi-disciplinary team as suggested by Latreille (2007). The group was established in 2007 with a view to having the module available for use in the academic year 2008/9. Important features of the module identified by the team were that learners should be:

- able to reflect on their own practice and identify their own learning and developmental needs
- able to demonstrate their learning in a variety of ways
- as autonomous as practicable in terms of structure and content
- able to develop their PDP throughout the course and meet their needs for lifelong learning

Traditionally, a paper-based portfolio of evidence would be created to show the success of the student within the module. However as PDP is continuous over an extended period of time and developmental in nature, this implies the need for flexibility and security, something difficult to achieve using traditional paper-based models. A paper-based portfolio was thus felt to be too limiting in this respect. Furthermore, bearing in mind the professional nature of the course, as Hallam et al. (2008) point out

> The use of electronic portfolios in teacher education as well as within the professional context is emerging as fundamental to professional development (p. 40).

In view of the forgoing and the above criteria an ePortfolio was considered more appropriate since it is recognised that ePortfolios are an aid to reflective learning and develop transferable skills (Roberts et al., 2005); they can assist with students understanding of their own learning (Lambert & Corrin, 2007). An ePortfolio could also be easily extended over time, demonstrate evidence for reflective and evaluative practice and be readily accessible from multiple locations by a variety of people. As there is a general perception that first-year university students are much more computer literate than was the case a decade ago (McLennan & Gibbs, 2008) it was expected that they would be able to successfully make the transition from traditional paper based working to an electronic format. The use of ePortfolios would, as Latreille (2007) suggests, be an electronic means of supporting personal learning. It would provide the flexibility needed as well as improved access, structure and editing, and aid the development of autonomous learning. Based on these deliberations, very early in this process it was decided that the use and integration of an ePortfolio would be an important element of the module. It was thus intended that the ePortfolio would be used to help provide the structure implicit in the definition above as well as a way of showcasing their development.

Having made this decision it was found that there was a variety of definitions and applications of ePortfolios. Lorenzo and Ittelson (2005) describe an ePortfolio as an assortment of digitised artefacts that can include text based, graphic or multimedia elements that the owner can control who views, interacts and gives feedback within the ePortfolio. The student's own reflection can lead to a meaningful learning experience. Or as Young and Lipczynski (2007) suggest, an ePortfolio is simply a collection of artefacts which can be used to demonstrate knowledge, reflection and learning. For our purposes a key aspect is the development of reflective practice so essential for the development of effective classroom practice.

Strivens (2007) suggested that there were some inconsistencies in how the HEIs defined an ePortfolio. Two distinctive views emerged with a positivist view that the ePortfolio should be based on output, i.e. the result, and the constructivist view that it is also developmental and the 'learning journey' is important. The later fits in with the Life Long Learning (LLL) agenda explicit in the Lisbon process. The College team decided early on in this process that this constructivist view should be followed. Implicit within this decision is a belief that there must be processes within the system that allow for a developmental or formative approach to learning and that feedback by tutors and peers can be accommodated.

It is important to identify that, although the Virtual Learning Environment (VLE) and the ePortfolio would be linked i.e. students would access the ePortfolio through the VLE, their roles are fundamentally different. The VLE is institution-centred whereas the ePortfolio should be learner centred (Roberts et al., 2005). The learner, not the institution, should populate the ePortfolio, as the focus should be on supporting the learning not the assessment (Sutherland, 2005). Concerns were raised regarding the use of ePortfolios for assessment as marking can be extremely time-consuming and grading criteria unclear while students often have difficulties understanding learning objectives (Young & Lipczynski, 2007). Sutherland (2005) also identifies that due to the nature of the data the institution has to collect to aid assessment, some pre-populating of the system is needed which can then depersonalise the whole process. An important element highlighted in Latreille's (2005) study shows that students were not tempted to use the variety of features and tools available to them within the ePortfolio system unless they were required by specific assessment criteria. It was therefore important for not only the ePortfolio to be a compulsory requirement of the PDP module but to encourage students to use all the relevant tools and features to showcase their learning in their preferred way. This tension between specifying the content and the learner having ownership is a real issue that must be addressed tactfully.

The ability to use the ePortfolio for the assessment of students' work is seen as an important but problematic element which appears, at first glance, to contradict the tenet of the student owning and controlling the ePortfolio.

Selecting the ePortfolio Software

This process started early within the development process, towards the beginning of 2007. The preceding few years' rapid developments had been made in software, hardware and the Internet itself. These developments generated a plethora of ePortfolio systems. Himpsl and Baumgartner (2008) noted that in late January 2008 there were around 60 ePortfolio providers. These ePortfolios have developed rapidly from a collection of digital files stored on the learner's computer available only to them to a complex managed web based system containing the full range of digital and audio media, created or selected, by the learner in support of their learning and development needs. The evolution of the web to the so-called web 2.0 has meant that information is much more readily transferred, in both directions, within the web environment. This has led to the development of new technologies that are of benefit to the learner. This pace of change is unlikely to slow and, whilst some decisions had to be taken relatively early, provision was made to keep as many options open for as long as possible.

The initial use of the ePortfolio would be to support the PDP module. However, early in the planning stage it was recognised by the group that it is likely that an ePortfolio would be useful in other areas. One such area was the students' continuing professional development (CPD) related to their teaching studies. The flexibility to have the ePortfolio to serve more than one master, without duplication of work by the students, would be a considerable advantage. Other key factors of importance identified by the group regarding the system software choice are that:

- the system chosen must be supported by either a commercial organisation or by a thriving community if open source
- the ePortfolio must be under the full control of the learner
- the system must possess the capacity and flexibility to allow the ePortfolio to be developed to meet any new challenges
- it must be easily integrated with Moodle, our College VLE
- all material generated and collected by the student and held within the ePortfolio must be available to the student at the end of their course in a format suitable for use throughout their professional career
- the software must be easy to use by academic staff and students
- the system must be easy to manage from a technical point of view

A restriction imposed by College policy dictated that any system containing student data must not be externally hosted.

The most commonly found systems in the UK, Strivens (2007) were linked directly to commercial VLEs such as WebCT and Blackboard and were not considered since they did not integrate with Moodle, the VLE used by the College. Initially five ePortfolio systems were examined:

PebblePAD: A commercial system widely used within the community. In her survey Strivens (2007) showed PebblePAD as the most popular choice for UK HEIs behind the systems linked to commercial VLEs.

Elgg: An open source system that was used by another School within the College. This does link directly to Moodle.

Mahara: An open source system that integrates well with Moodle. This is a relative newcomer to the market.

EasyPortfolio: An open source system that has been trialled in College. This integrates with Moodle and feedback from colleagues suggests that it is, as its name suggests, very easy for colleagues and students to use.

MyStuff: From the Open University (OU) is potentially a very exciting development since the OU are intending to use Moodle as their VLE and therefore MyStuff will link directly to this.

Preliminary investigations led to the elimination of PebblePAD from our possible choices since this system is hosted externally. EasyPortfolio was also discarded at this initial stage. Although this system was indeed found to be easy to use it did not offer the degree of flexibility or the long term scalability required for our needs. EasyPortfolio did not appear to meet our interoperability requirements that would enable students to transfer their ePortfolio to other systems.

Indications from early beta versions of MyStuff suggested that this system would figure highly in our rankings but unfortunately the release of finished versions did not appear in time for us to make a full evaluation. For this reason we decided not to include this system initially. In line with our intention to leave any final decision as late as possible this system was revisited at the end of our selection process where it was revealed that much work would be needed to adapt it to our needs since it was designed to meet the Open University's course requirements. This left the choice of two open source systems, Elgg (2009) and Mahara (2009). WCET (2006) suggested some 69 ePortfolio features and used these to review a range of ePortfolios. With only two systems to compare it was felt that such detailed analysis would be unlikely to produce a clear outcome, even using the five meta-level layers suggested by Himpsl and Baumgartner (2008). As a result the initial features identified by the team were used for this final stage. Using this, Mahara and Elgg both met the requirements but in two important aspects Mahara stood out. Using Mahara it was much easier to create different views for different purposes. These views are formed by dragging and dropping artefacts created by the students. This allows, for example, a résumé to be shared very easily by more than one view. Once created, any updates were automatically transferred to any view using this artefact. This enabled Mahara to serve more than one purpose. Finally, consideration was given to the transference of content to other ePortfolio systems. Mahara developers are actively involved in a JISC (JISC CETIS, 2009) coordinated process to meet the current LEAP2A (2009) protocols for import and export and ePortfolio interoperability.

As result Mahara was chosen as the system that best met our needs.

Implementation

As previously identified a multi-disciplinary approach is essential and must include the involvement of both academics and IT systems personnel. This necessitated many module planning meetings. Colleagues coming from many different disciplines presented various challenges. It was difficult for some to understand the principles of working in the electronic domain, whilst others embraced it. Some colleagues had problems adapting not only to the technology, but to the role the technology plays within the ePortfolio. Training was provided for the tutors who would be both delivering the module and assessing it. It was imperative that clear definition of the goals for the ePortfolio projects were identified (Roberts et al., 2005).

New students are often considered to have good ICT literacy (Roberts et al., 2005). McLennan and Gibbs (2008) also alluded to this. However, some mature students whose formal education ended some time ago may have outdated IT skills, meaning the above assumption is not always true. Thus it was important that the implementation of the ePortfolio ensured all students were included irrespective of age, gender or IT ability.

Three colleagues were responsible for running the PDP module and staff training took place on a one to one basis starting early in the development. The processes involved in the ePortfolio system were shown to each and it was left up to individuals to then develop their expertise with the support of trainers as required. Terms such as “blogging,” “textbox,” “blocks,” etc. were used by both trainers and academic staff who were undertaking the training as though both understood the said features.

For the students compromises had to be made in the allocation of time for the initial training and use of the ePortfolio system. A series of induction events was planned for the students of which PDP and the ePortfolio were but a small part. Since this was considered ICT related it fell within the block of time allocated to introduce the students to the College's computer facilities and procedures as well as the college VLE.

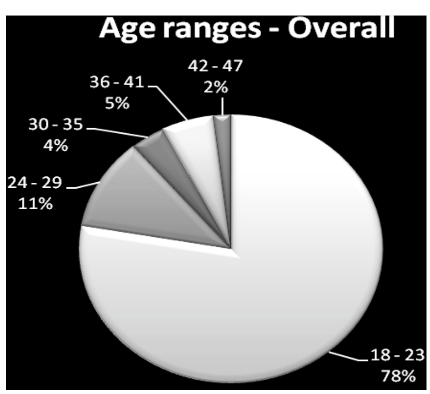
ICT specialists introduced the students to the ePortfolio system whilst PDP colleagues introduced the module content in separate sessions. Students were expected to create at least one view which incorporated evidence to meet specific criteria. PDP colleagues were quite prescriptive as to the shape of the evidence. Students were to reflect on specific scenarios, so were prompted to use a blog. They then completed their résumé and identified areas for development. The students' blog would be given formative feedback and a summative grade assigned. To facilitate this, students invited tutors to access their views in a specific time frame. This activity then repeated several times until the module was complete.

Methodology

At the end of the first semester the students were surveyed to ascertain their views and ideas on how well they thought they were prepared for use of the ePortfolio. Their views on the usefulness of it both in their studies and in their professional career were also sought.

The survey was carried out using a questionnaire designed in Google Forms and posted on Moodle. It comprised a series of questions using a Likert-like scale with values from 1–5 together with some free-response questions. All responses were automatically submitted to a spreadsheet which was then analysed. However to prevent exclusion of individuals a hard copy was made available to the students via the course notice board. The questionnaire was optional and anonymous. Figure 1 shows the age break down from the total of 32 replies from a cohort of 71. The age profile showed a predominance of students in the 18–23 age range (71%) with a significant 10% aged 36-41. Four out of the 31 were male (13%).

Figure 1: Age Ranges for Replies



Tutors were interviewed to gauge their perception on the success of the module as well as how well they felt prepared for both supporting the students and assessing the work. For the purpose of this paper the free-response questions were found to the more useful.

The Results

Indicative quotes from Student Responses (all responses are available from the authors):

‘If you feel the training in the use of the ePortfolio didn't meet your needs can you explain why below’:

> ‘I do not feel there was adequate time allocated to the training’
> ‘i would have liked three or four sessions over a period of about a month in order to digest the information’

Out of 31 students 21 added a comment. These comments were indicative of their overwhelming view that there was insufficient time given for the training. This identifies a need for more constructive and continuous training that needs to be threaded throughout the module, rather than just front loaded.

‘In your view, what advantages does an ePortfolio offer over a paper based portfolio’:

> ‘It does save a lot of time as you can do it from home and it also allows you to get feedback quicker’
> ‘Firstly it saves on paper and green is all important now. And secondly, once someone is familiar with using the application it is easier for submitting work and various other tasks.’
> ‘In my opinion, none!’
> ‘Paper based portfolio work can get lost…’

This question elicited a greater number of responses with all thirty one students replying. There was also a much wider range of views. These were centred on the following benefits:

- time saving
- easily accessible
- greener
- less chance of things being lost
- assignments could be submitted more easily

Although many practical advantages are identified, the expected advantages were not, i.e., the ability to evidence success in different formats, to show continued progression and reflection, to create multiple views and to have control over who views what when.

‘In your view what are the advantages of a paper based portfolio compared with an ePortfolio?’:

> ‘When i hand in the work i have a receipt and know for sure that it is handed in.’
>
> ‘One of the lecturers mentioned that they would like to be able to view previous when marking current work. This worried me as I feel the ability to see all work may affect the lecturers mark, for example on seeing previously weak assignments may sway the marker towards the lower grade scale rather than judging on each piece of work individually.’
>
> ‘Easier to hand in, and you know that the tutor has received them. (so less worry involved)’
>
> ‘‘Anyone can make one where as many people (students and staff) seem to struggle with the e- portfolio.’

Thirty students offered their thoughts. These seemed to centre around two themes. One was that students were not confident in the submission process and the other was of technology becoming a barrier to use.

An interesting point is also raised here pertaining to students being continually assessed and the assessor having preconceived ideas of the student’s abilities. Reassurance needs to be given to the learners to give them the confidence that this is not the case and indeed, that progression would be expected.

‘Please add any other comments on ePortfolios’:

> ‘So far I found the concept of handing in my work electronically more stressful the content of the assignments!’
>
> ‘The ePortfolio system is a good concept but the full possibilities of the concept have not been reached with this system.’
>
> ‘I can also see that this form of information collection would be far easier to transfer from one institution to another.’
>
> ‘I have submitted two assignments electronically and both have been returned to me on paper.’

Fourteen students made a comment. Many of the statements reinforced points made earlier. The training needed and the skills training of both students and staff had been underestimated and this contributed to a lack of confidence and belief in the system. It also meant that some staff printed the assignments out to assess and wrote the feedback on the paper which undermined the system and made the students feel the effort of learning the new skills had been pointless.

Discussions and Conclusion

It is clear from student feedback that they felt that more training was needed and that compromises made in the allocation of time for the initial training of students impacted on their ability to use the system. Some students would have liked the training to have been integrated throughout the module rather than it being front loaded. These problems were further exacerbated by misunderstandings by some colleagues regarding not only the ePortfolio but also key components such as blogging. Hence, students were asked to submit their blogs formatted such that feedback could be easily referenced to specific sections of their work. All students found this very confusing. Our assumption that the students would be proficient in ICT just because they live in a digitised society was somewhat optimistic. Students encountered difficulties understanding and creating views to showcase their achievements. This is certainly the most complicated aspect of the ePortfolio. The generation of template views is possible but this would inhibit or reduce individual expression. This last issue may well be responsible for the opinion of some students that the technology became a barrier to learning, which is certainly something that needs to be addressed. It could be that a compromise will have to be made between ease of use and individual expression and ownership.

One of the unexpected features of the ePortfolio was the social aspect which emerged with many students creating social views within the software to share with friends. This could be developed to add the new dimension of peer review into their development.

There was a communication issue between colleagues developing the PDP module and its tasks and colleagues who were responsible for training and developing the ePortfolio system. From each colleague's perspective the understanding seemed clear. Colleagues who were ICT specialists assumed that colleagues who were talking about blogging and had built this into the assessment process knew what blogging was and what it entailed. The colleagues responsible for the PDP module assumed they knew about blogs. As Rumsfield (2002) said "we don't know what we don't know."

The training for tutors needs to be revised and more structured in nature. Time must be allocated for this training and it must include specific focus on WEB 2.0 technologies used by the ePortfolio such as blogging.

Feedback was both formative and summative in nature. After discussions with tutors this appears to have been counter-productive since some students focused on the summative and took little notice of the formative. The assessment took place only two weeks after the start of their undergraduate programme, leaving students trying to become familiar with college systems as well as submitting their assignments. The developmental and formative nature of the PDP module would lend itself to a reduction in summative assessment early in the course. This could allow a completely formative element to be established in the first months of their studies. This element could include use of a wider range of tools such as video, sound, etc., enabling students to engage and become familiar with the full multimedia potential of the ePortfolio.

The issue regarding ownership of the ePortfolio is an integral part of its success, and care must be taken that the assessment is not overly prescriptive or standardised in nature. The learning experience should be as individual and unique as practicable with the need to achieve the assessment criteria. It could be analogous to a journey where students are given their destination, but (with support) make their own way there, choosing their own routes and preferred transport.

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LEARNING ABOUT ECONOMIC VALUATION OF THE ENVIRONMENT USING ONLINE SIMULATIONS

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Abstract

While e-learning has been widely adopted in the tertiary education throughout the world, its use has been limited mainly to content delivery. Many of the possibilities to use e-learning to promote a 'deep learning', student-centred approach have been left unexploited. This paper reports on the use of an online simulation designed to promote these learning approaches and to attain higher level learning outcomes. The context is within an environmental economics upper-level undergraduate class at The University of Sydney, Australia. The learning task is to do with the effects of alternative willingness-to-pay (WTP) question formats on the elicited responses and the mean WTP estimates from a non-market economic method for valuation of an environmental asset. Students were asked to fill online surveys that corresponded to four different formats of the WTP question. The results from the survey were fed back to students online. To control for attainment of learning outcomes, a quiz was administered both pre- and post-survey. The results indicate that this online simulation enabled students to achieve higher level of thinking and comprehending, and has somewhat improved measurable learning outcomes.

Introduction and Background

E-learning is about improving teaching and learning through the application of instructional techniques and strategies that are enhanced by use of technology, in particular by computer and internet technologies (Waterhouse, 2005). This relatively novel development has been widely adopted in the tertiary education in Australia and throughout the world since early 2000s. The online Learning Management System at the University of Sydney has been in place in one or another form since 2001. The first e-learning site for the upper level undergraduate course in environmental economics, with which this paper is concerned, was designed and used in teaching in 2005. In the last four years the site was used mainly for delivery of content via various learning objects: lecture notes, supplementary readings, and worksheets. Some interaction with, and among students was fostered via discussions bulletins, but with limited success in drawing students into a wide ranging participation. Nevertheless, the user's statistics for the site are quite good, and the student evaluations indicate high level of student satisfaction with the e-learning site.

While the technology for e-learning was there, it was felt by the instructor — who is the author of this paper — that this technology has been of limited use especially in fostering student focused, “deep learning” approach (Biggs, 1999). Some evidence from the literature seems to suggest that this is likely the case with many course sites in various online Learning Management Systems (LMS), where the focus is on content delivery (Gibbs & Gosper, 2006). While many areas of the knowledge domain studied within the curriculum of the environmental economics course could be identified as quite challenging and conceptual in nature, and hence favouring more profound approaches to learning on the part of the students, it was found difficult to use the e-learning site to promote such approaches. There is some evidence that given student’s connectedness with online technologies in their everyday lives, this more profound deep learning approach might be better fostered through the use of e-learning, rather then through more traditional teaching and learning methods, mainly by facilitating student-centred learning (Waterhouse, 2005).

The author of this paper has been considering for some time how the e-learning site for the environmental economics course could be used better to promote student learning of some of the more challenging concepts and methods discussed in class. The idea, from which the work reported in this paper originated, first occurred in early 2008 as a result of discussion with a colleague that has peer-reviewed teaching in this course. It emerged through that discussion that some of the functionality on the University’s online Learning Management System, such as online quizzes and surveys could be used to create an online simulation in which students would participate directly. The results derived from this online simulation could be used to further illuminate the material studied in class, and to provide an opportunity for experiential learning to students. This would then hopefully enable students to achieve higher level of learning outcomes, as described by the revised Bloom’s taxonomy (Krathwohl, 2002). Such online simulation was planned and designed in the first few months of 2009, and it was conducted during Semester 1 of 2009, in early April.

This paper reports on the educational literature describing the theoretical fundamentals that helped planning and designing the online simulation. It also explains the purpose of the online simulation and describes the way the simulation was put in place. The paper reports the outcomes from the online simulation, as well as from the pre- and post-simulation quizzes that were used to gauge student learning that occurred as a result of the simulation.

Theory and Prior Literature

The literature on the theory and practice of e-learning has seen rapid expansion in recent time. While the majority of published work reports on particular applications of e-learning, several recent articles have focused on the theoretical aspects of e-learning. Nichols (2003) calls for greater role of educational, and the more general cognitive theories in shaping the future of e-learning. That article emanates the message that e-learning should be treated as another, albeit powerful tool in the educational toolbox that helps teachers help students learn (Ramsden, 2003). The advent of the new technology that can be used in teaching and learning will not, in and of itself, result with a breakthrough in student learning. The instructors will need to cleverly use this technology to promote better achievement of the planned learning objectives. Thus, e-learning is not about what student learn, but how (and presumably how much) they learn. While the new technology offers opportunity for improved learning outcomes, such outcomes will not occur simply by adopting an LMS as a part of the course, which has been a tendency by most instructors, including the author of the present paper. Achieving improved learning outcomes will require designing learning activities within the LMS that will be conducive to ‘deep learning’ on the part of students. For example, the concept of simulative interactivity, where student can learn from their own choices through feedback, can be used to design such learning activities. This learning process will promote experiential, student-centred learning that has been shown to result in superior learning outcomes. Even though designing these learning activities might put additional strain on already overstretched instructors in the tertiary sector, it might prove a very worthwhile ‘investment’ into student learning.

This need for greater engagement of educational designers and instructors with the LMS at a more profound level is also recognised by Gibbs and Gosper (2006). They distinguish between e-learning driven by content delivery imperatives, and e-learning driven by imperatives for improved learning outcomes. The usual and most prevalent use of e-learning has been in the delivery of content-centric instruction which is consistent with the transmission model of learning (Prosser & Trigwell, 1999). This model is implying teacher-centred learning, where the teacher unilaterally transmits knowledge to students, and students are in turn expected to be able to reproduce this knowledge. Literature on cognitive theory and educational research suggests that this model of learning is probably not the most desirable for achieving high quality learning outcomes, as it keeps the student a passive object exposed to teaching, rather than being actively learning participant (Prosser & Trigwell, 1999). The alternative interpretivist and critical models of learning (Cohen et al., 2004) are viewing the learner (student) as an active participant and contributor in the learning process, as opposed to merely being a passive recipient and acquirer of knowledge. For e-learning to take a full advantage of its potential, it will have to make a transition from mainly delivery oriented tool, to a learning tool that helps students learn better.

The importance of experiential learning where students are able to learn by interacting with, and within, a learning environment (in class or online) that has been created by the instructor was highlighted by Laurillard (1993). In a current context, the online simulation is used to enhance a student-centred experiential learning, which fosters the capability of students to combine the learning that occurs as a result of traditional teaching/learning practices (lectures and readings) with learning that occurs through students' own activities and experiences. The links that are developed between the transmissive and the experiential components of learning allow students to learn by reflecting on their new understandings. This is a key to the practical application of another important characteristic of e-learning: its ability to transform the learning from a teacher-centered activity to a student-centred one. In a student-centred e-learning environment, such as the one that was created by designing the online simulation activity presented in this paper, students are enabled to take greater responsibility for their own learning, and they become actively engaged in the learning process (Waterhouse, 2005).

Context and Method

The learning task that was a subject of the online simulation reported in this paper is related to the methods of economic valuation of environmental and natural resource assets. Such economic valuation typically involves asking respondents how much they are willing-to-pay for preservation of environmental assets (e.g. How much are you willing-to-pay for preserving the Great Barrier Reef in Australia, or the Grand Canyon in the USA?). The purpose of asking this type of questions is to elicit the values that people place on these environmental assets. As those values can not be expressed through usual market behaviour — since markets for environmental assets typically do not exist — non-market valuation techniques have to be used. These non-market values are different from usual economic quantities, since they represent things that are not bought and sold on the market (one cannot simply purchase a given quantity of preservation for the Great Barrier Reef!), and hence intentions of behaviour under various environmental circumstances have to be stated by people (and hence the name 'stated preference methods' that is often used in environmental economics scholarly literature). The intentions of behaviour are elicited by administering surveys that are used to collect information on various characteristics of the respondents, such as income, age, gender, socio-economic status, as well as to ask a willingness-to-pay (WTP) question.

There are several different ways of how this question might be asked. Most commonly used types of WTP question are: **an open-ended question** — where respondents are simply asked to state their WTP by filling an amount in the blank provided at the end of the question (e.g. How much are you willing to pay for the protection of the Great Barrier Reef? _______ $ / year); **dichotomous choice** — where respondents are asked to accept (respond 'yes') or reject (respond 'no') a given value for the WTP (e.g. Are you willing to pay $150 / year for the protection of the Great Barrier Reef? Yes or No.); **iterative bidding (or n-bounded dichotomous choice)** — where a dichotomous choice question is initially asked, and then another dichotomous choice question with an increased amount (if the response to the first question was 'yes') or decreased amount (if the response to the first question was 'no') is asked (e.g. Are you willing to pay $150 / year for the protection of the Great Barrier Reef? Yes or No; If 'Yes', than ask: Are you willing to pay $300 / year for the protection of the Great Barrier Reef?; If 'No', than ask: Are you willing to pay $50 / year for the protection of the Great Barrier Reef?) Iterations of this type can be repeated many times; **payment list (or card)** — where respondents are presented with a list of amounts, and are asked to circle one (e.g. How much you are willing to pay for the protection of the Great Barrier Reef? Please circle one of the following: $0, $25, $50, $75, $100, $150, $200, $250, $300).

Subsequent to conducting the surveys, where the willingness-to-pay is elicited from the respondents, the collected information is arranged in data sets. The data sets are then subject to statistical procedures designed to derive mean willingness-to-pay, as an indication of the demand that respondents have for the valued environmental asset. The mean WTP is subsequently aggregated across the relevant population to obtain a monetary value for the environmental asset of interest. Sometimes very different monetary values are obtained dependent on the type of question format used in the survey. This is due to various biases introduced by the design features of the survey, and by other psychological phenomena (e.g. protest responses, anchoring, yay-saying) that are introduced by each particular way of asking the WTP question (Bateman et al., 2002). It is very important that practitioners who conduct these kind of environmental valuation studies have clear understanding of the influence that question format might have on elicited final monetary values. Consequently, it is crucial that students of environmental economics, who are likely to become practitioners in environmental valuation, develop that understanding during their undergraduate studies.

However, teaching and learning about the causes of the discrepancy in the estimated values for environmental assets that might be caused by different question formats, and about how exactly people's stated preferences change in response to changing question format, is challenging for both the instructor and the students. For the instructor, it might be tempting to adopt the transmission model of teaching, where the causes and the outcomes from asking alternative question formats are being 'told' to students, which might be supplemented by assigning relevant readings. Similarly, students may tend to adopt a 'surface' learning approach that will constitute of just memorising the alternative type of question formats, and simply knowing that they can influence the outcome, without understanding the key causes and the full mechanisms of this occurring. This might result in learning outcomes that correspond only with the less sophisticated levels of cognitive behaviour according to the Bloom's taxonomy (Waterhouse, 2005). Ultimately this may lead to professionals in environmental valuation not being able to design surveys that will adequately represent the respondents' valuation of environmental assets.

To promote students' deep learning approach towards this learning task in the environmental economics course, it was decided to make use of the functionality offered by the course e-learning site, by designing an online simulation where students themselves would be asked to respond to the WTP questions of varying type. In 2009, the size of the environmental economics class was 53 students. Students were split into four groups, corresponding to the four types of WTP question formats. Questions similar to the examples given above, and using the Great Barrier Reef as an environmental asset to be valued were designed as a survey on the course e-learning site. This site is a part of The University of Sydney's LMS CE6 that is based on WebCT. Each survey containing a specific type of WTP question was assigned to one group of students, who were then given a window of three days to respond to the survey online.

The data collected through this activity were used to calculate the mean WTP for the environmental asset (the Great Barrier Reef in this case). The mean WTP was calculated using non-parametric statistical techniques, based on estimating a survivor function (Bateman et al., 2002). The calculated value was then fed back to students online. The students were then asked to reflect on the effect that their own choices in completing the online survey had on the estimates of the resulting value for the mean WTP. This in effect provided simulative interactivity, and helped students' learning process by allowing them to explore directly the results from their own survey responses.

To control for the attainment of learning outcomes, an online quiz containing four multiple choice questions about the role of alternative WTP question formats on the results from a non-market valuation study was administered before and after the survey. The students were initially asked to complete the quiz immediately after the lecture that dealt with this topic in class. No marks were given to students, but their responses were recorded online. The following day, the students were asked to fill in the survey, with the actual willingness-to-pay question. After the survey was completed and the data were used to produce estimates of the mean

WTP for the environmental asset, the results from the survey were posted online and students were asked to look at those results. This happened within one day of surveys being completed. After they had two days to look and reflect at the results that came from the surveys, the students were asked to complete the same online quiz that they completed prior to completing the survey. It was expected that the proportion of correct answers will be higher on the post-survey quiz compared to the pre-survey quiz. In some sense the quiz served as a ‘control’ for the learning outcome, and the completion of the survey was a ‘treatment’. This was an attempt to measure the effects of this online simulation on student learning.

Results and Findings

The results are presented in terms of student responses to pre-survey quiz, in terms of the mean WTP estimates and the descriptive statistics of student responses obtained from the online surveys, and in terms of student responses to post-survey quiz.

Pre-survey Quiz

Out of fifty three students taking this course, thirty seven completed the pre-survey quiz. The maximum possible score on the quiz was 40, and the minimum was zero. The descriptive statistics of the student scores are given in Table 1.

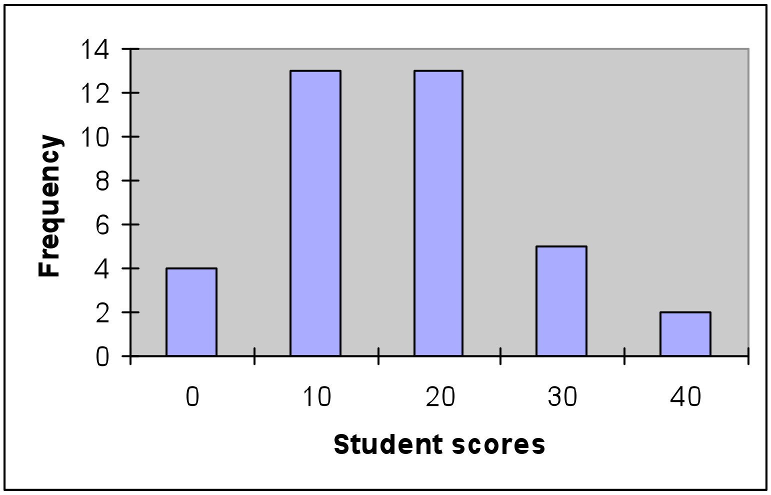
Table 1: Descriptive Statistics of Student Scores on the Pre-survey Quiz

Count	37
Mean	16.76
Standard Error	1.69
Median	20
Mode	10
Standard Deviation	10.29
Range	40
Minimum	0
Maximum	40

These statistics show that the mean correct response was less than 50%, which indicates that students did not do so well on this quiz, and might indicate only limited achievement of the learning outcomes for the studied concept.

The histogram of the frequency distribution of student scores is provided in Figure 1.

Figure 1: Frequency Distribution of Student Scores on the Pre-survey Quiz



Inspection of the histogram also reveals that the largest number of students was only able to provide half or less correct responses to the quiz questions, which again indicates very limited attainment of learning outcomes. It is interesting to note that while only two students have achieved 100% correct responses, four have achieved 0%.

Survey Results

The results from the analysis of the survey responses are presented in Table 2. The same table was used to communicate the results to students online.

Table 2: Results from an Analysis of Survey Responses to Four Types of WTP Questions

	WTP question format				
	Open Ended	Open Ended w/o outlying $1000 bid	Dichotomous Choice	Iterative bidding	Payment List
No of responses	11	10	16	9	8
Response rate	0.92	0.83	0.67*	0.75	0.67
Min bid accepted /stated	$20	$20	$50	$0	$0
Max bid accepted /stated	$1,000	$400	$300	$300	$150
Mean WTP	$196.40	$118	$175	$116.70	$62.60

* The response rate for dichotomous choice reflects the larger size of the sample for this question format due to the need to elicit responses to multiple bid levels (three in this case)

The results show high participation rate of student in the online survey, which is relatively consistent across the groups that were responding to the different WTP question formats. The results also show the wide discrepancy in the minimum and maximum bids — WTP values that were either stated (open-ended question format) or accepted (other formats) by the respondents — across the four different question formats. This discrepancy is also reflected in the estimates of the mean WTP. As expected and as widely reported in environmental economics literature, open ended question format resulted with an apparent 'outlier' bid (a bid that is unusually high) of a $1000. This single 'outlier' bid was responsible for a large portion of the estimated mean WTP for this question format, which came markedly down when this 'outlier' was removed from the data.

An unexpected observation is that 'open ended' format had the highest response rate, and that there were no zero bids stated (so called protest bids). The dichotomous choice was the question format that expectedly produced the highest estimate for the mean WTP, after correcting for the outlier in the 'open ended' question format. For the iterative bidding question format, the final estimate of the mean WTP reflects the starting point bias (the starting point was $150). The payment list format was the most surprising, with a relatively low response rate, a couple of zero bids, and the lowest maximum bid. The former two characteristics are usually typical for open ended questions.

These results were provided to students online immediately after the surveys were completed. Students were given one day to look at these results and reflect on them. On the second day, they were asked to complete the post-survey quiz. This quiz contained the same questions as the pre-survey quiz, and in addition contained a space where students could put their comments and observations in relation to the survey results.

Post-survey Quiz

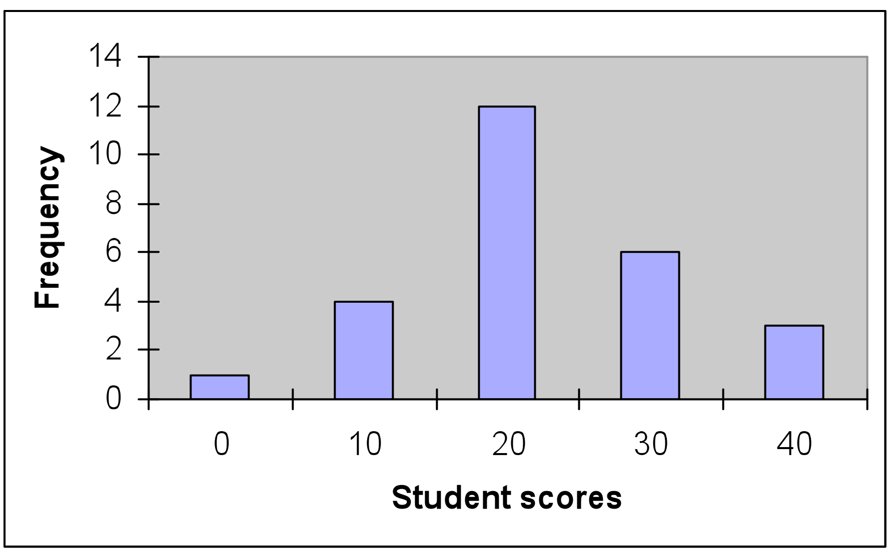
The post-survey quiz was completed by twenty six students out of the fifty three enrolled. Most respondents to the post-survey quiz were the same as the respondents of the pre-survey quiz. As in the pre-survey quiz, the maximum possible score on the quiz was 40, and the minimum was zero. Individual student scores were weighted by the score obtained on the fifth question in the post-survey quiz, which did not exist in the pre-survey quiz. This question asked students to reflect on their learning through the on-line survey. It was framed as follows: "In the space provided below please state any reflections and inference that you had while looking at the survey results. Have you noticed something that surprised you? Have you noticed something that reaffirmed your understanding?" The quality of responses to this question was graded based on the descriptive criteria for grading for the whole course, with which students were familiar. This grade was then used to weigh the answers to the other four questions. The descriptive statistics of the weighted student scores from the post-survey quiz are given in Table 3.

Table 3: Descriptive Statistics of Student Scores on the Post-survey Quiz

Count	26
Mean	19.35
Standard error	1.96
Median	20
Mode	20
Standard Deviation	10.01
Range	40
Minimum	0
Maximum	40

Compared to the results from the pre-survey quiz the mean correct response was much closer to the 50% mark, but does not indicate an overwhelming change in student learning outcome. The paired t-test for the difference in means between the responses to the two quizzes does not indicate statistical significance at the conventional levels (p-value = 0.32). Part of this can be explained by the lower participation rate in the post-survey quiz, and another part can be explained by several unusual results from the online survey, as discussed above. Nevertheless, the histogram of the responses from the post-survey quiz indicates some improvement in attainment of learning outcomes. It is presented in Figure 2.

Figure 2: Frequency Distribution of Student Scores on the Post-survey Quiz



The histogram indicates improvement at the two extremes of the distribution — only a single 0% correct response, compared to four 0% responses in the pre-survey quiz, and three 100% correct responses compared to two in the pre-survey quiz. In addition, significantly larger proportion of the students achieved 50% or more correct responses in the post-survey quiz than in the pre-survey quiz. This indicates that the completing of the online survey has increased student understanding of the learning task, and has increased somewhat the attainment of learning outcomes.

Conclusion

E-learning has been present in the higher education for some time, but its use has been largely reserved for online content delivery. To promote the use of e-learning for attaining better quality student learning outcomes, the educational designers and instructors will have to come up with specific online learning activities that will foster a student-centred, deep learning approach on the part of students. One such activity, an online simulation where students were asked to respond to a willingness-to-pay survey for an environmental asset was reported in this paper. This activity in the context of an upper level undergraduate environmental economics course at The University of Sydney was conceived out of dissatisfaction of the author of this paper with the way the e-learning site for this course was used over several years. The results presented in this paper suggest that students improved their learning through the use of this 'experiential learning' tool, albeit not at any spectacular rate. While various explanations can be offered for the modest improvement of learning outcomes, it seems that the process of learning is too complex to be accurately controlled by pre- and post- learning activity assessments, as attempted in this paper. As the learning in the course that was the subject of this paper is ongoing (the course concludes in June, 2009), continuous monitoring of learning outcomes will be applied to identify any further expected positive impacts from this online simulation. Assessing and quantifying the improvement in learning outcomes as a result of improved use of the e-learning site will be necessary in order to be able to justify the considerable extra commitment in planning, preparing and conducting online learning activities on the part of instructor.

The findings of this paper are in line with the previous published work indicating that the use of e-learning in tertiary education can be beneficial. There is no doubt that e-learning has a great potential to be effectively used in teaching that helps student learning. However, how to most effectively use it and whether its use is worthwhile — taking all costs and benefits into account— remain important questions that warrant further scholarly inquiry.

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BLENDING THE 'VIRTUAL' AND THE 'REAL' — USING FREEWARE 3D SIMULATION TO ENHANCE REALISM IN AUDIO ENGINEERING

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Abstract

Freeware graphics tools were used to create a 3D simulation of a building and deliver it online to audio engineering students via a Virtual Learning Environment. A pilot group of students were required to design a sound reinforcement system for the virtual building, while another group of students were given a similar task based only on 2D architectural plans. Questionnaires and interviews were used to assess the learning experience of the two groups. Results indicated that the use of the simulation increased realism of the learning experience, increased motivation and enabled more effective communication amongst the group compared to those using only the 2D plans.

Background

Teaching audio engineering produces a number of challenges to tutors. Like all engineering subjects, it is inherently practical, and a key requirement is for students to be exposed to realistic scenarios so that they can apply theoretical understanding to solve real-world problems. While it is often possible to base technical tasks in a laboratory environment, audio systems design and architectural acoustics courses examine the acoustic design of large buildings — both real and planned — which are often impossible to get access to for students.

Case studies in this area are traditionally based on using two-dimensional architectural plans to visualise the building and then basing calculations and design on these. However, audio systems in reality are frequently designed after the building has been completed and so the engineer will usually be able to examine and make measurements in and around the building. If the building is still at the design stage, measurements can at least be made around the proposed site of the building. This allows the engineer to visualise the space, comparing the materials, structure, location and noise levels to his or her prior experience of other constructions, allowing a more detailed visualisation than is possible from the plans. The application of prior experience of different spaces therefore plays a major part in defining solutions to audio engineering problems. Site visits also allow the use of on-site measurements, which are invariably more accurate than theoretical acoustic models.

The use of 3D Modelling and acoustical rendering software is in now common use in the audio engineering industry (Funkhouser et al., 2004). However, software capable of doing acoustical simulation is extremely expensive, costing several thousand pounds per license. In a university environment where there may only be a couple of site licenses of this type of software it is not practical to use with large cohorts of undergraduates, particularly if they need to work off campus. In addition, this type of software obviates the requirements for students to learn fundamental principles, as it removes the need for the learner to apply theory to the problem, as it removes several decision-making processes from the students and gives them to the computer. This can lead to students becoming reliant on 'correct' answers given by the software and eliminating the option of creative responses to this type of engineering problem.

A proposed solution is to use a simulated environment which can provide a simplified 'real' environment for the student to explore, but which still requires the student to make their own decisions regarding application of theory and synthesis of a solution to the design problem.

Simulated environments have been demonstrated to provide opportunities for students to both interact with learning materials and enhance realism of the learning experience (Dickey, 2005). Three-dimensional interactive environments such as Second Life and 3D graphics rendering programs provide potential alternatives to expensive architectural modelling programs for enabling increased interaction of students in this area.

The key educational attribute of a simulation in this context is its ability to model a real system in which variables are clearly specified, which feigns real situations and provides feedback to students, promoting the development of mental models and improved knowledge of reality (Milrad, 2002). Whilst technical accuracy and fidelity to reality are important, the simulation also allows for simplification, through an incomplete representation of a system which preserves its essential characteristics (Hung et al., 2005). This controlled reality allows learners to concentrate on the educational objectives of the designers (Sauve et al., 2007), and reduce the cognitive load on the learner (Schnotz & Rasch, 2005).

In their early work on the use of computers in education, Kemmis, Atkin and Wright (1977) describe simulations as "revelatory," whereby a student is guided through the process of learning by discovery. In simulations the software is acting as a mediator between the student and a hidden model, gradually revealing more information as they progress through it. This contrasts with instructional delivery, often associated with undergraduate students' most common interaction with computer-enabled learning, the virtual learning environment, where subject matter is presented by the system and the student's progress through it is controlled.

It is important to stress that there is a difference between simulations and games. Games have attracted widespread attention for their educational potential (see, for example, Gee, 2004; Kirriemuir & McFarlane, 2006), but they tend to be aimed primarily at primary and secondary school level learning rather than the undergraduate level. Little work reflects the diverse age range of undergraduate students and hence the variety of experiences they bring to their learning. Adult students especially want their learning to be linked to the real world (Schank, 1997) and to be based on their previous experience (Hartley, 2000), and to be delivered at a pace that they can control. The situated, authentic and student-controlled nature of simulations fits well with these requirements.

Unlike the use of Virtual Worlds in many situations, in which the interaction between students and student/tutor is key (Corbit, 2002), the main requirement for an audio engineering simulation is to allow the student to interact with the building itself, and in particular to assess both the construction materials and the situation/positioning of the building in relationship to the external environment. This means that the tools used must allow both 3-dimensional rendering and be able to create a virtual 'environment' for the building to be placed in, as location has a considerable impact on building acoustics.

This paper examines a pilot study in which a 3-dimensional graphical simulation of a building was integrated into an audio engineering assessment tool, delivered online via a virtual learning environment.

The key research question was to examine whether the use of computer simulation of 3D environments and the combination of the 'real' and 'virtual' environment affects the learning experience and the methods of interacting with the tasks of students working on an audio engineering assignment. In particular, does the experience enhance learning, and if so in what manner, or does it distract from the task?

Method

A number of available software tools were assessed for cost, capability, ease of use, 'realism' of environment and potential for integration into the university VLE While all of these packages are capable of creating 3 dimensional graphics, their primary purposes lie in different areas:

ODEON is a professional acoustics rendering package which enables the user to import 3D architectural plans, render them and perform acoustic calculations and modelling of a building. While highly able, it is a very complex programme, not suited to learning the fundamentals of acoustics. It has no means of integrating into a 'real world' environment, and is several thousand Euros for a license.

Fundamentally, it is capable of performing required acoustic calculations *on behalf* of the user, meaning that it would be likely to be a poor learning tool for a student learning basic theory. It could also not be integrated into a VLE due to complexity and licensing restrictions

Plan 3D is a cheap, web-delivered tool designed for home design and interior design. It is capable of 3D simulations of buildings, including visual representations of their materials. Links to the program or created files could easily be integrated with a VLE. However its price of £35 GBP per year per license would put students off using it, and it was not capable of integrating into a ‘real world’ environment.

Xara3D is an inexpensive and simple to use 3D graphics program which is capable of designing 3D objects and applying surface renders of materials. It is however unsuited to complex 3D graphics such as buildings. It could not integrate into a ‘real’ environment, and the cost to the students would still make it unsuitable for use for many students.

Second Life is an online ‘virtual world’ that has been commonly used for educational purposes. It is capable of being integrated into the university VLE and can have complex 3D buildings and renders. There is no cost to the user, to navigate the world and it is simple to operate. The university already has a Second Life presence so initially its use appeared to have considerable potential. However it lacked the ability to place the buildings in a ‘real’ environment, which reduced its effectiveness in blending real measurements and calculations of the virtual space. It also has a high cost to the developer for purchase of ‘land’ on which to ‘build’.

Autodesk is a Computer Aided Design (CAD) package, used widely by the design and engineering industries. It offers a free version for student use and can easily be integrated with the VLE. However, for students unused to using it, it is complex and time consuming to learn, and cannot place designs in a ‘real’ location.

The highest scoring tool was Google Sketchup, a freeware 3D rendering program developed by Google. This has similar graphics capabilities to Plan3D or Second Life, but also has the capability of integrating models into Google Earth, allowing extremely high levels of realism of situational placement. Programme features of all software evaluated are summarised in Table 1.

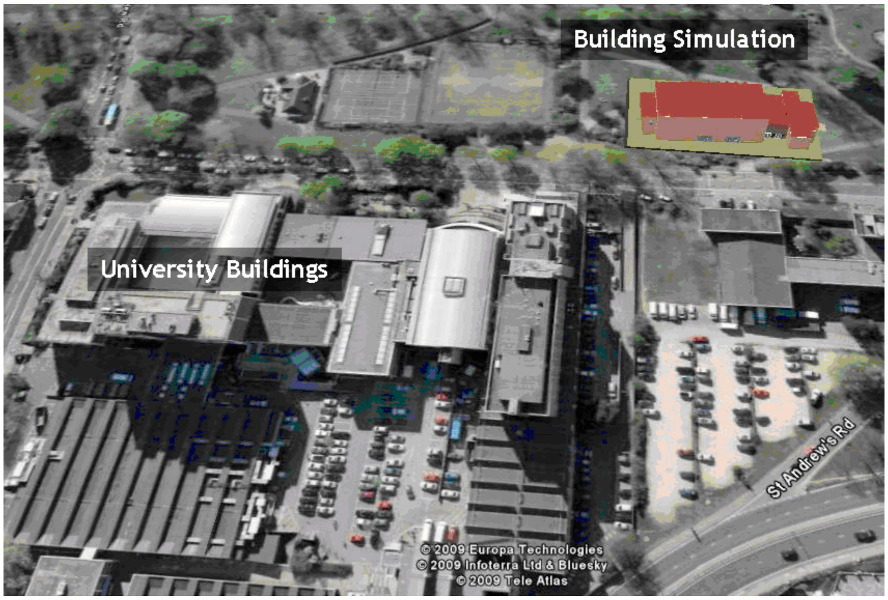
Table 1: Assessment of Available Software

Package	*3D capability*	*Surface render*	*Ease of use**	*Real world integration*	*Integration into VLE*	*Pricing*	*Cost per license*
ODEON	Y	Y	Complex	N	N	Payware	7000 Euro
Plan3D	Y	Y	Easy	N	Y	Payware	£35 pa
Xara3D	Y	Y	Easy	N	N	Payware	$29USD
Second Life	Y	Y	Medium	N	Y	Payware	Free to user. ~$40USD pm for land.
Autodesk	Y	Y	Complex	N	Y	Freeware (education)	Free
Google Sketchup	Y	Y	Easy	Y (via Google Earth)	Y	Freeware	Free

**Ease of use was assessed by the time taken for a 'novice' user to define and render a simple 3Dimensional structure.*

A case study was developed, in which a small pilot group (n = 7) of undergraduate students were required to design the sound reinforcement system and architectural acoustics of an auditorium in a conference centre. In order to integrate an architectural simulation into the learning experience, the building structure was simulated in 3D using Google Sketchup, including rendering of materials and placement of interior features such as furniture. The Sketchup file was then imported into Google Earth and virtually 'built' on a plot of land near the university (Figure 1). This simulation was made available online through the university's Moodle-based VLE, allowing students to download it and use it remotely on non-university computers. The application of Google Earth allowed the student to navigate around both the exterior and interior of the building (Figures 1 and 2), view in 3D key details such as construction materials, the number and type of seating and microphone positions, and get a general 'feel' for the building. The virtual placement of the building in Google Earth in a 'real' position close to the University allowed the students to visit the actual site on which the auditorium was 'built' enabling the student to blend the design calculations based on theoretical modelling with practical measurements and observations made on site.

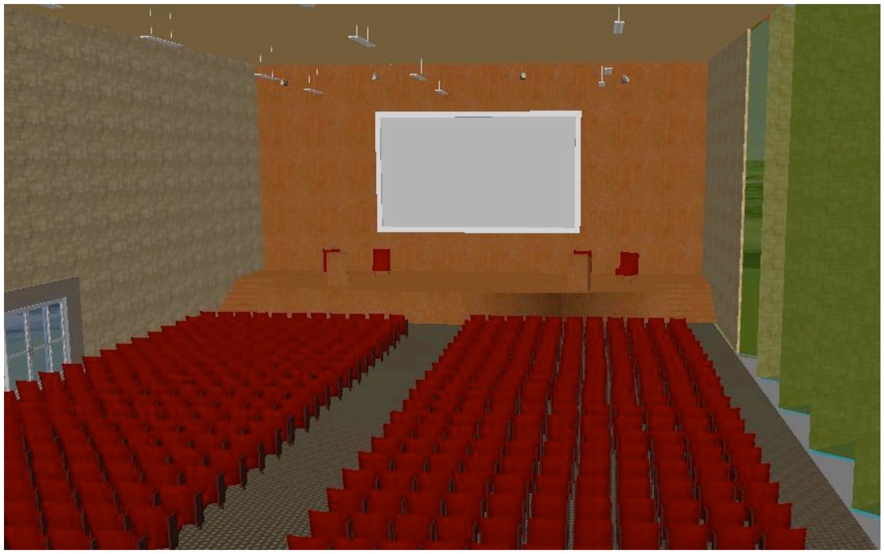
Figure 1: Location of the Simulated Building



(© Google Earth 2009)

The assignment task was designed around one that had been used many times before building upon a number of theoretical and practical exercises the students had done throughout the course. It had, traditionally, relied on a paper-based model with 2D architectural drawings and tables of physical values. So a control group of students (n = 8) were given a similar task to the pilot group, but using the traditional method, without the simulation of the building. The building design used for the control group was different in order to prevent this group making use of the simulation. The aim of the exercise in both cases was for students to be able to solve both the straightforward acoustic calculations required, and to examine the more complex interactions between different elements of the acoustic space to provide design recommendations for an audio installation.

Figure 2: Interior of the Simulation (Main Hall)



Data Collection

Traditionally, educational research has relied heavily of the proof of theory as a model. However, Salmon (2002, p. 198) advocates the rejection of the role of overarching theory in the research of online educational tools, preferring to focus on their actual use in order to develop models of understanding.

As this project was examining unknown attitudes, motivations, and approaches of students to learning a particular subject in a particular context, data collection was based on the use of independent questionnaires and semi-structured interviews. Questions focused on the way in which students had visualised the acoustic space, their approach to the assessment requirements, their interaction as a group and their methods of getting further information about the task. Their prior experience with online assessment and learning was also assessed in order to consider whether this had an impact on their approach to the task.

This study explores the processes of a group of students working on a piece of assessed material for a unit in Audio Systems Design. The sample numbers were defined by the subjects taking the unit, restricting the sample size. Whilst the sample is broadly representative of the larger student population, it is chosen on the basis of availability and can therefore not be considered to be truly random. The sample size is also not large enough for statistical interpretation of the student responses. However, as it would be inappropriate for the conclusions of an intrinsic case study to generalise about the whole population, this “convenience sample” (Cohen et al., 2007, p. 113) has only to represent itself and is therefore legitimate.

Analysis

Prior Experience and Motivation

There were no particular differences in experience indicated between the two studied groups. All of the students from both groups indicated that they were confident at working and learning online, with a high level of internet usage across a typical week (typically in excess of 20 hours). They all indicated that they had a good working knowledge of the VLE, and that they were confident with the studied subject matter. All students indicated that they were well motivated, partly intrinsically through a high level of interest in the subject and partly extrinsically through a desire to get good grades.

Visualisation of Building

An important affordance of any simulation is its ability to represent a complex system visually. Chris Dede promotes the use of "visualization" as a tool for enhancing learning: "People have very powerful capabilities to recognize patterns among images: much of our brain is 'wetware' dedicated to this purpose" (1996, p. 4). He asserts that learners gain increased insight into a system when tabular data of numerical values are represented by graphical objects with apparent shape, size, texture and colour. It has also been shown that graphical feedback and explanation improves comprehension and retention of information (Rebetez & Bétrancourt, 2007).

This was reflected by the comments of the simulation users, who said the 3D image made the assignment "about as realistic as it potentially could be" by "using Google Earth and Sketchup to view the interior and exterior." Interestingly, 'realism' was rated approximately the same by both study groups, regardless of method of delivery (though there is some suggestion in their comments that they may have interpreted realism to mean relevance). However, the group that used the paper-based task almost all suggested a site visit would have been useful to create a visual image of the space, unlike the simulation group for whom this suggestion was rare.

Without the simulation, the students tended to simplify the space into geometric shapes based upon the floorplan. They indicated that this made it difficult to imagine the more complex elements, such as the pitch of the roof and the various building materials. They also indicated that they were only using mathematical modelling to provide the 'answers' to the assignment task and that it was difficult to relate their results to reality. This resulted in an "assignment based on the numbers" which they felt was unsatisfactory.

Interaction with Task

Most of the students that used the simulation found the experience 'enjoyable', saying, for example, that it *"added realism to what is used in lessons rather than just theory"* and that this was particularly important to them. There were some verbal comments that the simulation was occasionally difficult to navigate effectively, and that it was possible to move through solid objects.

A number of students that undertook the parallel traditional, paper-based task suggested that they would have liked to have done the simulation as it was more "interactive", even though they had not actually seen it. Upon questioning, they revealed that this meant they would like to be in control of what they viewed and when they viewed it, and that they thought the simulation should provide them with that opportunity. Most of today's students come from a generation that has grown up surrounded by computer technology and they are familiar with the world viewed through electronically-generated images (Prensky, 2001). They therefore have a predisposition to the use of computer-based technology as a mediating tool and this may have motivated this suggestion. This view was not universal, and whilst it is clear that simulations often build on the curiosity, fantasy and motivation developed in young adults by computer-generated graphics and inexpensive video games (Kirkwood & Price, 2005), they will not appeal to everyone.

Interaction with Others in the Group

Both groups of students indicated that they discussed the tasks with other their colleagues, but the content of these discussions were different. The group using the traditional method tended to concentrate on 'surface' discussions of the task, such as useful resources, amount of detail required and what formats to use. The group using the simulation drilled down into more detail, discussing subjects like specific equations, absorption coefficients, gain, power and intensity. It appeared that the shared experience of the visual image of the acoustic space afforded by the simulation allowed them to more easily contribute to discussion about the content of the task. In this way, they jointly constructed more knowledge about the system than each would have done through the interpretation of their individual experience alone. So, the simulation could be seen not only as a method of scaffolding an individual's mental modelling, but also as a socially constructive discussion support tool.

Processes of Gaining Further Information

There was no substantial difference in the two groups' perceptions of the amount of information they had available, with around half of each group indicating that they believed they had been provided with all they needed. Of those who suggested they required more, the paper-based group were more likely to require information about the materials employed in the building whereas the simulation group were more likely to request details like clarification of scale.

Discussion

The delivery of the task via the computer did not, in itself, enhance the learning process. It would have been be possible to create simple computer-designed floorplan models of the acoustic space, together with height and material construction information, for the students to analyse as a practice application of taught theory. However, Jonassen et al. (2000) compared this cognitivist approach of traditional drill-and-practice technology with that of constructivist simulation technology and found that the latter provided measurable learning advantages.

A specific constructivist instructional design model that applies well to the case studied here is that defined by Jerome Bruner (1967) of discovery learning, whereby the learner draws on past experience, and explores a problem with questioning and experimentation to discover new relationships and facts. The simulation enables this form of learning by allowing the students the freedom to determine for themselves what to analyse, based on the knowledge and skills they have developed thus far as guided by their tutor (Hammer, 1997). Also, it has been shown that discovery learning may increase content relevance and student engagement (Rieber et al., 2004) So, the affordances of the simulation include hypothesis generation (*I think this space will conform to a particular model*), experimentation (*this is how I will measure that*), prediction (*these are the results I expect*) and data analysis (*what the results mean*) (after van Joolingen, 1999). The development of each of these four meta-cognitive skills is key to the objectives of the simulation, as well as being important in “solving” the problem that constitutes the overall assessment requirement of the task.

Conclusion

The use of the simulation impacted on the learning experience of the students in three key ways:

- The increased realism of a 3D model reduced the perceived requirement to visit the actual building — this is important because the control group students believed that the lack of a site visit created a substantial hole in their knowledge.

- The students enjoyed the experience of the simulation, despite some technical issues with navigation, suggesting an increase in intrinsic motivation.

- Most importantly, the shared visualisation of the space through the simulation enabled more effective communication between the students about the task itself, encouraging discussion and hence developing shared understanding.

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USING FICTIONAL CHARACTERS AS STUDENTS' ALTER-EGOS IN PARTICIPATORY DESIGN SESSIONS

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Abstract

The paper describes a novel approach to collaborative design of educational software, one that is based on the use of fictional characters (we introduce the idea of design alter egos) as a means towards eliciting and understanding students' requirements. Through the presentation of the design process, a case study application for the design of a course website and a quantitative and qualitative analysis of the results the paper's aim is to suggest the use of design alter egos as an appropriate, effective and efficient means of co-designing educational software with students.

Introduction

A number of methods and techniques have been developed, that allow the inclusion of children of all age groups in the design process of educational applications, e.g. Cooperative Inquiry (Druin, 1999), Bonded Design (Large et al., 2006), Mixing Ideas (Guha et al., 2004), KidReporter (Bekker et al., 2003). All methods share a strong belief that children can be active participants in the design of more situated and appropriate technology products, and at the same time they serve as pedagogical tools that enable constructivist learning to take place.

However, depending on their age, children may exhibit difficulty in expressing their ideas or find it hard to collaborate with other, mostly adult, team members, feeling intimidated by previously established power relations between them (Nesset & Large, 2004). In order to overcome such obstacles, it is necessary for any participatory design approach to (a) set up a solid ground for collaboration through the use of the appropriate mediating tools and techniques for the project at hand, (b) establish an environment that respects, motivates, stimulates and rewards children for their contributions (Bekker et al., 2003), and, eventually, (c) allow for them and their needs to become the central focus for both the designers and the design process.

The use of fictional characters in requirements elicitation, that either substitute the input of actual users or enhance idea generation processes, has been studied extensively the past few years. We claim that fictional characters can act as a valuable design artefact in collaborative design sessions with students that can support their participation and greatly enhance their creativity. In this paper, after discussing the theoretical framework followed and the two most prominent approaches concerning the use of fictional characters in design, we describe a novel approach, that of design alter egos, and present a case study application.

The We!Design Framework

The objective of the We!Design methodology (Triantafyllakos et al., 2008a) is to enable the design of educational software tools that respond accurately to the distinctive conditions of diverse educational environments. It fits with design circumstances where wide-ranging perspectives on the design problem are essential, time barriers are restricting and participants' long-term involvement is not feasible. It can become an integral part of the everyday reality of an educational institution, without disrupting the students' primary learning objectives and/or activities.

The methodology focuses on the collaboration of software designers with students (ranging from secondary to undergraduate university students, aged between 12 and 22 years old), educators and other stakeholders, for the design of educational software that supports and enhances typical educational processes such as communication, cooperation, knowledge management, knowledge sharing, course management, and so on. The first phase of the methodology consists of multiple iterations of the same, concise and highly-structured, collaborative design process, conducted with different students. During each design session students' problems, needs, expectations and design ideas are elicited and transformed to a low-tech prototype interface through a task analysis stage. In the second phase of the methodology, the designers analyze and synthesize students' suggestions and ideas so as to design a final software product. The methodology has been successfully applied for the design of several educational applications in the past. (Triantafyllakos et al., 2008a).

However, the analysis of these case studies revealed numerous opportunities for the methodology's improvement. In this paper we will focus on the problems, needs, expectations and design ideas elicitation stage of the methodology. By introducing the use of fictional characters in that stage, we aim at establishing a design context where students are encouraged to search for new situated interactions supported by technology — as opposed to mere technological solutions — understand and appreciate their internal motives, identify the causal links between them and their personality traits, and situate their design ideas in entrenched social behaviours.

Personas

Personas as a user-centred design technique were introduced by Cooper (1999) and have been widely used in design research and practice (e.g. Blomquist & Arvola, 2002; Chang et al., 2008; Grudin & Pruitt, 2002). They are considered to be abstract representations of archetypal users based on real user data that result from interviews, observations, field research and/or quantitative data analyses (Pruitt & Grudin, 2003) and have been used as guides to the design process. They are fictional characters that embody users' characteristics, histories, thoughts and feelings (Blythe & Wright, 2006) and have precisely defined aspirations, needs and goals (Blomquist & Arvola, 2002). Personas work complementary to other design methods and techniques that primarily aim at the creation of scenarios, and can greatly enhance their effectiveness (Grudin & Pruitt, 2002). They become a replacement of 'the user' throughout the design process, provide a shared language for communication between various stakeholders, allow designers to measure their designs' effectiveness, avert the risk of self-referential and/or elastic interpretations of 'the user' on behalf of the designers, and, eventually, act as an effective means towards committing design team members to the process (Chang et al., 2008; Cooper, 1999; Pruitt & Grudin, 2003). Yet, their most important benefit is that of being generative, allowing designers to easily project them in diverse contexts and situations and make inferences on their prospective behavior (Grudin & Pruitt, 2002).

However, when personas lack the necessary details that could render them as real, round characters, they could be reduced from user archetypes to user stereotypes (Blythe & Dearden, 2008). As such they can lead to erroneous and superfluous assumptions and, eventually, mislead design decisions.

Pastiche Scenarios

As an alternative to personas, pastiche scenarios propose the use of fictional characters from well-known cultural sources, such as literature, film and pop culture, throughout participatory design processes (Blythe & Wright, 2006). Their overall goal is to provide design stakeholders with the ability to "explore alternative understandings of how different people might respond to proposed technologies" while offering "a space where personal and upsetting issues can be discussed in a distanced and safe way" (Blythe & Dearden, 2008). Pastiche scenarios take advantage of the complexity and specificity in which fictional characters are described and also of people's tendency to strongly engage (Grudin

& Pruitt, 2002) and, at times, identify with them. Such characters can act as common denominators for all participants and reference points for further exploration of social, political or emotional contexts (Blythe & Wright, 2006). Furthermore, by introducing individual characteristics and behaviors in the design process it is claimed that design issues otherwise left unexamined can be brought to light (Dearden et al., 2006).

As in the case of personas though, pastiche scenarios do not come without problems. There is a difficulty for the designers to identify suitable characters, both familiar and engaging for the whole group of participants, especially when working with young participants (Dearden et al., 2006). Additionally, intense engagement with the fictional characters on behalf of the participants could lead to unfavorable discussions where hilarity and fantasy prevail over productive design space explorations (Dearden et al., 2006).

Design Alter Egos

We introduce the idea of design alter egos. Design alter egos have been conceptualized as fictional characters. They are portrayals of representative students with a face, a name, a personality and a life story, but, instead of being based on user data analyses, as in the case of personas, or derive from well-known cultural sources, as in the case of pastiche scenarios, they are created by the students themselves at the initial stage of collaborative design sessions. Each participant creates his own design alter ego, and develops his physiological, sociological and psychological traits through a process of introspection, recollection and organization of personal experiences, and, at the same time, reflection on other students' attitudes and characteristics. Eventually, each participant ends up with his own detailed and tangible rendering of 'the user', which becomes his communication agent throughout the design process.

The design alter egos' construction aims at working as a warm up, preparatory technique forcing the participants to recall and shift all aspects of real users to their working memory and focus their attention on them. In addition, they share several assumptions and benefits with personas and pastiche scenarios. Similar to personas, they intend to be generative and used as a creative source of inspiration, allowing the participants to project them in different contexts and situations, and make assumptions on their prospective behavior (Pruitt & Grudin, 2003). In a way not unlike that of pastiche scenarios, they aim at liberating the participants from the fear of straightforwardly exposing and talking about themselves during the design process (Blythe & Dearden, 2008). Overall, our hypothesis is that design alter egos can act as a technique that can intensify the participation experience and engagement and increase the effectiveness of various collaborative design approaches.

Case Study

In order to evaluate the design alter egos technique, we conducted 12 collaborative design sessions with the participation of 54 undergraduate students so as to elicit requirements for the design of an ideal course website. The process followed in the design sessions was structured and influenced by the requirements elicitation phase of the We!Design methodology (Triantafyllakos, 2008a). Twenty-six (48%) of the students were female and 28 were male (52%). Each design session lasted for approximately 2 hours and 30 minutes and was comprised of four to six students and two coordinators. The coordinators' role was to guide the students throughout the design process and provide support when needed.

A video camera captured the design sessions' setting in order to provide a detailed documentation of the whole process. Additionally, after each session's completion, students were asked to evaluate the design process, the final products, their experience with the design alter egos, and the coordinators' role in a questionnaire containing 5-point Likert scales. Coordinators also initiated in the end of each session a brief semi-formal discussion concerning the students' experience in order to elicit their rationale and critique of the process and their attitude towards the design alter egos technique.

The Design Process

During an introductory phase the students were acquainted with the design process and the problem at hand. The overall goals of the process were presented, followed by a short presentation of the basic principles of design and participatory design in particular. The main challenge set was the envisioning of a course website that meets students' learning particularities, incorporates and sustains technological trends such as social networking and blogging and which can be harmoniously situated in the daily routine of a modern, active student with multiple interests. So as to familiarize with the design process and support idea generation, students were provided with a set of 23 printed hand-sized cards. The cards played a dual role: (a) they acted as a guide for the students, directing them to the different stages of the design process, thus, making it easier for the coordinators to maintain and control the flow of the session; and (b) acted as visual (through their graphic design and pictures) and textual (through their descriptions) stimuli to support students cognitive processes and creativity when needed. The introductory phase lasted about 15 minutes.

Upon completion of the introductory phase the design alter egos concept was introduced. It was imperative to elaborate on the basic psychological assumption behind their conceptualization: that people share a strong ability to envision one's behavior and thoughts while knowing little of his character (Pruitt & Grudin, 2003). Students were then asked to play the role of a scriptwriter and develop their own design alter ego, a character with whom they can relate to and for whom they will be asked to create scenarios during the rest of the design process.

Each student was given a Design-Alter-Ego Form, a specially designed work sheet that allowed them to develop the discrete characteristics of their design alter ego's personality and life style. At the outset, students were asked to select their character's photograph among a variety of photographs depicting people close to their age taken from various cultural magazines. The photographs depicted every day, common people and had a balanced ratio of background, body and face characteristics. The remaining Form elements included the following: name, age, favorite motto, basic personality traits (e.g. extroverted, critical, anxious, enthusiastic, open to new experiences), academic status and ambitions, professional ambitions, technological skills and habits, daily routine and extreme habits. Eventually, students presented their design alter egos to the rest of the group. The duration of this phase was approximately 30 minutes.

The next phase included the design space exploration and constituted the core of the design process. Its duration was close to one hour and 30 minutes. The process was organized in a structured way around the following five design activities: (a) elicitation of existing problems and needs, (b) elicitation of design alter ego specific requirements, (c) search for new technological opportunities, (d) elicitation of requirements after design alter ego swapping, (e) existing solutions' evaluation and (f) envisioning the future. In each activity, students were provided with a set of visual and/or textual stimuli as a source of inspiration for the creation of scenarios describing instances of use of the course website by their design alter egos. Students were asked to work alone at first and present their scenarios and discuss them with the rest of the group in the end. Two or more rounds inside each activity took place.

Results

Informal discussions were transcribed, and students' responses in the questionnaires together with the video recordings were thoroughly examined in order to identify issues and themes regarding the value of the design alter egos in the design process. Table 1 presents summarized statistics from all 12 design sessions. We considered students' positive attitudes towards the session structure, the coordinators role and the design products as prerequisites for examining the effects of the design alter egos. The analysis of students' responses, as shown in Table 1, shows that their satisfaction with the design process was very positive (M: 4.31, S.D.: .41) as was their evaluation of the final list of scenarios (M: 4.29, S.D.: .67). Students believed that the suggested scenarios could eventually lead to the design of an original and particularly satisfying course website. The suggested scenarios covered a wide range of requirements, including both typical needs already addressed in most learning management systems (LMS) (such as providing news feeds, supporting team formation, making available video-recordings of the lectures) and innovative ideas (such as integrating each course with relative job agencies, providing inter-university services for similar courses or presenting course's history in the form of short documentaries). Finally, students acknowledged that the coordinators did not interfere or influence their design suggestions (M: 4.56, S.D.: .67).

Table 1: Summarized Statistics from the Design Sessions

Session	Total # of scenarios	Scenarios per person	Satisfaction with the process	Satisfaction with the products (2qs)	Satisfaction with the coordinators	Satisfaction with the design alter egos
1	23	6.25 (1.1)	4.46 (.07)	4.37 (.94)	4.62 (.47)	4.18 (.31)
2	28	4.50 (1.7)	4.59 (.18)	4.75 (.27)	4.87 (.20)	3.45 (.73)
3	24	6.00 (1.6)	4.10 (.85)	4.00 (.40)	4.62 (.47)	3.62 (1.0)
4	23	5.75 (4.8)	4.14 (.40)	4.12 (.85)	4.93 (.12)	4.25 (.79)
5	18	4.50 (0.5)	4.07 (.50)	4.12 (.47)	3.87 (1.2)	3.56 (.68)
6	22	5.50 (2.5)	4.50 (.27)	4.87 (.25)	4.93 (.12)	3.12 (1.0)
7	18	4.50 (2.2)	4.42 (.11)	4.25 (.28)	4.93 (.12)	4.37 (.47)
8	28	5.50 (0.5)	4.00 (.40)	5.00 (.00)	5.00 (.00)	3.25 (.35)
9	22	5.50 (3.5)	4.60 (.29)	4.50 (.57)	4.18 (1.5)	4.50 (.67)
10	19	4.60 (2.5)	4.25 (.15)	3.80 (1.1)	4.45 (.44)	4.40 (.45)
11	25	6.25 (1.9)	4.51 (.37)	4.37 (.44)	4.71 (.45)	4.46 (.55)
12	24	4.80 (2.0)	3.74 (.18)	3.70 (.83)	3.80 (.57)	3.10 (.74)
Mean (S.D.)	**22.8 (3.2)**	**5.24 (2.5)**	**4.31 (.41)**	**4.29 (.67)**	**4.56 (.67)**	**3.90 (.82)**

Students' Final Products

The analysis of students' needs and ideas allows us to assert that the methodology helped them externalize their prospects for the new generation of e-learning systems. It was rather evident that Web2.0 and its highly participatory and disseminating culture have affected their expectations. Their ideas revolved around the establishment of a learning environment that provides opportunities to (a) *initiate* educational activities, by suggesting lecture themes, organizing supporting lectures or assessing and changing the evolution of the course, (b) *produce* and *share* personal and self-initiated projects, links or comments, (c) *connect to the world* and *communicate* with instructors, fellow or ex-students, other students of the same course in different departments, professionals, and (d) *collaborate* and develop a *community of practice* with students, instructors and professionals, that will allow them to familiarize with relevant cultural and professional practices and exchange ideas, products and interests. Moreover, students seemed to recognize the importance of informal learning activities, and suggested the use of games, simulations and storytelling by professionals. Eventually, they critiqued the isolating and de-contextualized experience offered by traditional LMS approaches, and asked persistently for more socially situated learning experiences and rich media offering (podcasts, vodcasts, etc.).

Students' Attitude towards the Design Alter Egos Approach

The development and employment of the design alter egos were significant parts of the design process and hence students' positive attitudes towards the process indirectly referred back to those phases. At the conclusion of all design sessions, students commented those activities as being the most original, interesting and unanticipated.

Constructing the Design Alter Egos

Although the Design-Alter-Ego Form was concise, students were motivated and willing to engage deeply in the exploration of their design alter ego's characteristics. In almost all design sessions, they asked for additional time to complete the form, to think, develop and empathize with their characters. The creation of the design alter ego initiated a form of introspection which forced students to inspect and recall several elements of their own personality, interests and habits. This effect was in accordance with our initial goal of asking students to develop their design alter egos at the onset of the design process.

The majority of the students projected their own characteristics to their design alter egos. They claimed that they represented either an idealized version of themselves, or an ideal partner (especially in the cases where they selected the photograph of an individual of the opposite sex), or an intimate friend. Only few students experimented with extreme and divergent characteristics, while some created purely humoristic characters.

The selection of the photograph played a decisive role in the development of their fictitious characters. Several students stated they were inspired by the physiological and style features of their selected photograph in order to envision their design alter ego's personality traits and behaviors. In all sessions students were curious to see their colleagues' choices. So as to make students feel less self-conscious of their selection, the coordinators humorously advised students to pick an image of a person that they "will not marry, will not hate and will not help accessorize", but simply "can talk on behalf of him." Still, a few students made selections that were based on the distinctive features of the depicted individual and did not follow the coordinators' recommendations.

Design Alter Egos and Students' Participation

The design alter egos' functioned as 'liberating agents' for the students, since they allowed them to consider themselves not accountable for their proposals. This ascertainment was commonly accepted as one of the most crucial contributions to the process. The majority of the students felt free to explore new behaviors and ideas through the fictitious identity of their design alter egos, relieved from the burden of articulating their opinions straightforwardly and the fear of being criticized. This is further exemplified by the almost identical interpretations of the design alter egos, offered by students in different design sessions: *"The design alter ego) protects you and allows you to say things that perhaps you wouldn't say about yourself. It's a kind of camouflage." and "Several characteristics are mine while others are not. I prefer though to work with a design alter ego. Otherwise it's like playing The Moment of Truth — the TV game."*

Moreover, the development of the design alter egos functioned as a warm up technique since students had to concentrate on their personal characteristics and then re-introduce themselves and socialize with their colleagues with their new identity from the very beginning of the design process. However, students needed some time to get used to the idea of speaking through their design alter egos. As one student stated *"It was somewhat weird at the beginning, but then 'the ice broke'!"* Eventually, all students engaged with their design alter egos to the point that, even several weeks after the completion of the design sessions, they entertained themselves using their design alter egos' names in their conversations.

Design Alter Egos and Students' Creativity

The majority of the students did not think of the design alter egos as an obstruction during scenario writing (M: 4.20, S.D.: 1.08). Instead, they found them to be rather helpful during the whole process (M: 3.70, S.D.: 1.04) and considered them to be supporting their creativity (M: 4.09, S.D.:.99). Several students stated that they would not produce as many scenarios as they did without their design alter ego (M: 3.52, S.D.: 1.22).

The variance in the students' responses related to the extent at which their design alter egos represented a similar to them, or a totally different character. When the former was the case, the design alter egos played a twofold role. They were used as a means of recalling personal problems, needs and preferences, and at the same time, they functioned as a creative source of inspiration offering supplementary fictitious characteristics to think for. The comments made by the majority of the students whose design alter egos shared similar attributes with them, verify this argument: *"Sometimes (the design alter ego) helped me, sometimes it didn't. It brought some ideas to mind that I wouldn't suggest for myself but then I thought: yes, but X — my design alter ego — would like that."* and *"(The design alter ego)* *helped me think more. Most of my ideas were based on the design alter ego (even though I disagreed with him at some points).”*

However, the students who developed design alter egos with whom they could not eventually empathize confronted many difficulties during the scenario writing activities. They participated in the process by simply talking about themselves, or felt trapped in their creation and could not use it as a source of inspiration, or dismissed the whole design process and quietly abstained. In no such occasion did students state that their design alter egos affected them positively while at times they became an impediment to their participation: *“Mine, just made my life difficult.”* and *“My design alter ego was not close to my personality. It did not help me think more. I did not understand what (the design alter ego) had to do with the course website. I found it easier to talk about my self.”*

The design alter egos’ effect on students’ creativity was different during the various design space exploration activities. They worked effectively as generative devices during the first three design activities (elicitation of existing problems and needs, elicitation of design alter ego specific requirements, and search for new technological opportunities) allowing students to produce numerous diverse scenarios. However, the students’ references to their design alter egos diminished as the design process progressed, namely during the last two design activities (existing solutions’ evaluation and envisioning the future). This behavior was to some extent expected. The aforementioned activities presented students with novel and unprecedented views of the design space. Consequently, students needed more time to recognize and comprehend the suggested approaches at first for themselves and then for their design alter ego. It is important to mention that, on the whole, these two design activities facilitated the production of only few scenarios.

Discussion

Overall, students’ evaluations revealed that the integration of the design alter egos in the collaborative design sessions was successful. Our initial hypotheses were supported given that the design alter egos liberated the majority of the participants from the fear of straightforwardly exposing themselves, supported and enhanced their introspection and helped to establish a creative atmosphere throughout the design sessions. In particular, the design alter egos acted as a tabula rasa for the majority of the students to project upon them an idealized version of themselves together with characteristics and behaviors borrowed from others. This presented students with an opportunity to introspect and, in effect, re-invent themselves, while at the same time offered them a fruitful and stimulating source of inspiration that enhanced their creativity.

We could claim that the design alter egos provide a more suitable technique for working with young students as opposed to personas and pastiche scenarios. In both approaches, participants are presented with existing characters, either based on real user data derived from diverse data analyses, as in the case of personas, or born from the imagination of an author or scriptwriter as in the case of pastiche scenarios. However, the resemblance of the majority of the students with their design alter egos correlated significantly with their overall satisfaction from the design process and their view of the design alter egos as creative stimuli. Thus, it could be supported that the identity of a fictional character plays a crucial role for the successful outcome of his employment in a collaborative design setting.

Students' excitement with their participation allows us to assert that they want a more determinative role in inventing their future learning and are available to participate, to be involved and contribute in addressing their needs. Short duration participatory design sessions provide a window to transform the imposed and externally determined reality of educational environments to a co-formulated desired prospect that embeds and respects students' diversity. Eventually, they promote a decentralized future that empowers locality and diversity, encourage participation and involvement, as opposed to homogenization and passivity, and endorse change management without abrupt educational interventions (Siozos et al., 2008). We intend to continue investigating narrative approaches in collaborative design sessions with students, in order to understand and, at some degree, direct the participants' experience in a way that augments their engagement with the process, facilitates their participation and supports their imagination (Triantafyllakos, 2008b).

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THE NEED FOR EFFICIENT AND FLEXIBLE EDUCATIONAL IMAGERY — WHEN AMBITIOUS VISUALIZATION PRODUCTS MEET THE CONTEXT OF ACTUAL LEARNING ENVIRONMENTS

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Abstract

This paper reports findings from a project implementing the Virtual Labs site featuring Flash-based animations developed at Stanford University. The main conclusion in this paper stresses the need to design for flexibility and adaptability of interactive media to better suit the specific situation teachers encounter in their everyday work in order to allow them to build their own audiovisual presentation kits based on various available resources. Ambitious but rigid visualization products might otherwise end up not being used at all.

Educational Challenges and Goals

The use of interactive media in the K–12 classroom has been shown to engage students, increase performance, and help educators convey difficult concepts (Hall et al., 1997; Mayer, 1989). In science curricula, interactive media can transform classroom instruction, making dynamic processes come alive and interactive, while illustrating the connections between different disciplines (Jewitt, 2008). The creation of interactive media for science education has been prolific, however, the adoption of this media has been limited and disorganized (Bayne, 2008; Cuban, 2001; Rieber, 1990). Scientific testing of the use of interactive media has shown that it is not the media alone that contributes to positive results. Surrounding structures such as curriculum, pedagogy and assessment models have considerable impact on students' overall results (Roschelle et al., 2000).

The goal of this project was to consolidate all interactive science media produced to date from Virtual Labs and WGLN (Wallenberg Global Learning network, www.wgln.com) projects onto a single teacher resource website. The work included adapting the content for K–12 students, disseminating knowledge about accessible technology to teachers via workshops and on-site training, designing implementation strategies and best practice for the use of such technologies together with teachers and the development of four case studies. In this paper we report findings from the case studies, and discuss possible impacts our results might have on the further development of visualization products for educational purposes.

Implementation Model

Four teachers from different schools were chosen to participate in the implementation phase of the VL project. Each teacher was asked to choose a suitable application from the VL site and to reflect on how it could be used in any relation to their present course curriculum. It was up to the teachers to use the VL material to the extent that they found appropriate. Two Swedish teachers visited Stanford University for a week during summer in order to discuss and suggest changes together with the Virtual Labs team. The way to use the Virtual Labs material in the classroom was left for the teachers to decide.

The two Swedish teachers visiting Stanford worked intensively to transform the chosen VL application to better suite their needs in relation to their pedagogic model course content. They believed that parts of the applications were too advanced for their students. After the visit, the two teachers and the Stanford development team collaborated via e-mail in order to adapt, correct and improve the chosen applications. The teachers provided remarks and suggestions. They also made critical comments considering some mistakes in the applications. All changes and adaptations were carried out from the Stanford side and a special site for the Göteborg project was created.

Design of the Study

The implementation model was based on a process model including close collaboration with the teachers. Their input in the process was considered to be a key for understanding how teachers would benefit from using VL applications and for future revision of the site. Thus, pre-meetings as well as post-meetings after the implementation were held with the teachers where suggestions for possible teaching scenarios were discussed. We wanted to get the view of the end user, in this case the teachers, but we were also interested to grasp the students' points of view. Accordingly, focus group discussions were conducted with students after the implementation. The rationale for putting a lot of focus on teachers within the project was our belief that no implementation will ever be realized if teachers are not engaged (Pintot & Millet, 1999). The chosen teachers were engaged and enthusiastic persons teaching biology and natural science. They were all willing to try out some of the VL applications in their own classrooms. Since we were interested to find out also how surrounding factors might impact on the implementation of VL applications, the four schools and teachers participating in the study varied in relation to both available technology, previous use of technology in the teaching situation, general level of IT knowledge and knowledge in natural sciences among students.

The teachers represented four high schools in the Gothenburg region:

Komvux Ale, a school where adults can complement previous studies or get gymnasium grades that they for some reasons didn't achieve in high school. According to the teacher, the school is struggling with low resources in general including technological resources.

Hulebäcksgymnasiet, a school with high reputation and high-achieving students. The school is well equipped with technological resources.

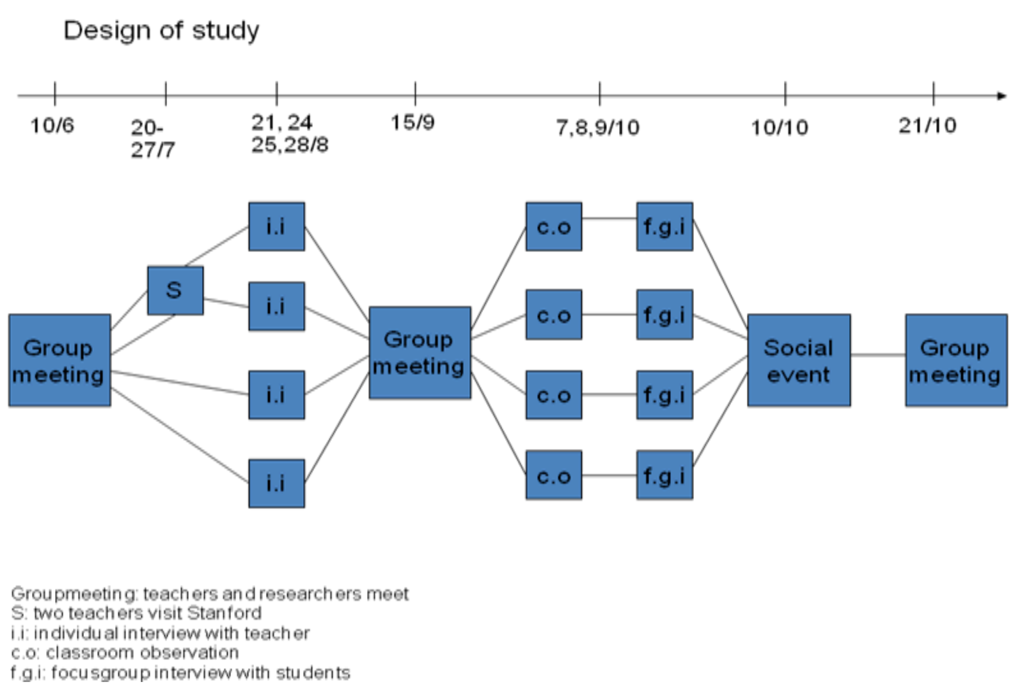
Lindälvsgymnasiet, similarly to Hulebäcksgymnasiet, a school with high reputation and high-achieving students combined with excellent technological resources.

Angeredsgymnasiet, a school situated in suburban Gothenburg, regarded as a low-status school with low-achieving students, particularly in natural science. The school has limited technological resources.

In order to capture the complexity of the situation gaining a deeper understanding of the various issues, this project used method triangulation in qualitative research (Silverman, 2005). A combination of methods was used for data collection: group discussions with teachers, individual interviews with teachers, classroom observations and focus group interviews with students. Interviews were recorded and transcribed for later analysis. Classroom observations were transcribed and classified. Teachers were also asked to reflect upon their own thoughts and attitudes while working with anything related to the VL project. Such situations could be for example when going through available applications at the VL website, when reflecting upon how the material might be used in their own curriculum and pedagogic activities, response and feedback from colleagues or superiors or experiences from the use of new techniques in the classroom in general. Our intention was to ‘get under their skin’ to get an understanding of how the teachers experienced possibilities and constraints in relation to the use of VL applications in teaching situations. The close interaction between teachers and researchers was the philosophy behind the VL project. Teachers later reported that the group meetings between the researchers and teachers were important in having them feel involved in the project.

Below, we present the model we used implementing the VL application. In each phase of the study we evaluated what teachers experienced, wished, and suggested.

Figure 1: Design of Study



Actual Use of VL Application in Classrooms

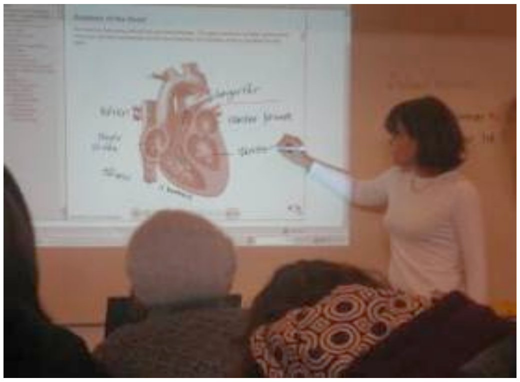
As mentioned previously there was no obligation for involved teachers to use any material from the Virtual Labs website. Consequently, we did not know whether any teacher would actually use anything from the available content. During our classroom observations it became evident that the variations in the individual school's resources such as available technology, previous experience of technology in the teaching situation and general level of subject matter knowledge among students would impact on the teachers' way of using the VL applications in the classroom. Thus, the four teachers differed greatly in relation to how they implemented and made use of the VL site in their teaching. We can — based on our own classroom observations and on focus group discussions with the students — categorize the teachers in relation to how they used the VL application in the classroom the day of our observations: 1) high integration; 2) short side presentation; 3) multiple screens presentation; and 4) not using VL at all.

High Integration

In Komvux Ale, the teacher is an experienced user of IT technology in the teaching situation. The students are highly motivated even though many of them previously have failed in school. The typical student is an adult catching up the gymnasium exam. The school setting is flexible and students have various possibilities to follow courses either at a distance or in traditional campus/ classroom settings. The students are used to having access to part of the course material online at the school's own web portal where course material is presented.

The teacher being the only teacher at the school teaching biology has no network for collaboration within the school. The teacher was interweaving the VL application throughout the lesson actively using the VL site and drawing on the whiteboard. Since the VL images were projected on the whiteboard it was possible to write personal comments straight on the screen, but also to draw handwritten images at the side. The teacher was using active body language and later also hands on lab activities for the students. During hands-on activities, the teacher verbally related back to the VL animations and images presented previously.

In the following focus group interview with students they all appreciated the use of the VL material in the teaching situation and expressed that animations were good and helped them understand difficult concepts. They appreciated the variation of methods used in the classroom. They also liked the order of sequences the material was presented in. As an example, the teacher first gave a lecture and then let the students conduct experiments in relation to the previous presentation. This teacher expressed high satisfaction with the VL application saying *"I believe that this year, my students test performance improved in relation to their ability to present* *more detailed answers of how the heart is structured and its functions. This was a positive surprise for me."*




Picture above: Using the whiteboard to project the VL image makes it possible to white "on the picture"	Picture above: Picture taken during a heart dissection, one of the practical parts of the curriculum

Short Side Presentation

The teacher in Hulebäcksgymnasiet is a very experienced user of IT technology in the teaching situation and has developed his own teaching material. The students are considered as high achieving and are highly motivated in both biology and natural sciences. Teachers in this school are mainly working individually. The teacher had a previously developed PowerPoint presentation that was presented for the students. The lecture was given mainly with this material. At one point during the lesson, the teacher projected an animation from the VL site on a screen parallell with the PowerPoint presentation screen. This animation was approximately two minutes long.

In the following focus group interview with students, they declared that they liked this style of teaching and in particular they liked the teacher's body language presenting 'physical animations' with his own body. They believed that digital animations might be a good supplement but that they might also distract from paying attention to the teacher. The teacher had gotten increasingly skeptical to use virtual representations of lab exercises during the VL project: *"Well, I think it's useless to use these as lab exercises. I don't believe in virtual labs any longer. Why not? Because a lab is very much a question of touching things you know, the feeling, smell, being there, be able to do mistakes and all this."* In spite of this sceptical attitude he also saw some benefit of using VL applications: *"I think you could use it to show things in a lecture and then let the students work with it at home in order to repeat and learn. They can repeat as many times they wish."*

Picture above: The use of two projection screen simultaneously to show a PowerPoint presentation and the VL animation at the same time	Picture above: helping the students focus on the important parts of the animation

Multiple Screen Presentation

The teacher in Lindälvsgymnasiet is very experienced in using IT technology in teaching situations. The students at this school are considered to be high achievers with high motivation. The school is well equipped with IT technology at all levels, computers, wireless network connections and projectors in many of the classrooms. The teachers in this school work in teams and plan the courses and the teaching together. She presented her lesson as usual making the students look at various screens during the lesson and moving their chairs around to get a better view of each screen. Her students like her way of teaching but think the technology equipment should be improved since some laptops don't work and projectors occasionally go down during lessons.

Students commented on the video shown: *"I liked seeing the movie in real life. You get a better look at it. But you don't really learn from it."* They said they learn from lectures and that videos are useful for seeing *"what something looks like"* but not *"how it works."* Their suggestion was that videos should be played last after the topic has already been presented. They described the VL animations as *"better than gestures,"* and *"simpler to see what's going on, where in the video it's all goo."*


Picture above: many projector screens are in use simultaneously in the classroom	Picture above: Presenting images on one of the screens

Not Using VL At All

The teacher was, according to herself, inexperienced in using IT technology in the teaching situation. The school is poorly equipped with computers. The students are usually not allowed to work on their own in the computer room. The teacher is part of a teaching team as the entire school is working with a fully developed model of problem based learning. Each team of teachers plan together what to do in their classes and courses. Students in this school are considered to be low achieving and have poor motivation for biology and natural sciences. Many of the students are studying art, thus natural science is a compulsory subject that isn't very popular. However, students clearly like their teacher and the teacher successfully involve them in the subject by putting a lot of effort in getting them engaged.

In the focus group discussion, the students had a lot to say about the use of images and animations. They discussed the notion of being misled by images as well as being too entertained by animations. They feared that with entertaining animations, learning might become less important than the entertainment in itself.

Conclusion

The VL project's most important finding is related to the issue of providing flexibility for teachers. This concern became evident during the second meeting with teachers when they had all been able to work within the VL site. It was evident that teachers didn't like the fact that images and animations within the site could not be cut out and pasted into a personal PowerPoint presentation. Also, VL applications that teachers would like to use in their own course curriculums were fixed in already preset format and content whereas teachers needed flexible and adaptable material to suit their own individual needs when developing their lectures. Another problem was that the text-based explanations connected to images and animations were all in English and could not be translated. For the Swedish teachers this was a huge drawback. Even if Swedish gymnasium students generally are good at English, a foreign language undoubtedly raise an extra barrier when it comes to learning new biology terms and concepts. The teachers also believed that the download time for images and animations was far too long and they feared that students would lose their patience if having to wait several seconds for each animation to download and start playing.

Apparently, what we observed during the VL project is a contradiction between a "traditional" view on knowledge creation and knowledge transmission and what teachers are actually asking for in their everyday practice. Whereas the producer traditionally is producing a fixed product that the teacher traditionally is supposed to utilize in its preset format, many teachers are now asking for material that they are able to modify and adopt to their own pedagogic model and course curricula. The teacher wants to be in command being able to build their own lessons based on various available resources. This change of roles very closely mimics a general development in digital media, where there is a move from big professional media producers and passive consumers, to blurring boundaries between producer and consumer (Denegri-Knott 2003). We are actually seeing a rapid development in the use of web sites such as Wikipedia and Youtube also in educational settings, and this is just the tip of the iceberg in this development (UNESCO, 2008).

When creating content for teaching, media producers need to take this into account. We believe that moving away from a traditional producer/consumer perspective is necessary. What the modern user/teacher/consumer/producer needs is the building blocks, the bits and pieces for building their own products. Most teachers can't produce imagery on their own, but they have the need and willingness to select, adapt and structure images from a proverbial smorgasbord of content. As noted before, any web site or other tool offering these bits-and-pieces must be user friendly. If ready-made material, like many of the VL web-site products, will be used by teachers, it is important to restructure the material so that it enables users to use it their own way. It should for instance, be possible to cut out pictures and insert text in relation to individual courses and groups of different students. The VL web site material was created using Flash which seems to be a production tool too rigid for this purpose? Future designs should use programs that create flexible applications to allow for end users to adapt the sequence of images as well as animations in relation to their own situation.

We also believe that the Virtual Labs' animations need to take into account the range of possible levels of complexity which a representation — an illustration — can have. As Bayne puts it "image is never neutral or 'innocent'", but rather works to enable particular ways of seeing and occlude others, situating and constituting subjects in specific ways (2008). Rose (2001) also stresses that visual images do not just emanate meaning in some kind of vacuum, despite claims to the contrary. Meaning is made with them, from them, against them, by particular people in particular places. Their audiences are fundamental to their effects.

As mentioned previously, representations in a class room situation can range from hand gestures to digital animations or computer games. Primarily, the Virtual Labs animations fall somewhere in between, in a narrow range of short, not very interactive animations. As we try to illustrate in the diagram below, each of the four teachers had their own individual response curve to different levels of technical and pictorial complexity. Some prefer simple representations, other dream of something very complex. The same goes for students. The crucial question is of course how well each illustration achieves the target of teaching. From the viewpoint of efficiency, simple representation with high achievement is to prefer. At the same time, sometimes a high level of complexity could promise an even higher level of target achievement. There is no answer to where on the line between simplicity and complexity an illustration should be. It is dependent on each case. But we do believe it is important for producers of learning material to be aware of the whole range of possibilities. Sometimes, hand gestures may be better and extensive images or animations are not needed. Sometimes, huge resources had better be channeled into advanced game like simulations. Or sometimes, ‘best practice’ is found in the combinations of different ways of presenting the course content as one student pointed out: *“I liked the combination of the presented material such as mixing handwritten images on the whiteboard with animations and having lab exercises as well.”*

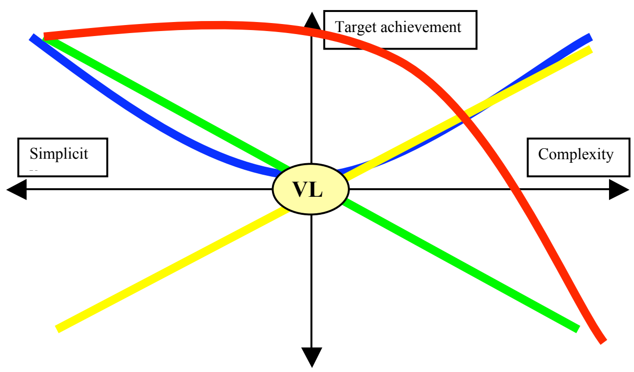
Komvux Ale is indicated in Figure 2 below by the red line. Simple hand gestures was used by the teacher and appreciated by the students. The VL animations were also appreciated by both students and the teacher. However, based on the low technical resources at the school, complex visualization products become useless since they will be impossible to demonstrate and therefore target achievement goes down the higher complexity the digital visualization product becomes.

Hulebäcksgymnasiet is indicated by the blue line. In this case, the teacher used simple hand gestures to illustrate issues during the class in combination of his own visual representations. In this highly technical equipped school there are extensive possibilities to use complex visualization tools, something that students also talked about as interesting possibilities. However, these students also raised critical comments thinking that visual illustrations might sometimes be misleading. The teacher disliked the VL applications and was reluctant to use them in his teaching practice. Therefore simple illustrations as well as highly complex ones are seen as leading to high target achievements whereas the VL illustrations are associated to mediocre target achievement.

Lindälvsgymnasiet is indicated by the yellow line in the model. The teacher at this school clearly preferred visual illustrations and the higher the complexity the better. Therefore target achievement with the teaching is seen as increasing as a function of increased complexity in the visual product.

Angeredsgymnasiet is indicated by the green line in the model. In that case, target achievement decreases when complexity rise since technical equipment is very scarce in the school.

Figure 2: Conceptual Model Finding the Right Level of Complexity in Representations for Target Achievement



To conclude: the most important conclusion is to design for flexibility and adaptability when developing visualization products for educational purposes. Such products should allow end users to adapt the product to their individual preferences and circumstances which is something that designers mostly are unaware of. Of course there are restricted possibilities to produce such flexible applications. However, locking the order of sequences in a given application should be avoided in future development of visual tools for educational purposes since this study shows that when such ambitious visualization products meet learning situations, they tend to become useless for teachers. Rigid applications will be rejected in favor of resources that are more adaptable and thus suitable for the individual learning situations individual teachers encounter in their everyday work.

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INTEGRATING GAMEPLAY AND LEARNING IN VIDEOGAMES

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Abstract

Videogames are increasingly becoming the preferred entertainment activity for young people. Researchers claim that videogames have the ability to enrich and encourage learning by augmenting traditional learning methods. Here we are investigating how videogames can support physics education by stimulating students and creating an environment for them to experiment through a series of game activities. We have developed a pilot platform game for students attending Year 2 of secondary school in Greece (13 years old) to cover the course "Forces and their Effects." The aim of this work is to explore whether integrating the learning process to the game play can enrich learning and investigate if videogames can offer an alternative tool to the teaching of concepts that students have difficulty in understanding.

Introduction

Students raised in the new digital age are gradually losing interest in the traditional forms of teaching and learning. One of the subjects that particularly suffers is science. According to a report by UK's NESTA[1] pupils in the UK are losing interest in science because too often the subject is being taught as just facts on a blackboard. The current, narrative, teaching methods do not allow practical experimentation whereas the fundamental scientific principle of 'trial and error' is not encouraged.

The new generation of students has been developed and shaped in the new digital world. Digital technology is fully integrated into their everyday life and they use it for searching for homework, maintaining relationships and playing games (Green & Hannon, 2007). The nature of digital technology has influenced and shaped the way they receive and process information. As a result, traditional teaching fails to keep them stimulated and challenged.

In particular, videogames appear to be one of the favourite pastimes of young people. A study in the USA showed that virtually all American teens play computer, console, or mobile phone games (Lenhart et al., 2008). Similarly in the UK, 82 per cent of children play games after class at least once in a fortnight (Sanford et al., 2006)

In response to that, over the last decade there is a huge amount of research concerning the use of videogames in learning in general, and in science in particular. Videogames can develop and enhance a lot of the skills that science requires. They enhance inductive discovery by allowing players to make observations, and figure out the rules governing the behaviour of a dynamic representation (Prensky, 2006) and they create a safe simulated environment where kids can experiment, develop critical thinking and problem solving qualities through playing.

These qualities can potential create a fun and stimulating educational environment. Although there is a lot of theoretical work tackling this issue, the number of games that integrate learning in their gameplay is limited. This reflects the difficulties and challenges that such an effort involves (Klopfer et al., 2009).

In this work we investigate whether an action game can enhance teaching of physics in secondary school students and examine how integrating learning in the playgame can produce an educational but fun and involving game. We also explore what the impact of using a videogame is on students learning physics.

Contrary to the published edutainment products of the past decade, our aim is to create a simple videogame with clear educational value which will equally entertain and educate the students without introducing them into a formal educational environment.

In this paper we review the potential of videogames as learning tools for teaching focusing on physics education. We present the initial phase of our pilot study which attempts to investigate how videogames can enhance physics learning. Towards this, we have designed a 2D platform game which integrates physics concepts (forces and their effects) into the gameplay mechanics.

Learning through Videogames

The origins of learning through videogames can be traced as far back as the first successful videogames console, the Atari 2600. Those primitive games took advantage of the unprecedented graphic and interaction capabilities of the early consoles to introduce some basic educational applications to children such as Fun with Numbers. In the early eighties the personal computer, in the form of Apple II and Commodore 64, found its way to many households and along came educational software as a major hook for parents to justify the purchase of those expensive machines. In the nineties, the personal computer acquired high resolution colour displays, CD-ROMs, music playback and large processing power. A whole new market segment evolved with the sole purpose of producing educational games for children (eduntainment) targeted at parents. By the end of the nineties, the rise of the Internet as an educational tool and the failing quality of educational games shrunk the eduntainment market segment. The new millennium saw the renaissance of videogames as an educational tool to enhance the learning process in the classroom (Chen, 2005).

At a first glance it may seem contradictory to combine learning with fun, as learning is thought of as a serious process that requires great concentration and effort. There is a large body of, mostly theoretical, work that advocates the suitability of games as a learning tool.

Why are Videogames Suitable for Learning?

Playing games is not a privilege restricted to the human species, but a universal process across the animal kingdom. Most animals use game-playing as a means to learn crucial survival skills, such as hunting alone or in groups, fighting off enemies, escaping danger. Humans use games in a similar way in the context of a more civilized, social, environment. For instance, board games that evolved over the years for entertainment and socialization purposes have also been used for centuries to enhance decision-making skills by the Army.

Videogames are, in essence, interactive virtual simulations of physical spaces and processes, populated by characters and objects. The player is represented by a character (or more generally an avatar) and can navigate and interact with this virtual world. In the past decade the virtual world of videogames has been almost exclusively presented in three dimensions, with high quality graphics and sound.

The videogames exhibit an abundance of characteristics that can prove useful when used in education (Chen 2005; Gee, 2007; Prensky, 2007):

- Representation. The virtual world represents a physical environment, at various degrees of abstraction, and any component or process in it. The virtual world is rendered visually and aurally and frequently augmented by tactile input/output.

- Simulation. Processing power is cheap nowadays and this allows accurate simulation of many processes in a virtual world, including physical interaction, motion and intelligent behaviour.

- Rules. A virtual world is bound by rules and is deterministic. For every action we can define an outcome. Furthermore we can design the rules in such a way as to teach.

- Interaction. A player can interact with the virtual world in real time and navigate through it.

- Feedback. A player receives instant feedback on her actions. If she performs well, she will be rewarded. If not, she can learn what she did wrong.

- Motivation. Through interaction, feedback and reward the player is motivated to keep on playing the game, for much longer that she would spend reading the textbook or paying attention to the teacher.

- Collaboration. Many players can take part in a videogame through a local network or the Internet and learn collaboratively.

- Logging. User actions and consequences can be logged in a videogame and later studied and evaluated.

- Low cost. A virtual simulation is cheaper as well as safer than a real one.

In a videogame the player can interact with various components, she feels “present” in a virtual world where she has perform actions to progress. Learning through doing is compatible with a relatively new popular learning theory called constructivism (Fosnot, 1996; Gijbels et al., 2008). According to this theory the student is not a passive consumer of knowledge but has to actively participate in knowledge-producing by experimenting and applying processes herself.

Each videogame is an abstract version of a real system, bound by rules and processes. The player is motivated to learn those rules and processes in order to play the game successfully. Through this, learning knowledge is acquired. The expectation and belief is that this knowledge can then be transferred from the virtual to the real world. This (and how it takes place) is the main research goal of this work, as well as the work of other researchers’ that study the use of videogames in education.

Different Modes of Learning

Videogames can support two different modes of learning. The first is through narration which is not directly related to the gameplay. The student plays the game and receives information about a topic at intervals. For instance, information could include the history of a building or place that appears in the game. Alternatively, the player receives the information at the end of the level (often through a video cutscene). The second mode involves learning through gameplay (i.e. through doing).

In the first mode gameplay is just a hook to keep the learner involved and motivated to keep playing. In the second mode an attempt is made for the player to gain knowledge through actively following processes and performing actions.

Learning through narration in a videogame can be efficiently used in some cases, for example in teaching history or culture. Furthermore it is the easiest mode to implement in an educational game since gameplay mechanics are not really affected by it. Learning by doing on the other hand requires special game design, in order for the gameplay to assist in knowledge construction.

We believe that actively integrating learning and gameplay is better suited to science education and especially physics education. The player takes part in a simulated world, and learns through a “physical” interaction with it. We have based our game design on this assumption.

Physics Education and Videogames

Physics is probably one of the most challenging subjects to teach using videogames. Physics runs through any videogame, everything from racing cars and flying airplanes to water flow and character animation is simulated using the fundamental principles of physics.

Physics simulation is a fundamental ingredient of videogames, enabling the implementation of realistic interaction with the virtual world, which leads to increased immersion in the game. When playing a game, players come across a range of physics concepts all well built-in into the game activities that become unnoticed. So how can a game designer integrate physics learning, without spoiling the player’s experience?

There are a few empirical studies investigating the impact of videogames in teaching. The potential of teaching physics has only recently been tackled.

Can videogames provide a visual and experimental space for students to understand complex and abstract physics concepts? Research using the 3D simulation game Supercharged! (Squire et al., 2004) showed that games can be effective tools in physics education, but they suggested that students did not infer some of the more complex concepts and were unable to interpret game events in terms of physics concepts, while some misconceptions about the interaction among charged particles persisted.

Methodology

We have designed an action platform videogame to allow students to develop an intuitive understanding of concepts relating to the unit “Forces and their effects” taught within the Greek curriculum to the Year 2 students of Secondary school. Specifically the game deals with the following concepts: representation of forces using vectors, forces and interactions, measuring forces, balance, friction, inertia, types of forces. Players learn about the related physics concepts by helping the main character overcome a series of obstacles in order to complete the game successfully.

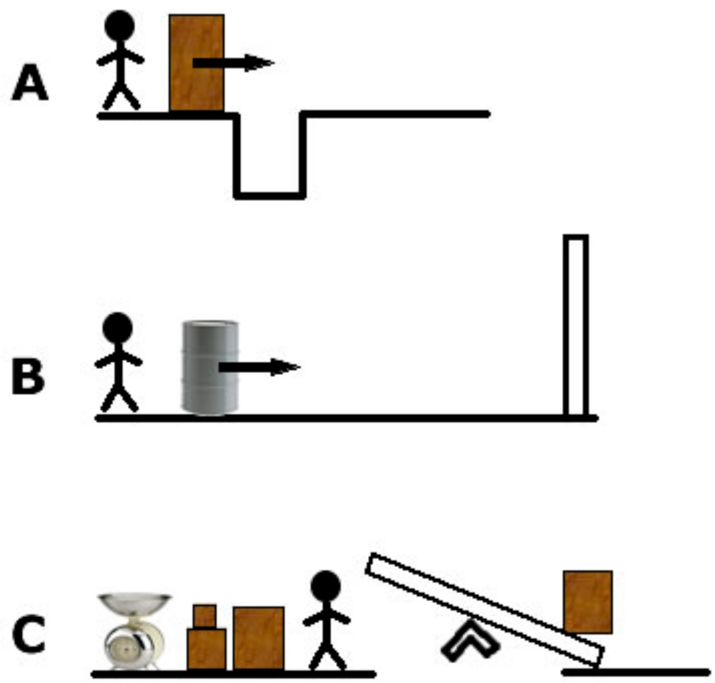
Designing a Videogame for Physics Education

The game is a two-dimensional platform game, in the same vein as the early Mario games. Platform games are a very popular genre among children and their mechanics are well understood. Furthermore we decided the game to be in two dimensions so as to remove the requirement of three-dimensional navigation which some players, especially the inexperienced, are not comfortable with. The fewer degrees of freedom supported by a two dimensional game is expected be less of a distraction and to allow the player to concentrate at the tasks at hand. Finally, two dimensional games, in general, require less computing power and display capabilities and run equally well on older personal computers. This is very important when designing a game to be used at school computer laboratories which often are not state of the art.

The aim of the game is for the player to reach the end of each level, negotiating the various obstacles and collecting treasures in the process. Various enemy characters are present on the game platforms which pose a threat to the player’s character. To enhance competition between children we reward players when they successful pass obstacles with extra points.

In Figure 1 we show samples of concept art developed for the pre-production phase. Through the gameplay mechanisms, players visualise that the length of the vector representing the force depends on its magnitude (A), try to overcome an obstacle by using the concept of inertia by adjusting the mass of the content of a barrel so that it reaches and breaks the obstacle (B), use the forcemeter and comprehend balance (C).

Figure 1: Sample Gameplay Design



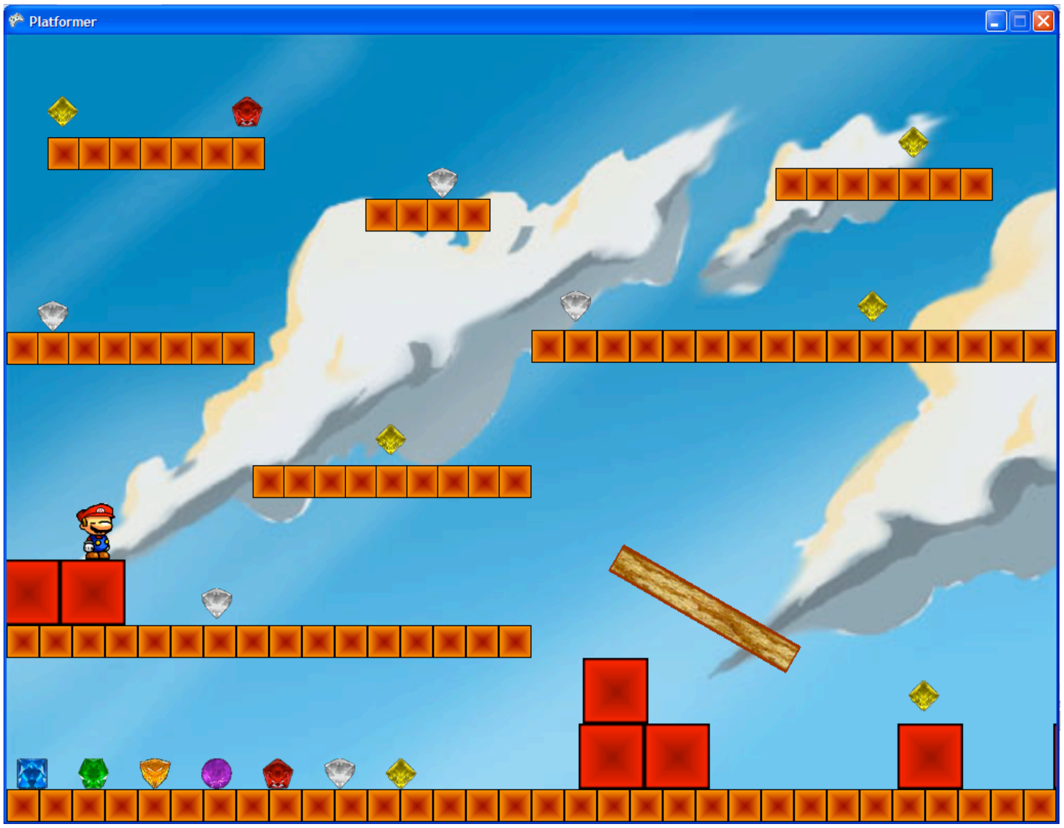
Implementing the Videogame

The game was implemented using the XNA Game Studio 3.0 platform[2] which is available for free over the Internet. Games developed with XNA Game Studio support both Windows and the Xbox360 console. In our case the game will be tested on Windows XP platform only and the keyboard is used as the input device.

Data Recording and Evaluation Plan

This game is a pilot study to evaluate the impact of videogames in the learning of physics. The game is designed for Year 2 secondary School students (age 13) and attempts to support the unit "Forces and their effects." On that year students come across abstract physics concepts for the first time, so the sample is well suited as a testing ground to evaluate whether complementing the learning process with a videogame actually enhances their understanding of conceptual science.

Figure 2: Sample Game Instance



The pilot study will take place at a secondary school on Corfu, Greece and will involve 32 students, all taught by the same teacher. All students will be taught the content of the “Forces and their effects” unit using the traditional method of teaching that the teacher employs. In addition, a subgroup of these students will play the videogame.

We will use post-game tests and interviews to assess the impact of the game in the learning process.

Conclusion and Further Work

Employing videogames as a user-friendly and powerful interactive simulation is expected to enhance the learning of science topics, especially physics which is the subject of our work. In this paper we have presented our initial work on a pilot study we are conducting on the use of videogames to assist in physics learning. The next step of our study is to evaluate the videogame following the evaluation plan described above (qualitative and quantitative), with a group of secondary school students. The results will give us an indication on how much and how the videogame has improved the understanding of key physics concepts relating to "Forces and their effects."

Notes

1. A Mission for Innovation — Fostering science enquiry learning across the UK, http://www.nesta.org.uk/a-mission-for-innovation-fostering-science-enquiry-learning-across-the-uk/
2. XNA Game Studio, available at http://creators.xna.com

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THE IMPACT OF INTERACTIVE COMMUNICATION TOOLS IN ONLINE LEARNING COMMUNITIES

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Abstract
This paper discusses the use and importance of existing and emerging interactive communication tools used in online courses. The challenges and opportunities associated with the use of those tools are examined in light of student feedback. Our findings show that interactive communication tools in online courses have the potential to greatly contribute to a positive online learning experience, if used appropriately. The implications for faculty teaching online courses are also discussed.

Introduction

Higher education in the United States is at a pivotal time in history and online education is playing a critical role in the long-term sustainability of many programs and institutions. The U.S. economic recession has resulted in severe cuts in state funding for four- and two-year colleges/universities, declining endowments, and decreases in fundraising while at the same time operational costs have continued to rise. For increasing numbers of colleges/universities, online education provides extensive programming options to reach new student markets through quality academic curricula and innovative delivery which can increase tuition revenues as well as expand an institution's future alumni base.

The National Center for Education Statistics (2008) reports that two-thirds (66 percent) of two-year and four-year Title IV degree granting higher education institutions in the United States offer online, hybrid/blended, or other distance education courses. In fact, online student enrollment growth rates now exceed overall higher education enrollment growth rates in the United States. According to Allen and Seaman (2008) the online enrollment growth rate increased 12 percent between fall 2006 and fall 2007 while overall higher education enrollment only increased 1.2 percent. Allen and Seaman (2008) also reported that over 20 percent of all U.S. higher education students reported taking at least one online course.

Recognizing online students may infrequently or never come to campus, it is critical that online programs develop and integrate effective communication strategies to connect students to peers, faculty, and the campus. Communication strategies must be developed to engage students and build community through programming (e.g., student orientation, online first-year experience programs, academic advising, student support services, online events, etc.) and instruction (e.g. asynchronous — lecture materials, voice and text announcements and emails, blogs, wikis, etc; synchronous — live classroom lectures, teleconferences, text messaging, etc.). Those communication strategies are commonly used in online learning communities. Ingram (2005) argues that all of Ormrod's (2004) criteria for defining a learning community (e.g. discussion and collaboration among members, critical assessment of participants' work) are also applicable in an online setting. Ingram's key question for the online learning communities is whether the online communication strategies such as the ones mentioned above provide a comparable experience in terms of immediacy as their face-to-face counterparts. Clearly, effective communication is vital to student recruitment, engagement, community development, and retention which are directly linked to online program long-term sustainability.

Review of Literature

"Communication is a growing discipline" (Pfau, 2008, p. 598). However, according to Littlejohn and Foss (2005) establishing a single definition for communication "has proved impossible" (p. 12). Tubbs and Moss (2006) state that "many people find it helpful to use a tangible model" to describe the human communication process (p. 10). Therefore, this paper will build upon the Tubbs Communication Model which includes Communicator 1 (the sender/receiver) and Communicator 2 (the receiver/sender). Tubbs and Moss (2006) describe both Communicator 1 and Communicator 2 as sources of communication since each originates and receives messages simultaneously. These messages are transmitted verbally and/or nonverbally. While Communicator 1 originates the message, the transmittal of the message may be affected by the channel or interference. Channels of communication include face-to-face communication, organizational communication, and mass communication.

In online education, effective communication is particularly important because there may be limited or no face-to-face communication and interaction throughout a student's enrollment" (Betts, 2009). Therefore, faculty/adjuncts who teach in online programs must receive training on effective communication, the role of communication in online education delivery, and how to properly use new technology to support effective communication. As indicated by Lorenzetti (2003),

> Faculty members are one of the most critical hires that you have to make in your online program. While traditional, on-campus students form an impression of your institution based on factors from physical plant to extracurricular activities, the one face that often represents your entire institution to online students is the instructor. (p. 1)

Faculty play a critical role in student engagement and retention. According to Tinto (2006), "Frequency and quality of contact with faculty, staff, and students has repeatedly been shown to be an *independent* predictor of student persistence" (p. 2). Additional research by Chickering and Gamson (1987) reveals that knowing faculty and faculty concern assist students get through challenging times and enhance a student's intellectual commitment**.** Interaction in face-to-face, online, and blended programs vary depending upon the channels of communication integrated into the courses. Therefore faculty need to be trained in how to communicate in an online environment. This is particularly important since, according to Faharani (2003), interaction in a face-to-face program is predominately based on verbal and nonverbal communicative behaviors while interaction in online courses is predominantly based on written communication. As further indicated by Collison, Elbaum, Haavind, and Tinker (2000) "in the virtual world, there is no body language from which the instructor can gauge the interest of the participants and, consequently, adjust the tone or pace of the presentation" (p. 1). Therefore, faculty/adjuncts need training to successfully communicate with students through new technologies and course management systems.

Purpose of Study

In light of the literature findings described above, the purpose of this study is to examine the importance of a selected number of online course management system tools in establishing an online learning community. In addition, this paper will provide insight into how the specific online course management system tools affect students' overall perception of the course experience. Based on those two goals, the study attempts to answer the following research questions:

- What is the effect of the communication tools used in online courses in creating online communities?
- What is the effect of the communication tools used in online courses on students' overall perceptions of the course?

Course Management System Tools

Hardware and software improvements have allowed for the creation of a number of interactive course management system tools which afford course users the opportunity to communicate both synchronously and asynchronously. This section summarizes the use of the interactive communication tools to which the study's participants were exposed to. Included with the description of each tool is an empirical assessment of the opportunities and challenges associated with each use based on the authors' experience.

Text Discussions

This traditional mode of online interactions allows users to post text based messages and participate in asynchronous discussions. Broad or specific discussion topic areas could be posted by the course instructor and students are often required to provide a response the instructor's prompt as well as respond to fellow classmates. This is one of the most commonly used communication tools in online courses. Online participants benefit from the traditionally text-based discussions by reading the different responses from their peers. In addition, text-based discussions are easily accessible as users can submit a response from virtually any internet- ready device. However, the lack of non-verbal communication elements combined with the asynchronous nature of the text-based messages and the limited presence of the paralanguage code *may* result in a decline in both the quantity and the quality of the participants' interactions. *For example*, students may feel less engaged and motivated in responding to a plain text post. While the instructor can influence to some degree the motivation level of the participants it is the online students who ultimately control the nature of the text-based discussion.

Blogs

A more recent text-based communication tool used in online courses is the blog. The blog tool allows users to make asynchronous text-based entries that appear on a webpage format. Course participants are typically able to comment on individual blog entries if the course instructor enables that option. Course instructors also have the option of allowing students to create their own individual blogs or create one blog for the entire course. The course instructor also has the option of making the blog entries private (viewable only by the instructor) or public (viewable by the entire group). This journal-type tool does enable students to interact a bit more informally; however, the fact that blog interactions typically contain less structure than the traditional text-based discussions may pose a challenge for students who prefer detailed instructions in terms of the content of the entries.

Audio Discussions (Voiceboards)

Audio discussions allow users to post audio based messages and participate in asynchronous discussions. In other words, audio discussions or voiceboards, as this communication mode is often referred to, are created under the same basic assumptions in terms of their purpose and expected use as the traditional text based discussion tools. However, voiceboards enable participants to record their contributions. The inclusion of the contributors' voice may result in a stronger sense of communication immediacy among students. While the non-verbal communication elements are still absent in this mode, users are exposed to paralanguage features such as tone, pace, pitch etc through the audio interactions which may result in an increased level of motivation to participate and engage in the discussion. In addition, a well thought topic submitted through the voiceboard tool may result in the development of an asynchronous "debate" as opposed to a simple message exchange which is typical of a traditional text based discussion. A possible drawback of the voiceboard tool is the specific accessibility requirements: participants need to have access to a microphone and speakers in order to use the voiceboard tool. Therefore, the accessibility of voiceboards is more limited compared to the text based discussions.

Announcements/Voice Announcements

The announcement tool allows the instructor of an online course to post frequent text-based updates and reminders on the home page of the course. Conversely, the voice announcement tool enables instructors to post audio announcements; students have to click on a play button and listen to the instructor's commentary through headphones or speakers. The use of the voice announcement tool may result in a closer interaction between the students and the instructor as opposed to a plain text-based update. For example, students may be able to relate to the instructor much more through the voice announcement tool as its use includes two out of the three main communication codes (verbal and paralanguage).

Voice E-mails

In addition to the traditional text-based e-mail messages, online instructors have the option of sending voice e-mails to students. When a voice e-mail is sent, students receive a link that includes a control panel through which the message can be played. Students can listen to the e-mail message through the use of headphones or speakers. As with the other voice tools, the communication process is likely to be more immediate between the instructor and the student through a voice e-mail due to the presence of the paralanguage code in addition to verbal code.

Live Classroom

The live classroom software is one of the few tools used in online courses that allows for synchronous interactions between the members of the course. It is also the only tool that enables the main presenter to use live video communication. Typically, course participants are invited to join a live classroom session through a designated link (called a room). Once in the room, participants can see a live video feed of the main presenter along with the optional use of visual aids (PowerPoint, websites, notes on the board, etc.). Students can interact with the other members and the presenter by using a text-based chat function, indicate that they wish to speak by using a "raise hand" function, agree or disagree with a statement by using the "yes/no" function and/or communicate a certain action (applaud, approve, want the presenter to speed up) by using the "emotions" function. While the synchronous mode of communication allows for a high level of interactions due to the presence of all three communication codes (verbal, non-verbal, paralanguage), scheduling can be a challenge as online course participants are spread out across different time zones in the world.

Student Perspectives on Course Management System Tools

Survey Description

In order to effectively use all of the interactive course management system tools described above a significant time commitment and effort is required from the instructional and course design teams. Therefore, it is important to solicit feedback from online students who were exposed to the tools described above in order to gain an understanding on the impact of those tools in students' overall perception of the course and the ability of those tools to meet their intended function. Accordingly, students in three online courses which included one section of interpersonal communication and two sections of public speaking from a major university in the United States were surveyed in regards to their views on the use of the communication tools used in their courses. The survey was available during the last week of each course. Student participants were awarded a 5% extra credit bonus towards their final grade for completing the survey. Overall, a total of 40 students were invited to participate in the survey of which 30 responded, a response rate of 75%. Results were reviewed for any major discrepancies between the three different sections. While slight variations were observed in terms of the preference of some communication tools over others across the sections, no statistically significant difference was detected.

Quantitative Findings

As indicated on Table 1, most students clearly felt that the voiceboard tool was overused.

Table 1: Communication Tools Overused

Text Discussions	27.27%
Voiceboards	40.9%
Voice E-mails*	9.10%
Live Classroom	13.63%
Blogs	9.10%

*Voice E-mail description may include voice announcements.

This is a surprising finding given the fact that participation through the voiceboard tool was only required in about 30% of the discussions.

On the other hand, as indicated on Table 2, a significant number of students felt that the voiceboard tool was used appropriately coming second only after the traditional text-based discussions which is the standard communication tool for most online courses.

Table 2: Communication Tools Used Appropriately

Text Discussions	28%
Voiceboards	25%
Voice E-mails	14.71%
Live Classroom	22.06%
Blogs	10.30%

An even more surprising finding of the survey results as shown on Table 3 is that a high number of students felt that the voiceboard was not used enough, again coming second only after the live classroom sessions. Due to scheduling limitations live classroom sessions were utilized twice for the purpose of interacting and four times for the purpose of completing required presentations for the students who chose to use that option.

Table 3: Communication Tools Underused

Text Discussions	11.54%
Voiceboards	30.77%
Voice E-mails	7.69%
Live Classroom Sessions	42.31%
Blogs	7.69%

In terms of the communication tool through which students feel were best able to interact with their peers and the course instructor the findings are mixed. As highlighted in Table 4, text discussions and voiceboards are the top two tools that students feel allowed the maximum level of interaction. Live classroom sessions were ranked third by students in terms of the level of interaction, a surprising finding given the potential level of interaction that can be achieved through this tool.

Table 4: Communication Tool Contributing Most to Interactive Ability with Classmates and Instructor

Text Discussions	30.30%
Voiceboards	30.30%
Voice E-mails	12.12%
Live Classroom Sessions	21.21%
Blogs	6.07%

The most important finding of the quantitative component of the survey deals with the students' overall perception of the use of the communication tools in the selected courses. As highlighted in Table 5, an overwhelming majority of students believes that the specific communication tools do to at least some degree contribute to a positive learning experience. It is important to note that more than 70% of the student respondents indicated that the communication tools used in their courses made a significant contribution towards a positive learning experience.

Table 5: Overall Perception of Communication Tools Used

Significantly contributed to a positive learning experience	70%
Somewhat contributed to a positive learning experience	20%
Had no effect on the learning experience	10%
Negatively affected the learning experience	0%

Qualitative Findings

The qualitative finding of the survey, triangulate to a large degree the quantitative findings. Students were asked to indicate which of the communication tools they enjoyed most and which ones they enjoyed least and provide reasons regarding their rationale.

Specifically, students report that they enjoyed the interaction and immediacy associated with the voiceboard tool and a few of them would like to see more audio discussions. In addition, according to the survey results students enjoyed the opportunity for real-time interactions as well as to the resolve questions through the live classroom sessions. The least favorite tool for students was the blog; students reported that the lack of structure did not allow them to really understand the role of this communication tool.

While the qualitative findings show the features of the communication tools that students mostly enjoyed, they also point at areas of concern that need to be addressed. For some students, the voiceboard discussions seemed unnatural as it was a tool outside their comfort zone of traditional text-based discussions used in online courses. In addition, the hardware (use of microphone and speakers) and software requirements (high-speed and firewall free internet connection) for some of the communication tools proved to be more of a distraction rather than an advantage for some students.

Below is a sample of positive and negative qualitative comments regarding the use of the specific communication tools mentioned above:

Positive comments (most enjoyable communication tool)

> *The communication tool I enjoyed most in the course was the audio voice board. Sometimes it is nice when you are having a discussion to hear the responses instead of just reading them. It makes you feel more connected to your classmates.*

***

> *I think, for me, voice discussion board was a new way of interacting with the class. At the beginning it was little out of my comfort zone. But very soon I realized that it is little more powerful in learning — may be because it put more responsibility and accountability on my part than just text discussion.*

***

> *I enjoyed Live Classroom the most as it enabled me to hear and see others in the course and interact in a real time environment rather than waiting for a reply to a post.*

***

> *The live classroom session because it afforded me the opportunity to interact with my instructor and classmates realtime. I also liked having the ability to ask question on topics that were unclear in the course. I truly believed this technology is innovative and is a wonderful addition to the learning process*

Negative comments (least enjoyable communication tool)

> *Voice message boards. I was not able to purchase the correct microphone until the second or third week of class; also, sometimes I can do homework on my lunch break, but I am doing it from my desk and it is much easier to type than it is to whip out a microphone and "talk" your homework.*

*I****

> *I did not like the voice board at all. If I wanted to talk to people I would sit in class and do so!*

***

> *Live class room discussion was least enjoyable for me. But not due to its effectiveness but due to the timing. In the States couple of hours of time differences does not may that much of an issue, but there is a 9–12 hours time difference, it can be very inconvenient.*

***

> *The blog is the tool that I found to be the least rewarding. I did not know what to say and I routinely tried hard to think of ideas that I could relate back to the course material.*

Discussion and Conclusion

The findings of this paper indicate that the majority of the students appreciate and enjoy the opportunity to interact with their peers and instructors through the use of the existing and emerging communication management tools. However, the effective use of those tools is subject to a few qualifications. First, the instructor or course moderator must be knowledgeable in the use of the specific tool. In this way the tool can be utilized properly and in such a way as to make students comfortable with its use. Second, different course management tools are best fitted to specific subject areas (e.g. the blog tool can be valuable in a reflective-based course, but not in a Mathematics course). Third, and most important it is crucial that online students are given a few options in regards to the type and amount of use of the different communication tools; using too many of those tools can be confusing whereas using only one can be risky. With the continuing software and hardware improvements it is expected that the use of the interactive tools discussed in this paper will increase in online courses. Further research is needed in order to establish how students and instructors in online courses can use the increasing number of options for interactive tools available to them in order to maximize the quality of the online learning experience.

Effective communication is extremely important to student engagement and retention in online education. For most online students, their primary contact with an institution is through their communication with faculty. In this capacity, faculty are truly institutional ambassadors; therefore, instructional and communication training is essential (Betts, 2009). While in online education, students may not have the advantage of the many visual and vocal cues inherent in face-to-face courses, advancements in technology and telecommunications provide faculty with the ability to reach out to students through course management system tools that support text, voice, and video communication.

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FACULTY EXCHANGE PERIODS — MAIN OBSTACLES AND POSSIBLE SOLUTIONS FROM FACULTY VIEWPOINT

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Abstract

Internationalization is an important part of higher education and faculty exchange periods are one typical way for it. This paper presents a case study of the barriers and challenges relating to faculty exchanges at the Turku University of Applied Sciences. Seven categories of barriers were identified: family and friends, language skills, work responsibilities at home university, lack of information, personal insecurity, too much work needed for an exchange period, and finance. Seven possible categories of challenges were identified as well: yearly working plan, language training, exchange implementation, share experiences, reasons to participate in an exchange, concrete support, and curriculum changes.

Introduction

Internationalization is emphasized in various reports. In the literature, there are three dominant ideas relating internationalization (Murphy, 2007):

- internationalization is a process and not an event,
- its goal is to expose students and faculty to ideas, methods and people from other countries and
- internationalization is considered beneficial and essential in most universities worldwide.

Murphy (2007) continues that the process of internationalization has three interrelated components: internal, imported and exported. Murphy (2007) reported that the exported component provides the highest potential for higher international awareness. Van Damme (2001) states very similarly: Faculty mobility can be considered as the second most important form of internationalization in higher education. Furthermore, according to another report the faculty is the key group for international success within a university (Nilsson, 2003). In Finland faculty exchanges have a central role as well. The Finnish Ministry of Education has named faculty exchange as purposeful and essential part of internationalization of the higher education institutes (Ministry of Education Finland, 2007).

Internationalization is thus a strategic choice of the Faculty of Telecommunication and e-Business in the Turku University of Applied Sciences and faculty exchanges are an essential part of it. Mobilizing teachers is as important as mobilizing students. While students' normal exchange period is at least half a year, a typical exchange period for our teachers is only one week. Every year around 15–20 teachers go for one-week exchange period to our partner institutes. Most of our teachers use the Erasmus international mobility program, but some also use Nordplus and go to Nordic countries. These figures represent roughly 17 percent of our personnel. However, promoting faculty exchange is a challenge. The group of teachers going to exchange does not vary much yearly meaning that we have many teachers who haven't participated in any of the international mobility programs. We wanted to learn the rationale behind this and hopefully find solutions to support exchange periods.

In this paper, we first look back at the literature and other researches relating to faculty exchanges. After that the research is introduced. In the results section we report the identified barriers and possible solutions to faculty exchange. Finally, there are discussion and conclusions.

Faculty Exchange in Higher Education

The latest development plan of education and research by the Finnish Ministry of Education emphasizes globalization as a possibility for national and international wellness (Ministry of Education Finland, 2007). To make this more concrete it is crucial to include the importance of international experiences or opportunities within University's mission statement (Fung & Filippo, 2002). Furthermore, months-long periods abroad should become a norm for students and teachers (Ministry of Education, 2005). Actually, five different types of international staff mobility are listed: participation in international conferences, guest lecturing abroad, international visits to study and research, international peer review work and research collaboration (Smeby & Trondal, 2005).

The literature generally presents mobility as something positive and associated with all kinds of benefits (Musselin, 2004) and the benefits derived from international efforts are well worth the risk (Fung & Filippo, 2002). For a single teacher, the cross-cultural experiences and the comparisons she/he makes abroad within the host country's natural setting are the foundation for inter-cultural learning (Bodycott & Walker, 2000; Fung & Filippo, 2002). The academics travelling to teach overseas broaden their horizons and this informal learning can translate into improved teaching practices at home as well (Razzano, 1996). Thus the international faculty exchange programmes can be cost-effective methods for faculty development and enhanced student learning as well (Lange & Ailinger, 2001). At best, a teacher's experiences might be like Uhl described: "Awareness of the similarities and differences in their culture, teaching and learning strategies, social behavior, and norms of society . . . and the subculture of the university, food, climate, transportation, leisure time activities, and the natural beauties of the country . . . are experiences that change the thinking of the visitor forever" (Uhl, 1993). To summarize the basic idea of exchanges: international experiences can promote the idea that people should enjoy the similarities and respect the differences in other cultures (Fung & Filippo, 2002).

Despite highly positive expectations many barriers and challenges relating to international mobility has been identified too (Fuller, Amillo, Laxer, McCracken, & Mertz, 2005). These barriers are written from the student viewpoint, but many of them are valid with the teacher exchanges as well. The barriers are categorized in two categories: personal and institutional barriers. The personal barriers related to languages, finances and the overall willingness to go abroad. The list of institutional barriers contained items such as calendar differences, curriculum differences, quality assurance and cultural mismatches and misunderstandings. Other problems that are identified in earlier studies are heavy teaching load in teacher's mother university, limited financial and administrative support (van Damme, 2001).

Since challenges and problems relating teacher exchanges are identified different solutions are presented as well. There are for example three ways a university can prepare their staff for teaching exchange (Gribble & Ziguras, 2003):

- provide staff information about general issues that lecturers routinely face in exchange
- provide country-specific information to assist lecturers to make their teaching relevant to the context
- develop systems that support and enhance the informal support and sharing of information between staff.

Lange and Ailinger (2001) modelled faculty exchange even more precisely and introduced a model for international faculty exchange. This model included the components of pre-exchange planning, academic activities, socio-cultural events, communication and evaluation of outcomes (Lange & Ailinger, 2001). For pre-exchange planning they created a checklist with the following items (Lange & Ailinger, 2001): expectations, educational level of students and faculty, library resources, electronic databases, internet and e-mail access, academic and public holidays, university events and customs, dress code, living arrangements, transportation, church & shopping locations, work contract, country visa and money management. Academic activities focus on the academic work both before and during the exchange. Socio-cultural events should also be planned well and this dimension is important for understanding the culture and the people better.

Good communication is an essential element in the model as well as evaluation of the outcomes.

Nilsson (2003) reported actions to increase the language competence among both teaching and administrative staff. They offered language courses for the faculty such as “How to Teach in English” and “Practical English for Administrators” (Nilsson, 2003).

The importance of the money is emphasized as Fung et al. (2002) report that funding will be essential to encourage faculty participation. Faculty participation in exchanges could be encouraged by sending people over in pairs or small groups, particularly on a lecturer’s first trip to a new teaching site (Gribble & Ziguras, 2003).

The Research

In this research qualitative methods were used and the research was a descriptive case study. In general, a case study aims for in depth-understanding of the context of the phenomenon (Cavaye, 1996). Furthermore, a descriptive case study presents a complete description of a phenomenon within its context (Yin, 2002). A case study is well suited to capture the knowledge of practioners and to document the experiences of practice (Benbasat, Goldstein, & Mead, 1987). This study presents identified barriers and challenges relating to faculty exchange at the Faculty of Telecommunication and e-Business in the Turku University of Applied Sciences.

The Turku University of Applied Sciences is one of the biggest of its kind in Finland. Our University is organized in six units of education that promote multidisciplinary learning. The faculty of Telecommunication and e-Business represent four different fields of education: technology, business, natural sciences and culture. Our main goal is to work in close co-operation with our region and to answer the requirements of the working life.

The Faculty of Telecommunication and e-Business operates in two cities and has six different degree programs (Table 1) leading to the Bachelor of Engineering and Bachelor of Business Administration. The Bachelor of Engineering is a four-year degree with 240 ECTS and Bachelor of Business Administration is a three and a half year degree with 210 ECTS. In addition, we have a Master of Engineering program called Technology Competence Management. The faculty has approximately 1500 students of whom roughly 550 study in Salo campus and 950 in Turku campus.

Table 1: Bachelor Degree Programs in Telecommunication and e-Business

Degree Program	Credits ECTS	Discipline	Students
Information Technology - English - Finnish	240	Information Technology	727
Electronics	240	Computer Engineering	259
Business Information Technology	210	Information Systems	196
Business and Administration	210	Business	176
Library and Information Services	210	Information Services	85

Internationalization is one of the focus areas in our mission statement: The Faculty of Telecommunication and e-Business operates interactively with the working life educating future international experts, activating entrepreneurship and developing our region with applied research. Our international activities are based on our internationalization strategy. The strategy defines our main lines and gives guidance for more detailed yearly operational plan in internationalization. The strategy defines that

- Internationalization is part of our daily operations through teacher and student exchanges as well as through R&D-projects.
- Intercultural environment enriches our learning and motivates us to pay attention to courses offered in a foreign language.
- Our international activities are focused on India/China besides Europe.

We wanted to learn the barriers and challenges with the faculty exchange. Two open questions were presented:

- What are the main barriers to going to exchange?
- What are the solutions to these barriers?

The faculty members answered both questions anonymously in separate papers. The data was analysed with content analysis.

Results

Altogether 77 faculty members answered the survey. The survey resulted in 115 barriers to faculty exchange and 78 possible solutions to support and increase faculty exchanges. The named barriers were classified in seven categories (Table 2).

Table 2: Barriers of Exchange Periods

Categories	**Count**	**Percentage of faculty members**
Work responsibilities at home university	22	28.6 %
Too much work needed for an exchange period	17	22.1 %
Lack of information	9	11.7 %
Language skill	9	11.7 %
Family and friends	36	46.8 %
Finance	3	3.9 %
Personal insecurity	19	24.7 %

The biggest barrier category to faculty exchange was “Family and friends.” Almost half of the faculty named family and friends related topics as barriers to participating faculty exchanges. The respondents gave the following answers for example:

- Who will take care of the children while in exchange?
- Home responsibilities (hobbies and other activities)
- Spouse travels much
- Spouse has irregular working hours
- Small children
- Dogs and cats — who will take care?

In addition, quite many just answered Family without any explanations. A good summary of all the named barriers was the answer saying: the situation of the civilian life doesn’t make it possible to go the exchange.

Almost 29 percent of the faculty members named barriers that were grouped to "Work responsibilities at home university" category. The barriers belonging to this category were such as

- Too much work at the moment
- A lot of work waiting when you come back from the exchange
- The schedule is too tight — not possible to be away for one week
- How to arrange the responsibilities here during the exchange?
- So much teaching that all time is needed for preparation.

Barriers relating to "Too much work needed for an exchange period" and "Personal insecurity" categories were named by about 17 faculty members. Following barriers where classified to "Too much work needed for an exchange period" category:

- Preparing teaching for foreign environment is difficult (the technical environment is not known, a lot of communication is needed)
- Schedule differences
- A lot of work to modify the teaching suitable for exchange (language, context related issues)
- Too much paperwork and other arrangements needed
- Communication problems with the partner
- The exchange period is not precisely connected with curriculum.

The "Personal insecurity" had barriers such as:

- Afraid of flying
- What could I do there?
- Will I manage it?

Finally, there were a number of faculty members expressing that they have received too little information on the exchange possibilities. Also, a number of faculty members saw that their language skills are a barrier to exchange. Only three faculty members answered that financial issues are a barrier.

The solutions provided by the faculty were classified in seven categories (Table 3).

Table 3: How to Support Exchanges?

Categories	**Count**	**Percentage of faculty members**
Yearly working plan	8	10.4 %
Language training	7	9.1 %
Exchange imlementation	21	27.3 %
Share experiences	8	10.4 %
Why go to exchange?	13	16.9 %
Concrete support	19	24.7 %
Curriculum changes	4	5.2 %

There are two categories that together gathered over half of the solutions: “Exchange implementation” (27.3%) and “Concrete support” (24.7%). The faculty proposed following “Concrete Support” actions for example:

- support for taking family with you
- more help for practical matters
- better financial support
- support for the family staying home
- turnkey exchanges
- managers are in key positions.

The faculty proposed following solutions to “Exchange implementation” for example:

- more advertising about the exchange possibilities
- exchanges with colleagues
- replacement solutions in home university during the exchange
- better planning of the exchange period besides teaching
- connecting the exchange to some common development project with the host university
- head-to-head exchanges.

The rest of the solutions are presented in the

Table 4.

Table 4: More Proposed Solutions

Category	Proposed solutions
Yearly working plan	The exchange should be included in the teachers' yearly working plans. The exchange should be agreed on yearly performance review discussions.
Language training	Tailored English courses. Language courses abroad. Cultural coaching before exchange.
Share experiences	Better reporting of realized exchanges. Presentations by the teachers already been in exchange.
Why go to exchange?	Make exchange a mandatory part of work. Emphasize the personal benefits of exchange.
Curriculum changes	Work placement should be moved elsewhere from spring.

Discussion

The faculty named many barriers and possible solutions relating to exchange periods. The barriers and solutions were analysed in the management board and in the internationalisation working group. Previous researches and this case study showed many similar results.

Internationalization is part of our mission statement and we have given the attention to internationalization as Fung et al. (2002) emphasized. However, we still have a big challenge to make long exchange periods a norm for our teachers like the Finnish Ministry of Education (2005) suggests. On the other hand most of the different types of international staff mobility that Smeby and Trondal (2005) reported are in place in our faculty. Our staff participates regularly in international conferences. A basic requirement to be financed to a conference is that the teacher has some active role in the conference i.e. either a presentation or a chairing responsibility. Our faculty members give guest lecturers abroad, but they travel to different meetings relating education development and research collaboration as well. An example of an education development network is the CDIO network (www.cdio.org) that aims to develop education closer to the working life.

The benefits reported in the earlier researches are not surprising. Still, our research showed that there is lack of information among our faculty: there are people that don't know why they should go to exchange. There are a large group of faculty members thinking that too much work is needed for an exchange period. Certainly we need to correct these ideas with right and sufficient information.

The personal barriers Fuller et al. (2005) reported were also found in this study. Our faculty reported languages, finances and overall willingness to go abroad as barriers to exchange too. In addition, the institutional barriers Fuller et al. (2005) listed were mostly found in this research as well. Heavy teaching load in teacher's home university that van Damme (2001) reported was identified as the second frequent barrier for going to exchange in our research. However, the most frequent barrier in this research was "Family and friends" which was not reported in earlier studies.

Earlier researches emphasized the importance of good preparation of exchange periods. We need to focus more on the pre-exchange planning as over half of the faculty suggested that we should provide more "Concrete support" and improve "Exchange implementation".

We have offered language courses to our faculty similarly as Nilsson (2003) reported. The courses were started based on the identified barriers and possible solutions found in our research.

Fung et al. (2002) emphasized the importance of money for encouraging faculty to participate in exchange periods. In our faculty, during the exchange period the teacher receives a normal weekly salary (40 h) even though the new Erasmus requirement is only five hours of teaching within a week. All travel and accommodation costs are covered and in addition a normal daily allowance is provided.

Gribble et al. (2003) suggested that sending people over in pairs or small groups might encourage faculty participation in exchanges. Our faculty suggested the same solutions.

The solutions which faculty named to support exchanges are already partly in use, but faculty members haven't recognized them. For example, the faculty management board has agreed that the exchanges should be included in the yearly working plan and they should be agreed in the performance review discussions. In addition, we have tried to implement a better reporting system to make the information and experiences of faculty members returning from an exchange available to those thinking of going abroad.

Conclusions

The research showed that the barriers and provided solutions are quite similar to earlier researches. However, the research confirmed us that certain actions can be taken to enhance faculty exchange. It seems that despite all information and active discussion about exchanges there is a need to improve the quality of information and the way we inform our faculty over the exchange possibilities. We need to emphasize the benefits of an exchange to the person him/herself besides the benefits to our faculty and to the students as well. There is still lack of basic information relating to exchange arrangements and possibilities among a portion of our faculty members.

There are many tasks where we can improve our processes:

- Collect and make precise information on our partner universities available to other faculty member going to exchange
- Change the informal briefings of faculty members going abroad to a pre-departure training
- Create a pre-exchange checking list.

The faculty suggested supporting exchanges using exchanges with colleagues. This is one of the ideas that we have discussed, but we have to develop the idea further.

Finally, this research gave us the confidence that we are going in the right direction with our efforts to activate faculty exchanges. With these results, we can further improve our processes in faculty exchanges and make faculty exchanges even more common in our faculty. We also hope that this research can help other universities to support and improve exchange experiences.

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USING SHORT MESSAGE SERVICE (SMS) TO ENHANCE TEACHING AND LEARNING

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Abstract

In October 2008, a pilot study using Short Message Service (SMS) to deliver quizzes to 14 students studying statistics at an Australian University was conducted. Data collected and analysed from the pilot included student responses to the quiz questions as well as their evaluation of the learning experience, measures of their approaches to learning, and attitudes to computers. The results from the pilot support the efficacy of using SMS to encourage students to engage with material outside of class and suggest that student learning is enhanced as a result.

Using Short Message Service (SMS) To Enhance Teaching and Learning

Short message service (SMS) has been used effectively in a number of ways in educational settings. Although the main applications have been administrative, such as sending students information about enrolment and exam results, SMS has also been used to encourage peer support and assist students' transition into university life (Harley, Winn, Pemberton, & Wilcox, 2007). These sorts of applications are not intended to enhance learning specifically, although SMS could potentially be used in a number of ways that *would* quite directly impact on and enhance student learning. In this paper, we both describe a specific application for SMS that is designed to improve students' learning and present the results of a pilot study using text messages to deliver quizzes to students studying research design and statistics. From the evaluation of the pilot, we are able to recommend using SMS to encourage students to engage with material outside of class, as well as providing suggestions for future research on SMS as a teaching and learning tool.

Research reports confirming the effectiveness of SMS as an e-learning tool have begun to appear in the literature, alongside those describing teaching support and administrative applications for this technology. There are several reports emerging from a range of discipline areas using SMS to enhance learning from mathematics and teacher training to teaching languages. Thornton and Houser (2004) used SMS to send mini-vocabulary lessons to Japanese University students learning English. Words to be remembered were placed in an elaborative sentence that methodically built students' comprehension of vocabulary. For example, students were sent an SMS with the message "Today's word, vision, is the same as eyesight. Do you have good vision or do you have to wear glasses?" Words were sent at three, fixed time periods per day to encourage spaced rehearsal. Those students who learnt vocabulary via SMS recalled significantly more words at test compared to students who learnt using a computer or paper methods. In addition, these students reported that they preferred receiving the vocabulary via SMS compared to the other methods and that they did not believe that mobile phone screen size had inhibited learning.

Another application of SMS to enhance student learning has been reported by Hagos (2008) who developed mini mathematics lectures delivered via SMS to make use of downtime students experience when lecturers are late for class, absent or unable to interact with them. These lecture-texts were designed to promote flexible, self-paced learning and be easy to use. The text messages consisted of mathematics problems sent to students by the lecturer, students then solve the problems and send their solutions to the lecturer before the next class. A total of 90 students responded to the Hagos's evaluation of the lecture-texts, indicating satisfaction with all aspects of the experience using SMS to learn mathematics concepts. These students also reported it was convenient to study in this way and that it provided opportunities to review concepts when it suited them. Although no data was provided on how well the students learnt with this method, the evaluation findings indicate that the students found working with the lecture texts stimulating and motivating.

Cheung (2004) used SMS in his microeconomics classes to allow students to participate in simulation games to demonstrate the properties of markets and models in economics. In these learning activities, students were individual decision makers in an economic interaction based on theories studied in class. Afterwards they analysed the patterns of behaviour seen in the interaction and evaluated the outcomes. The use of SMS streamlined data entry and collation, facilitating reporting of results and provision of individual feedback. These classroom experiments provided a bridge between the subject matter of microeconomics and the real world. Using SMS to deliver the classroom experiments made them easy to incorporate into lectures and promoted interaction between students.

The usefulness of SMS for managing interactions between supervisors and trainee teachers was demonstrated by Seppala and Alamaki (2003). Photographs of teacher training events and learning activities taken by students with a digital camera were downloaded to a shared database and then uploaded to a mobile device. Students and supervisors made comments and observations about the pictures via SMS. With no face-to-face interaction occurring, the use of SMS in this way created a virtual collaboration between peers and supervisors. Evaluation of this experience showed that students and teachers were positive about the benefits of convenience, immediacy and increased interactivity of learning. An example of using SMS to support student-to-student communication and collaboration is the SMS application developed by Silander, Sutinen, and Tarhio (2004). This application was used by students to engage in collaborative concept mapping of tree species. Students out in the field used SMS and script language to add concepts and relations about tree species to a database managed by students in the classroom using wireless laptops. The students worked collaboratively inside the class and out in the field to gather information about tree types. Analysis of the message content showed that the concept mapping exercise encouraged spontaneous participation and communication between students both in the field and the classroom. It was also an enjoyable experience for students, who found it easy to add new concepts and their relations. In a similar way, Markett, Sanchez, Webber and Tangney (2006) used SMS to encourage interactivity in the classroom, to facilitate building learning communities and for providing feedback for lecturers. Evaluation data showed a high level of student satisfaction with the experience of using SMS in this way, with students reporting that when using SMS they asked more questions and raised issues that normally would not have been raised during a lecture.

To date, then, researchers have demonstrated that through the simple technology of SMS, embedding information in rich and elaborate contexts can improve foreign-language learning in students above traditional paper and pen rehearsal methods. SMS has also been used to support collaborative learning and encourage interaction, critical thinking and behavioural development with peers and educators as opposed to the traditional passive lecture-style method of delivering educational content in a process of transmission. Mobile devices generally can be used to allow students to interact with an environment outside of their classroom and collaborate at any point in time (Librero, Juan Ramos, Ranga, Trinona, & Lambert, 2007). SMS is a cheap, convenient, accessible and almost ubiquitous mobile technology that offers great potential as an educational tool that has yet to be fully embraced.

The pilot study conducted at Victoria University, Melbourne, Australia and reported here was informed by the research findings summarised above regarding the use of SMS to enhance student learning. SMS was used to send 14 students studying research design and statistical analysis short quiz questions on research design and statistical analysis that assessed their understanding of concepts covered in class. By sending students messages across the week, it was hoped that they would be motivated to engage with the subject material outside of class. The provision of feedback via a return SMS was included in the study so that students knew whether they had the correct answer or not. An explanation and directions on where to get further information — for example which lecture or part of the text this question was drawn from — were also provided in the feedback. It was hoped that students who did not get the question right would review the relevant material to address any gaps in their understanding.

One of the reasons for using SMS outside of the designated teaching space is that once students leave the classroom, many do not think about the subject material again until the next class, unless they have an assignment or some other assessable learning activity to complete. It was hoped that the short quiz questions delivered directly to the students via their mobile phones would encourage them to review concepts from class and to perhaps spend more time on this subject than they would have otherwise. Unlike a traditional online learning management system (LMS) where students need to be relied on to log into the system to access material, SMS allows the material to be delivered to the student at any time regardless of where they are and whether they like it or not! The bite-sized nature of material sent via SMS also makes it more likely that students will spend a few minutes engaging with a question or problem, as opposed to needing a larger amount of time to deal with a more complex learning activity.

Since many factors contribute to student learning behaviour, we also measured the learning preferences and attitudes to computers of participants in the study. It was hoped that these additional measures would provide insight into factors influencing how students use and respond to this type of learning. Since the pilot study was exploratory in nature, no fixed hypotheses were developed for testing. However, we were interested in measuring students' reaction to using SMS in this way, as well as gaining insight into how this technology could be used to support their learning. In particular, at the end of the pilot we wanted to be able to determine whether students found using SMS in this way to be convenient and helpful and to understand what impact it might have on their learning.

A Pilot Study Using SMS to Support Teaching Research Design and Statistics

A total of 14 second-year psychology students took part in the SMS pilot study; 6 males and 8 females with an average age of 20.1 years (SD = 1.2). The total enrolment for the unit was 28 students, so the trial participants represented half the students taking the course. Participants were recruited during one of their normal classes. The third author, who also co-ordinates the subject, introduced the researchers and briefly explained the nature of the pilot study. One of the researchers then gave a brief presentation to students on the study explaining that participation in the study would involve completing a questionnaire before and after the study as well as responding to text messages sent to them daily with questions relating to their studies in this subject. Students were told how many text messages would be sent and how often, and the researcher explained the voluntary nature of the study and that privacy and confidentiality of students' contact numbers and responses would be maintained. It was also explained to students that they would be compensated for the cost of text messages sent during the trial with coffee vouchers redeemable at the university coffee shops. Those students who indicated interest in being part of the pilot were given a consent form to sign and provided a mobile phone number for use during the study. They also completed a questionnaire that included items relating to demographic information and data on mobile phone use, together with the measures of their attitudes to computers (CAS, Computer Attitude Scale; Loyd & Gressard, 1984) and their preferred learning approaches (Approaches & Study Skills Inventory for Students, ASSIST, http://www.etl.tla.ed.ac.uk/questionnaires/ASSIST.pdf).

The CAS (Loyd & Gressard, 1984) consists of four subscales measuring how much the respondent likes working with computers (Liking), how useful they perceive computers to be (Usefulness), how confident they are working with computers (Confidence) and how anxious using computers makes them (Anxiety). Each subscale consists of 10 items, scored using a 5-point scale where 1 = strongly disagree and 5 = strongly agree. Higher scale scores indicate a more positive attitude to using computers. This measure was included to provide an indication of the participants' attitude to technology and to see whether students' attitudes to using computers were related to SMS use. The ASSIST was included as a measure of preferences regarding learning. It consists of subscales measuring the extent to which students adopt a deep, strategic or surface approach to study, as well as preference for different types of teaching methods. Items for each subscale are scored using a 5-point scale, with higher scores on each subscale indicating a stronger preference for a study approach or teaching method.

Mobile phone numbers for those students who completed the first questionnaire in class were entered into a group contact list in a desktop SMS application that was used to send messages during the period the pilot study was conducted. The first text message sent to students was designed to check that students understood how to respond via SMS and asked them to rate their confidence with statistical analysis and design, where 1 = very low, 2 = low, 3 = medium, 4 = high and 5 = very high. After this initial message was sent and the researchers had confirmed that students understood how to respond to the text messages, the phase of the pilot during which questions about research design and analysis were sent out began. A total of 18 SMS were sent to students participating in the pilot over a three-week period either in the morning, after lunch or in the late afternoon. Students who sent a text message in response to messages sent to them as part of the study received a reply text message with feedback on their response, which for the SMS with questions related to their study included the correct answer, an explanation and where to get further help. The questions, which were developed in consultation with the subject coordinator, mapped to material that had been taught in previous lessons. Questions required either a fixed response (e.g., True/False or multiple choice) or a free text response. Examples of questions sent to students include:

> How many separate samples would be needed for a two-factor, independent measures study with 2 levels of factor A and 3 levels of factor B? a)2, b)3, c)5, d) 6?
>
> If decreases in the X variable are accompanied by decreases in the Y variable, then the correlation between X and Y is positive. TRUE OR FALSE?
>
> You are asked to evaluate 3 weight loss groups (1)No carbs (2)No protein (3)No fat. 10 volunteers are randomly placed in each group. What design would you use?

At the end of the pilot, the last SMS sent to students asked them to again rate their confidence with statistical analysis and design at the end of the pilot study. In the last class for the semester, students were asked to complete the evaluation for the study and to return these to the subject coordinator. Students were followed up via SMS to encourage all participants to complete and return the post-trial evaluations. Unfortunately, 5 of the participants did not return the post-trial evaluation. Coffee vouchers were distributed to the study participants at the same class that the evaluation was given out. The evaluation instrument included questions about when students preferred receiving text messages, how soon after receiving a message they responded to it, and whether the message was intrusive, convenient to receive in text format or important. There were also 16 statements relating to the use of SMS for teaching and learning purposes which they were asked to rate using the scale 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree and 5 = Strongly Agree.

The message content of student responses for each question sent via SMS was exported as a text file from the desktop SMS application and matched to the data from the pre-pilot questionnaire and the post-pilot evaluation. All the data was then imported into (Statistical Package for the Social Sciences) SPSS for scoring and analysis.

Findings from the Pilot Study

Preliminary data analysis consisted of evaluating the responses to SMS questions as incorrect or correct and calculating scores for each of the measures of attitudes to computers and preferred learning and teaching approaches. Descriptive statistics, including means, standard deviations and correlations were obtained for all variables of interest.

Attitudes to Computers and Preferred Learning Approaches

Scores for the subscales on the CAS (Loyd & Gressard, 1984) showed that as a group, these students were moderately confident using computers ($\underline{X}$ = 35.39, $\underline{SD}$ = 4.23, $\underline{N}$ = 14) and tended to agree that they liked using computers ($\underline{X}$ = 36.5, $\underline{SD}$ = 6.28, $\underline{N}$ = 14). However, they were not anxious using computers ($\underline{X}$ = 41.57, $\underline{SD}$ = 6.16, $\underline{N}$ = 14) and agreed that computers were useful ($\underline{X}$ = 43.21, $\underline{SD}$ = 3.26, $\underline{N}$ = 14). This suggests that the students who participated in this pilot were comfortable using technology such as computers, but were not necessarily technology evangelists.

Scores on the subscales for the ASSIST were computed for the deep, strategic and surface approaches to learning, as well as preference for different types of teaching methods. The average scale score for the deep approach to learning subscale, which consists of 16 items was $\underline{X}$ = 59.6 ($\underline{SD}$ = 8.4, $\underline{N}$ = 13). For the 20-item subscale measuring a strategic approach to learning the mean scale score was 69.5 ($\underline{SD}$ = 15.2, $\underline{N}$ = 13), while for the 16-item subscale measuring a surface approach to learning the mean score was 48.4 ($\underline{SD}$ = 8.3, $\underline{N}$ = 13). This pattern of scores indicates that the participants agree that they tend to be strategic and adopt a deep approach to their study, but are undecided as to whether they prefer a surface approach to their learning or not. For the two subscales measuring preferences for different types of teaching methods, the mean score for the 4-item subscale measuring a preference for a teaching style that supports understanding was 15.4 (SD = 2.9, N = 13). For the subscale measuring a preference for a teaching style that supports transmission of information, which also has four items, the mean score was 16.9 (SD = 4.1, N = 13). This pattern of scores shows that the students who participated in this pilot showed a strong preference for teaching styles that promoted understanding, while at the same time wanting the lecturer to tell them what they need to know for the course, what to study and how to study it.

The post-pilot evaluation was completed by nine participants who evaluated the experience positively as indicated by their responses to the statements about using SMS. As a group they agreed that "receiving information relating to their studies via SMS is a good idea", that they "would like to receive important information from the university via SMS", and that they didn't mind receiving text messages from their lecturers provided they are relevant. However, they also tended to agree that they would feel uncomfortable if they started receiving SMS about their studies, but disagreed that they would prefer to keep their mobile phone for personal purposes. Several items on the post-trial evaluation asked about the comparative value of SMS over e-mail as a medium of communication. In general, these students did not have a problem with receiving information in more than one format (e.g., via SMS and e-mail) and disagreed that receiving information via SMS is more convenient than receiving it via e-mail. Consistent with this, they tended to disagree that they would rather receive information via one method only. Finally, they tended to disagree that receiving a text message more than once a week for a unit they were studying would be annoying. These nine students also reported that they preferred to receive text messages of this nature in the morning or the afternoon and the majority of them read the text message either immediately or within an hour of it being received. They did not find the messages intrusive, and rated receiving the questions this way as convenient. They also felt that the content of these messages was important to them. In response to the question about how much they would be prepared to spend on using SMS in this way for a subject, these students indicated that between AU$1 and AU$5 per subject per semester would be the maximum.

Analysis of Text Messages

The average number of text messages students responded to was 10.6 (3.6) with the maximum number of messages replied to being 14, and the least being 3. Five students replied to 14 messages, while only 1 replied to only 3. For the messages students responded to, on average they answered 59.3% (SD = 25.1) correctly. The average level of confidence at the start of the study was 3.5 (SD = .86, N = 14), while at the end it was slightly, but not significantly, lower at 3.4 (SD = .71, N = 9). These mean scores indicate that students had a moderate level of confidence relating to research design and statistics at the start of the study which was maintained across time.

No significant correlation was found between the total number of replies a student submitted and any of the approaches to learning scales or the attitudes to computers scales. Total number of replies made was however, significantly and negatively correlated with scores on the computer attitude scale of Liking ($r = -.60$, $p < .05$, $r^2 = .36$ $N = 14$), suggesting that students who do not like using computers will send fewer text responses than those who do like using them. There was no significant correlation between exam scores for the unit and the number of responses students made. Exam performance was also not correlated with the number of questions responded to. However, a significant correlation was found between exam grade and the percentage of correct answers submitted (adjusting for the total number of responses a student made) $r = .749$, $p = .002$, $r^2 = .56$ $N = 14$. Since no causality can be inferred from this significant correlation, it would be interesting to investigate this relationship further. In particular, it would be helpful to know if the regular knowledge checks delivered via SMS assisted students in identifying areas of strength and weakness in their understanding of the material, which they were then able to use as part of their exam preparation. Overall, students perceived participation in the pilot study as a positive experience, with over three quarters of respondents indicating that receiving the text messages had contributed “quite a bit” to their learning experience for the unit.

To gain some insight into the possible impact of this SMS intervention on student learning, a t-test for independent samples was conducted comparing exam scores for the students who took part in the study with those who did not. This analysis showed a significant difference between scores on the final exam in the subject for students who participated in the trial and those who did not ($t(26) = 2.624$, $p < .05$, $r^2 = .21$). On average, participants in the pilot study scored significantly higher ($X = 43.2$, $SD = 11.8$) compared to those students who did not ($X = 33.1$, $SD = 8.1$). However, the reason for this superior performance cannot be unequivocally attributed to the effects of participating in the study. It may be that the students who elected to participate in the pilot were academically stronger, or more motivated to achieve, than those who did not. However, it could also be that taking part in the study highlighted to students that they did not know the material as well as they thought they did (as indicated by the relatively low number of correct responses submitted) and this may have encouraged them to study more for this subject than they would have normally. Feedback on each of the questions sent via SMS could also have helped students to focus their study efforts on topics where they did not get the questions correct.

Future Directions and Challenges for Mobile Learning Technologies

Due to the exploratory nature of this pilot study, no hypotheses were formulated for testing. However, it was intended that data collected for the pilot study would be used to determine whether students found using SMS in this way to be beneficial and acceptable. We also wanted to gain some insight into what impact it had, if any, on their learning. From the analysis of the text message content and the data from the pre-pilot questionnaire and post-pilot evaluation, we have been able to confirm that students did respond positively to the experience and also have some data that points to a positive impact on student learning. From the analysis of the pilot data, it has also been possible to identify future research directions that will add to our understanding of how to use this technology effectively to improve student learning.

Consistent with previous research, students' generally perceived the experience of receiving and responding to questions about research design and statistical analysis via text messages positively. A negative relationship was found between number of replies sent and scores on the computer liking scale, which may explain the low number of responses some students sent. Even if this did contribute to response rate, however, it does not necessarily mean that receiving the questions via SMS was not useful for students who do not like using computers, only that they are likely to reply to fewer messages. This could be for a number of reasons, including time and cost. Not responding to a question does not rule out the student actively learning from the question in the text message, as they could still answer the question without sending a response. The problem with not sending a response is that the explanation and instructions about where to get additional help for the question are only sent when a response is received. Therefore students who do not reply miss out on potentially beneficial information.

The data collected for this pilot does not provide any insight into what students did when they received an SMS, other than some indication that they responded to it either immediately or within an hour of receiving it. The high percentage of incorrect responses suggests that students did not consult any notes or their text book before responding. This in turn suggests that students were either confident their answer was correct, or it didn't bother them if they got the answer wrong. Although it was hoped that students would take the time to consult other sources such as their notes, textbook or other classmates, before responding, this did not seem to happen. In future studies using SMS in this way, it would be valuable to obtain data on what students do when they receive a message. This could be collected using an observational technique or through interviews where students report on what they typically do in this situation. A research design could also be employed where students study some topics with SMS quizzes and some without.

In this way it will be possible to directly compare each student's performance on the different topics and better assess the impact of the SMS quizzes on student learning outcomes, assuming topics studies with without SMS are of equal difficulty.

Another aspect we did not directly observe or measure is whether students consulted or collaborated on the answers to the questions. While collaboration is to be encouraged, merely copying another student's answer and submitting it should be strongly discouraged. To try and avoid students waiting to find out the correct answer before responding, we did not send instant feedback to students on each question. Rather, feedback was only sent after students had sufficient time to submit their response. In this way we tried to encourage students to work out the answer for themselves rather than waiting to find out the correct answer and then submitting a response. As this technology is used in different contexts, teachers will develop strategies for managing some of the student behaviours and strategies that are not helpful to their learning.

Participants in the study had a moderate level of confidence in their understanding of research design and statistical analysis. This level of confidence was maintained across the period of the pilot study. It is reassuring that students' confidence did not decrease, which could have occurred if students were concerned about getting the questions wrong, which they did quite frequently. However, it is also not possible to make comparisons with the confidence level of students in the class who did not take part in the pilot and we have no way of knowing what their confidence was at the start and whether it stayed constant, increased or decreased. We do know that those students who took part in the pilot study did significantly better on the final exam than those who did not, despite not performing consistently well on the SMS questions. Given this, it is not unreasonable to assume that taking part in the pilot and getting feedback that you do not know the correct answer to a problem that is likely to be on the exam could be quite motivational. Through their participation in the pilot study, students may have been made more aware of their lack of knowledge and studied more to make up for this. They may also have been able to focus their study efforts better by receiving feedback on which questions they got right and which ones they did not.

An interesting finding was that students in the pilot all favoured teaching approaches that used transmission of information as well as supporting understanding. Students who favour a transmission of information approach would likely find the use of SMS in this way appealing as it gives a very good indication of what content the lecturer sees as important. It also provides an example of how this content can be assessed. Equally, for the student who favours a teaching approach that supports understanding, this application would be appealing as it provides another source of information that can be used to assess whether a student understands the material or not. Students in this study scored high on both the transmission of information and supporting understanding approaches. It would be valuable to explore this further in future studies to determine whether use of SMS to support learning is dependent on favouring a transmission of information or supporting understanding approach to teaching, or both.

While using SMS in this way had benefits for students, it also offers opportunities for teachers. As the pilot study progressed it became clear that greater use could be made of the analysis of student responses to the SMS quiz questions. In particular, the number of correct responses received provides the lecturer with an indication of whether students understand the concepts being tested. If sufficient numbers of students get a question wrong, then the lecturer can use this information to address this in class. Although the findings from this pilot are very positive, they need to be interpreted with care due to the small sample size. SMS used to support students studying research design and statistical analysis was successful as a pilot, but needs a larger scale implementation and evaluation. Future studies should also incorporate research designs and data collection methods that allow evidence to be obtained about the learning outcomes associated with using SMS in this way. For teachers to be confident using this technology to support student learning, it is necessary to move beyond subjective evaluations of the learning experience by the participants, to gathering hard data on the impact on student learning. However, mobile learning technologies in general, and SMS specifically, appear to have great potential of improving student learning outcomes. The possible applications need to be explored and validated so that both teachers and students can realize the benefits of these approaches.

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MODERN METHODS OF LEARNING TEXT PUBLICATION

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Abstract

Web-based learning is an important part of the e-learning ecosystem. Using the Internet as a medium for technical learning text publications can bring two major problems: the problem of learning text re-usability and the problem of interpreting a mathematical notation. Thanks to modern web technologies it is possible to solve both problems and suppress the difference with the paper-based learning text publications. This paper provides an overview of possible solutions emphasizing one particular implementation of technical learning text publication implemented in the TUL University E-learning System environment.

Introduction

Thanks to the expansion of the Internet in the last decade, the term "e-learning" is used more for web-based type learning than for any other means. More than ever before, it is important to have a possibility to share the source of the learning text between the web presentation and the printed form of textbooks. Both media are different and therefore they need a different approach and set of tools. This is especially true for the case of a technical learning text with mathematical notation.

Web-based Presentation

Learning text within an e-learning environment can be represented by a text document or even better by an HTML (W3C, 2008a) page. Obviously an HTML page can provide more interactive content than the standard text document. An HTML page can contain not only static texts with images but also dynamically generate texts with animated images, audio and video content, Java applets and other multimedia content. Jan Amos Komenský (1630), known as the teacher of nations, had a saying: "Learning by play." Exactly that should be the meaning and the purpose of the learning text represented by the interactive multimedia HTML page.

The World Wide Web (W3) was born at CERN (CERN, 2008) in 1989. There is no doubt that it was one of the most important inventions of last century. Since that time, there have been developed a large number of tools which can help produce an HTML page. Each of the HTML editors can be more or less user friendly with different levels of conformity and support of world-wide respected norms of web development. Many e-learning systems, which use HTML for learning text presentation, have usually some kind of HTML editor as a part of the system. These systems have one important advantage. For editing of the HTML code it is not needed to have any other software than a web browser which is a standard part of each modern operating system today.

Printable Output

Development of interactive multimedia HTML pages can take a lot of effort. Printing of the learning text directly from the HTML page is not so simple because the printed document may not have the same layout and quality as the original. This can obviously lead to many problems during study of this printed material. Therefore many learning texts are available as static documents containing only text content. These documents are then exposed on the web page where they are available for download. The user can download this file and open it in a specialized viewer or editor. The advantage of having the document written in a specific format is that it can always be displayed or printed out in the same layout and quality.

Probably the best known printable document format these days is the Portable Document Format (PDF) created by Adobe Systems in 1983 for document exchange. This format is as known in the field of text documents as Google is in Internet search engines. This success is based on its open format, independent of hardware type, operating system and application software. PDF is supported by Microsoft Office, OpenOffice.org and many other Office suites which allow users to save their documents directly into the PDF format. This provides an easy way of text document publication in very good quality. The high quality of the printed output is reached mainly because each document encapsulates a description of the text, fonts and vector graphics that compose the documents.

Mathematical Motation

E-learning is used in many branches today — from psychology and language education through economics and computer science up to theoretical mathematics and physics. If the learning text tries to explain some parts of mathematics, it is usually necessary to use mathematical notation. The traditional tool for writing mathematical documents has always been LaTeX (LaTeX, 2008). The strong points of this typesetting system are the extensive facilities for automating most aspects of typesetting and desktop publishing, including numbering and cross-referencing, tables and figures, page layout and bibliographies. It supports also mathematics notation which allows description of any kind of mathematical expression in a very simple way. Because its output is PostScript (PS) or PDF, it is a perfect tool for creation of documents for printable output.

Implementation of LaTeX for the web is not directly possible, because it was not developed for it. There exists a project (LaTeX2HTML, 2001) which allows production of an HTML page from LaTeX but its implementation into the e-learning environment is the least very complicated. Fortunately there exists Mathematical Markup Language (MathML) (W3C, 2008b) which is designed especially for integration of mathematical formulas into the web documents and becomes as a standard for mathematics on the web.

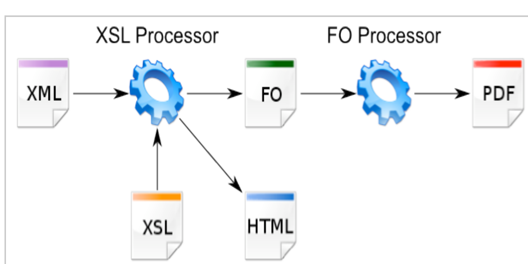
General Solution — DocBook

Once the learning text has been written as an HTML page, it is very difficult to transform this text into a printable document or share it without any modification with another e-learning system. A better solution is to have the learning text in such a form that would allow transforming it into the printable document, HTML or any other format. A format which allows this already exists and it is called DocBook (OASIS, 2008a).

DocBook is a semantic markup language for technical documentation which was originally intended for writing technical documents related to computer hardware and software. It also can be used for any other sort of documentation including learning texts. As a semantic language, DocBook enables the creation of document content in a presentation-neutral form that captures the logical structure of the content. That content can then be published in a variety of formats, including HTML, PDF and Rich Text Format (RTF), without the need to modify the source.

DocBook is actually just a XML language described by a set of schemes (OASIS, 2003; W3C, 2008c; W3C, 2007) which are defining the structure of the document. DocBook document do not describe how its content look like, but it describe the meaning of the content. That is why for a more presentational format of a DocBook document it is necessary to use the DocBook XSL Stylesheets (OASIS, 2008b). These are XSLT (W3C, 2008d) stylesheets that transform DocBook documents into a number of formats. The principle of XSL transformation is shown in Figure 1. These stylesheets are very adaptable and intelligent. By setting several parameters (Stayton, 2007) it generates automatically the title page, chapter and figure numbering, tables of contents and any other parts that are extracted from the content and structure of the document.

Figure 1: DocBook Publishing Model



Since DocBook is a semantic language designed not only for a description of the information but also for easy use, the creation of the document is intuitive and fast. Anyone who looks for the first time at a DocBook document immediately understands what that part of the document expresses. A simple document is visible in Example 1, where the basic structure of a DocBook document is shown.

Example 1: Simple DocBook Document

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE book PUBLIC "-//OASIS//DTD DocBook XML V4.4//EN"
"http://www.oasis-open.org/docbook/xml/4.4/docbookx.dtd">
<book>
  <bookinfo>
    <title>My first book</title>
    <author>
      <firstname>John</firstname>
      <surname>Doe</surname>
    </author>
  </bookinfo>
  <chapter>
    <title>First chapter</title>
    <para>Some text of the first chapter.</para>
  </chapter>
  <chapter>
    <title>Second chapter</title>
    <para>Some text of the <emphasis>second</emphasis> chapter.</para>
    <section>
      <title>First section</title>
      <para>Some text of the section.</para>
    </section>
  </chapter>
</book>
```

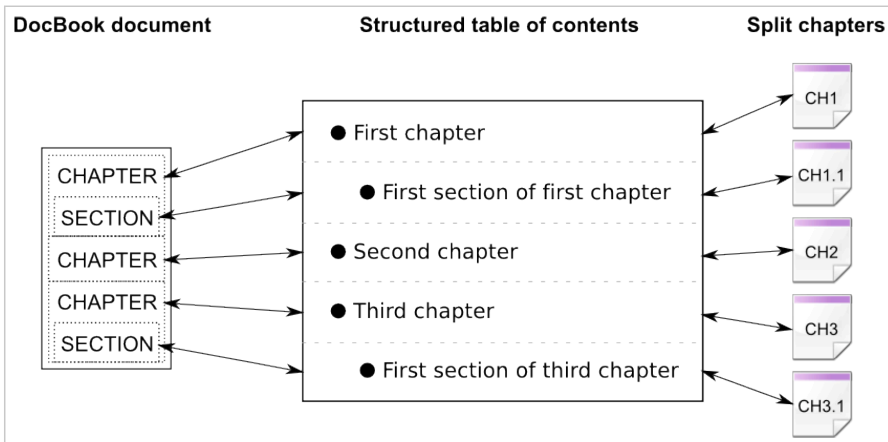
DocBook Implementation

Use of XML-based authoring methodology in an e-learning environment is not uncommon as discussed by Ger et al., 2006. At the Technical university of Liberec, DocBook has been implemented into the University E-learning System (UES). UES makes it possible to publish a learning text in a classical HTML format as well as in a DocBook format. In the case of DocBook use, it is possible to choose between several document types: book, chapter, article and reference page. In the third line of Example 1, each type is specified as a DOCTYPE definition.

Because the learning text in an e-learning environment is often used as a complete text or as a single chapter, the most suitable document type is book and chapter. To keep the data integrity and to improve the search performance of the e-learning system it is better to have all the learning texts stored in a database management system (DBMS). Because the learning text is browsed by chapters, they all have to be stored in the DBMS separately. This should be taken into account during the database modeling in order to be able to restore the original structure of the learning text from the various chapters.

Adding a new learning text into the UES takes place by the creation of a structured table of contents. If the learning text is split into chapters, each chapter actually represents a new learning text which can be displayed separately. The newly created structured document can then be called a theme which will group all the parts of the learning text together.

Figure 2: Theme Structure



Each item of the themes represents a chapter or a section of a DocBook document. Each chapter of the theme is inserted as a text of the specific item of the table of contents of the theme. This situation is visible in Figure 2 (from left to right). The initial creation of the theme structure can be automatized by importing of the whole learning text as a DocBook document into the e-learning system. Updates can be done by editing the source code of the chapter directly in the internal UES editor or in another editor having access to the DBMS.

Web presentation. Each chapter in the UES is represented by a piece of DocBook document which belongs to a particular theme. For visualization of the DocBook code, it is necessary to use DocBook XSL Stylesheets to create the HTML by using an XSL transformation (XSLT). To avoid doing the XSLT every time the HTML page is displayed, the result of the XSLT can be saved into the database. Reading of the pre-processed HTML code from the database is much faster than the process of the XSLT and it has significant influence on the system response time. For easier implementation of the theme structure, the name of the chapter is stored in the database separately from the rest of the chapter. This allows the user to write only the inner part of the chapter which consists of a set of paragraphs or similar elements.

Because each chapter in the system is not fully defined, it is necessary to create the full DocBook document structure before the XSLT. This means creating the chapter document type definition, creating the body of the chapter including its title, and inserting below the title the part of the chapter created by the user. Only documents following this procedure can be transformed into the HTML output.

DocBook XSL Stylesheets produce by default a complete HTML page output. Because the UES itself is displayed in the web browser as an HTML page and because the output of the XSLT is also an HTML page, it is bad practice to insert the output of the XSLT as it is into the page. Therefore it is necessary to chop off the parts of the XSLT output, which are not a content of the body of the HTML document. This preempts a collision with the HTML definition of the UES page. It is only this modified output of the XSLT that can be saved into the database and later shown as a part of the UES output.

Printable output. Since the web presentation and the printable output share the same learning text source, one has to create the DocBook document first. In the environment of the UES it is possible to create printable output of each chapter separately or group all the chapters into one complete document and create a book. Compared to the creation of the web presentation, the XSLT output for printable output is XSL Formatting Objects (FO) which are the source for the FO Processor that produces a PDF file. In the UES the PDF file is accessible on the same page as the web presentation of the chapter.

The process of book creation is more difficult. Because the book consists of all the separate chapters which exist in the theme, it is necessary to reproduce the same structure of the future book into a single DocBook document. This structure is taken from the structured table of contents of the theme. The process flow (from right to left) is shown in Figure 2. In comparison to the creation of a single chapter DocBook document, the DocBook document of a complete book contains information which includes book title, name of authors, publisher name and copyright. From this information and from the structure and the content of the chapters a title page, table of contents, abstract with keywords, acknowledgment, preface, list of acronyms, chapters, sections of the chapters, bibliography and appendixes are automatically created. The document prepared in this way is transformed with XSLT and FO processing into the PDF file and stored in the UES. The user can click on this PDF file on the page with the structured table of contents of the theme.

DocBook and Mathematical Notation

Mathematical equations can be described in the DocBook format by three environments. These are ‘Equation’, ‘InformalEquation’ and ‘InlineEquation’. The ‘Equation’ environment is used for referenced equations, as shown in Example 2.

A suitable environment for non-referenced equations is ‘InformalEquation’. This two mentioned environments do not provide a facility to construct in-line mathematical formulas but these can be inserted into the document by using the 'InlineEquation' environment.

Example 2: MathML Equation in DocBook

```
<para>
  <equation>
    <title>First MathML equation</title>
    <math>
      <mrow>
        <msup>
          <mi>c</mi>
          <mn>2</mn>
        </msup>
        <mo>=</mo>
        <msup>
          <mi>a</mi>
          <mn>2</mn>
        </msup>
        <mo>+</mo>
        <msup>
          <mi>b</mi>
          <mn>2</mn>
        </msup>
      </mrow>
    </math>
  </equation>
</para>
```

Example 3: LaTeX Equation in DocBook

```
<para>
  <equation>
    <title>First MathML equation</title>
    <math role=”latex”>$$c^2 = a^2 + b^2$$</math>
  </equation>
</para>
```

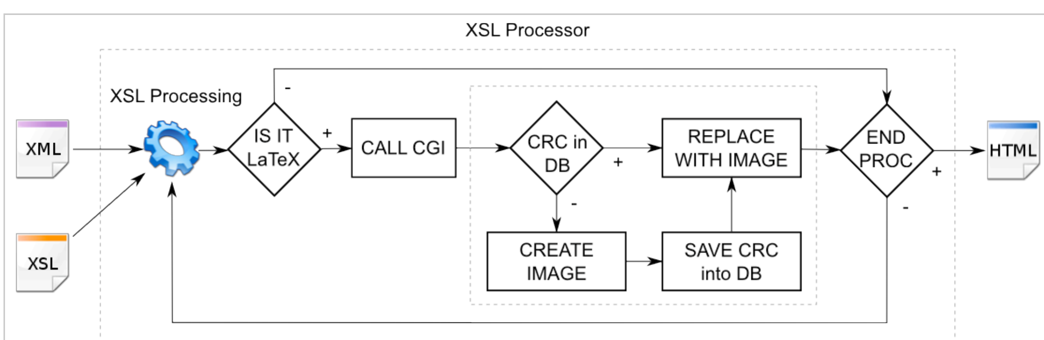
All of the environments can contain a definition of mathematical formulas. In principle, there are two ways of writing formulas. The first one is based on the pure XML language MathML. The advantage of MathML is that it is still XML so it is possible to process it like the rest of the DocBook document. The disadvantage is that the XML description of any mathematic formula is too descriptive and can take a lot of space. Also for a human it is harder to create and to read. The second possibility is to write the mathematical formula in old-fashioned LaTeX form. The advantage of this solution is that this form is very compact and transparent. The disadvantage is that the mathematical formula is not XML anymore and it has to be processed as text. Both forms of the same equation are shown in Examples 2 and 3.

The use of LaTeX mathematical notation in DocBook has other reasons. The first reason is more or less historical, because there were not many possibilities for writing a accurate mathematical formula in the context of a typesetting system other than LaTeX. The second reason is that people know LaTeX and they want to use it even in the XML context. Good examples of this approach are the existence of several projects that are trying to convert XML documents into LaTeX (DB2LaTeX, 2004), (PassiveTeX, 2005) or vice versa (TeXt4ht, 2007).

Web presentation. Even if MathML is specially designed for implementing web documents, its implementation faces several problems. The first problem is the lack of direct support in all web browsers. MathML is only supported by web browsers based on the Gecko engine or by the newest version of the Opera web browser. In other browsers it is usually possible only with a particular plug-in (Design Science, 2008). The second problem is the need to have particular fonts installed which allow the display of special mathematical symbols. A better solution is the possibility to transform the MathML into Scalable Vector Graphics (SVG) which have much a wider support in web browsers. This situation has been described by Goossens (2002) in the project "Tools for Innovative Publishing in Science." Even if this review is old, not much has changed since.

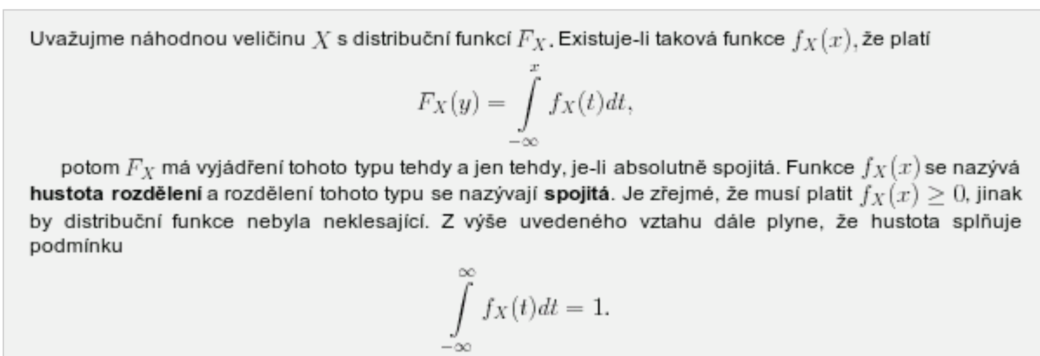
Due to the poor MathML support in the web browsers, the only viable way for many users is the use of images. This is the only universal solution for all web browsers today. On the other hand, this has also some limitations that can bring some problems. First of all, it is very difficult to align correctly an equation to the baseline of the surrounding text. The second problem is that it is just a picture, which has to be generated somehow and stored somewhere. In the environment of the UES a procedure is used that fixes at least the second problem. This procedure is shown in Figure 3.

Figure 3: XSL Transformation into HTML with LaTeX Mathematical Formulas



Every part of the DocBook document is processed by an XSL Processor. When a LaTeX mathematical environment is detected, the mathematical notation is encoded by a Base64 algorithm and sent to the CGI script. This script decodes the text and checks if the same mathematical notation was already processed. If not, it saves the text into a LaTeX file. This file is processed by LaTeX to create a DVI file. From the DVI file a PS file is created which is then processed by GhostScript (GhostScript, 2008) into the transparent PNG image. Because the generation of the image is time consuming, the image is saved on the disk. On top of that, the Cyclic Redundancy Check (CRC) of the decoded text is saved into the database for later use. After that, the original definition of the mathematical environment is replaced by a corresponding graphical environment that includes the link to the PNG file. All the mathematical environments in the document are processed in the same way. The result of the XSLT is an HTML page with pictures in the place of the definition of the original mathematical notation as shown in Figure 4.

Figure 4: Example of HTML Output of the Text Containing Mathematical Formulas



Uvažujme náhodnou veličinu X s distribuční funkcí F_X. Existuje-li taková funkce $f_X(x)$, že platí

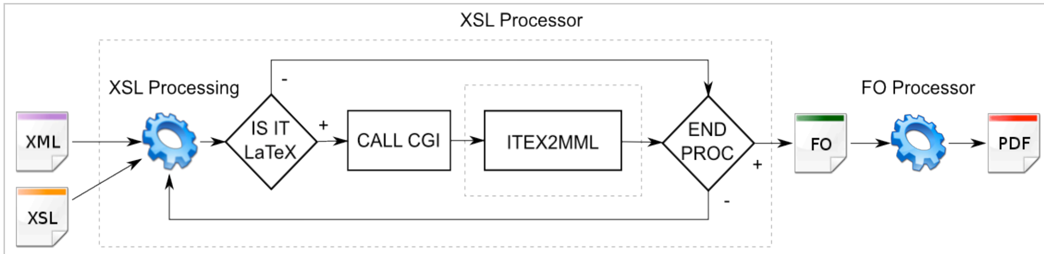
$$F_X(y) = \int_{-\infty}^{x} f_X(t)dt,$$

potom F_X má vyjádření tohoto typu tehdy a jen tehdy, je-li absolutně spojitá. Funkce $f_X(x)$ se nazývá **hustota rozdělení** a rozdělení tohoto typu se nazývají **spojitá**. Je zřejmé, že musí platit $f_X(x) \geq 0$, jinak by distribuční funkce nebyla neklesající. Z výše uvedeného vztahu dále plyne, že hustota splňuje podmínku

$$\int_{-\infty}^{\infty} f_X(t)dt = 1.$$

Printable output. As shown in Figure 5, the creation of a DocBook printable output with mathematical formulas uses almost the same procedure as in the case of the web presentation. Because PDF is giving the best results when using vector graphics, it is not desirable to have mathematical formulas as an image. The use of MathML is preferred because it is easy to transform into the SVG format. For users, describing mathematical formulas in LaTeX is much easier, so it is necessary to have a tool that allows the transformation from LaTeX into MathML (itex2MML, 2008; ORCCA, 2002a). This tool is called during the process of the XSLT to replace the LaTeX formula with its MathML equivalent.

Figure 5: XSL Transformation into PDF with MathML Mathematical Formulas



The output of the XSLT is an FO that will be transformed into the printable output. If the learning text contains mathematical formulas, it is necessary to use the FO Processor (Apache, 2008) with MathML support (JEuclid, 2008). An example of the PDF file including mathematical formulas is shown in Figure 6.

Figure 6: Example of PDF Output of the Text containing Mathematical Formulas

Uvažujme náhodnou veličinu X s distribuční funkcí F_X. Existuje-li taková funkce $f_X(x)$, že platí

$$F_X(y) = \int_{-\infty}^{x} f_X(t)\mathrm{dt},$$

potom F_X má vyjádření tohoto typu tehdy a jen tehdy, je-li absolutně spojitá. Funkce $f_X(x)$ se nazývá **hustota rozdělení** a rozdělení tohoto typu se nazývají **spojitá**. Je zřejmé, že musí platit $f_X(x) \geq 0$, jinak by distribuční funkce nebyla neklesající. Z výše uvedeného vztahu dále plyne, že hustota splňuje podmínku

$$\int_{-\infty}^{\infty} f_X(t)\mathrm{dt} = 1.$$

Conclusion

As shown in this paper, XML technologies are suitable to describe information in the e-learning environment. It can be used not only as a description of the learning text presentation, but also for sharing of learning objects within another e-learning system. DocBook, as one of the XML languages, is a ready-to-use tool which allows transforming the learning text into several formats. It helps the maker of the learning text to create a single source text and transform it into the web presentation as well as into the printable output.

Although mathematical formulas are supported by web browsers, displaying them correctly can be very problematic, even if the standards exist already for some time. Therefore it is unfortunate to say that the most reliable solution is still the use of images. For printable output containing mathematical formulas, the situation is very different because most of the documents are produced in LaTeX. This strong influence is also felt in mathematic related XML technologies where it is still possible to write mathematical formulas in the old-fashioned LaTeX form. We can only hope that in the future the support of mathematical notation on the web will grow and reach a level that can compete with the quality of LaTeX.

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STUDENTS' RESEARCH SELF-EFFICACY DURING ONLINE DOCTORAL RESEARCH COURSES

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Abstract

This study will explore student skill development and research self-efficacy as related to online doctoral students' first core research course experience. Collected data includes course grades, discussion content, instructor capstone assignment ratings, and scores on the Research Self-Efficacy Scale (RSES). Findings from this study will be used to inform instructors and university faculty in effective ways to support and guide doctoral students during their early research experiences. This support can help better ensure that online graduate students will develop well-crafted dissertations and, following graduation, continue to conduct research and inform their fields of practice.

Introduction

Many graduate students in education and the social sciences have concerns about learning research concepts. In addition, many fail to master key concepts needed to prepare them for designing dissertations and future studies at a doctoral level. Anxiety and doubt can greatly interfere with students' ability to learn and master research concepts. Research has shown that low research self-efficacy can interfere with students' research training and practitioners' willingness to conduct research and add scholarly contributions to their field of study (Love, Bahner, Jones, & Nilson, 2007). Research has also shown that high research self-efficacy is an important factor related to students successfully conducting research and pursuing research beyond graduate study (Forester, Kahn, & Hesson-McInnis, 2004). In online graduate schools it is important to ensure that the first core research course experience provides the needed support and mastery experiences to enhance research self-efficacy in graduate students. It is also important to understand the personal factors that interfere with student learning in online research courses. Online courses present a particular challenge in research training because the courses may not work naturally with students' specific learning styles (West, Kahn, & Nauta, 2007).

Purpose of the Study

The purpose of this study is to understand factors in doctoral students' first core research course experience that enhance student skill development and self-efficacy related to handling future research projects and courses. Factors that may serve as obstacles to learning and research self-efficacy will also be investigated.

Research Self-Efficacy

Bandura's (1977, 1982, 1986, 1995, 1997) concept of self-efficacy as applied to research can be defined as confidence in carrying out research activities from organizing a research plan to carrying out the research process from library research and reading to writing and publication (Holden et al., 1999; Lei, 2008; Uranu & Beck, 2004). Self-efficacy is a good predictor of behavior and research self-efficacy is particularly useful in identifying the forces at work in career choices for graduate students regarding whether or not they will engage in research formally in their work (Mullikin, Bakken, & Betz, 2007).

Nationally, American doctoral graduates lack interest and experience in research and, once they secure a faculty position, spend little time on research (2009 National Survey of Student Engagement). Yet, "people form enduring interests in activities in which they view themselves to be efficacious and in which they anticipate positive outcomes" (Bard et al., 2000, pp. 48–49). Thus, as students, these same doctoral graduates perhaps viewed research courses with negative associations that led to diminished amounts of time spent in and effort spent on research courses and projects (Lei, 2008; Papanastasiou, 2005). Research courses that bridge prior learning with new applications for and motivation to conduct research may be the road to building research self-efficacy in graduate students. In fact, high research self-efficacy has been connected to both future research involvement and higher research productivity (Bard et al., 2000; Bieschke, 2006; Lei, 2008).

Self-efficacy in research for graduate students appears to begin with positive experiences in the early research design courses. This parallels Bandura's (1986) understanding of cognition as a social phenomenon a la Vygotsky in which a structural network of influences either supports or undermines cognition. This structure is created within research courses, and has certain important self-efficacy building/undermining capacities. In fact, this structure forms "self-perceptions of capability [that] help determine what individuals do with the knowledge and skills they have . . . and what knowledge and skills are acquired in the first place" (Pajares, 1995, p. 2). Therefore, the authors of this study understood the research courses to be important public spheres of cognition in which people's behavior would be "both mediated by their beliefs about their capabilities and . . . [better] predicted by these beliefs than by the results of their previous performances" (Pajares, 1995, p. 4). For that reason, this study assumes self-efficacy as the construct by which the potential for student research capabilities in their graduate school career and beyond are viewed.

Research Questions

Within a pilot exploratory case study, the following research questions are explored.

- What aspects of the course experience contribute to the development of necessary research skills?
- What aspects of the course experience interfere with development of necessary research skills?
- What aspects of the course experience contribute to students' research self- efficacy?
- What aspects of the course experience interfere with students' research self- efficacy?
- What role did personal factors play in this self-efficacy development (learning styles)?

Original Research Design

The original research design was a grounded theory study where both qualitative and quantitative data were to be collected prior to students starting the course and following course completion. The researchers proposed to collect data through interviews, observations in the form of documented online discussions and correspondences, and the Research Self-Efficacy Scale (RSES) developed by Kathy Bieschke (1996). Course grades and final research outline projects were supposed to be examined to determine student mastery of key concepts. Within this grounded theory study, researchers would have analyzed data using inductive procedures where codes "emerge" from the data. Data from the initial qualitative questionnaires would have been coded to determine which students entered with research concerns and doubts about how they would perform in the course. Data from the end-of-course, qualitative questionnaires would have been coded to determine which students experienced key skill development and positive perceptions of their course experiences. Data relevant to key factors that enhanced or inhibited learning would have been coded. Course grades and final research outline projects would have been examined to determine student mastery of key concepts. All qualitative data would have been coded using approaches outlined by Glaser and Strauss (1967), Strauss and Corbin (1998), and Charmaz (2006). Coding procedures and justifications would have been presented in great detail as would have been justifications for codes. The RSES scores would have been tabulated and examined in relation to qualitative findings.

Following the specific procedures for this approach, findings should have provided key themes and a resulting theoretical model, which would enable instructors of online research courses to enhance research self-efficacy and skill development in their students.

Challenges with Original Research Design

Approximately 60 Walden University students from the PhD in Education program were invited to participate during the 2008 implementation. A convenience sample of students that agreed to participate was selected. To the authors' surprise, the response rate was much lower than common response rates in this kind of research study even though the authors assumed that beginning doctoral students would realize the opportunity offered to them by participating in this study. During the first quarter that the study was offered to students, only four participants volunteered and completed the pre-test with two completing the post-test. After the same study was offered once again during the next quarter, the participants grew to 10 volunteers but only 5 of those completed the post-test survey.

Through informal conversations with students and a presentation of this research design to a small roundtable of graduate students and colleagues (Baltes & Hoffman-Kipp, 2009), the authors learned that online doctoral students realize the importance of participating in this study but were just overwhelmed with the demands of their personal life, work, and their doctoral program. Participating in this study would have been an additional task that seemed meaningful but plainly impossible. This was an interesting finding in itself which only stressed the importance of considering the population of online graduate students. The authors of this study came primarily from traditional universities and traditional programs, having worked as research assistants over the years, thus, having opportunities that online doctoral students do not have.

Modified Research Design

Due to the limited number of participants and the need to further test plans for data collection and synthesis, the authors decided to apply an exploratory case study method and use this as a pilot to inform a larger study. Going forward, the authors will recruit students through the Walden University Participant Pool. The Participant Pool consists of many Walden students across disciplines. Consequently, this study will be open to all students across the university that are in their first year research course, and not only doctoral students in education.

The final result of the case study analysis will be detailed descriptions of each case with discussion of categories and themes along with the exploration of commonalities and differences. The question guiding the case study is: What elements contribute to successful self-models that depict the issues as well as relationships between factors impacting research skill development and self-efficacy in online doctoral students? Findings from this study will provide information helpful for adjusting instructional and curricular approaches to enhance support for online students that are wary about taking research courses. Ideally, specific approaches will be determined to foster good practice opportunities and mastery experiences. To fulfill Walden University's mission of positive social change, it is essential that Walden's doctoral students are able to understand as well as conduct research.

Data Sources

Multiple data sources informed this pilot study and will inform the larger study. These data sources include:

Discussion analysis. A discussion analysis of asynchronous classroom discussions using the Critical Thinking Assessment Framework (TAF) developed by Weltzer-Ward, Baltes, and Lynn (2009) provided insight both into learners' applied understanding of the course material and into their ability to employ that understanding within a critical context. Discussion analysis was conducted independent of other analysis by a member of the research team who was familiar with the other assessments and tools being utilized but was not familiar with the performance of the individual case-study learners on those assessments and tools. Analysis included discussion posts from weeks 3, 6, and 11 of the research methods course. These discussion were chosen to represent both a time and content cross-section of the course with week 3 asking learners to generate and revise research questions, week 6 asking learners to assess and revise proposed quantitative methodologies, and week 11 asking learners to create, assess, and revise either mixed methods or action research methodologies.

Assignment grades. Grades from weekly assignments were examined to see trends of change for the participant over the course. These are considered in relation to the discussion content.

RSES scores. The instrument was used to look at initial perceptions of research capabilities prior to the course as well as following the end of the course. Items load into the following areas:

I. Conceptualization – 16 items
II. Implementation – 20 items
III. Early Tasks – 5 items
IV. Presenting Results – 8 items

Course expectations questionnaire. This is an open-ended questionnaire to gather qualitative, first-hand data on perceptions of skills prior to the course and expectations for the course. Some basic, relevant demographic data is collected in this questionnaire as well.

Course experience questionnaire. This is an open-ended questionnaire implemented after the end of the course to gather qualitative first-hand data on experiences that occurred during the course and the participants' perception of how this impacted their perceptions of their own research skills.

Instructor rubric. A rating was developed for instructors to assess the final capstone project for both conceptual understanding and alignment. This, along with course grades, can be used to consider actual success in the course in relation to perceptions of research capabilities.

First Results

A single case was examined in depth in preparation for the larger grounded theory study. Four additional cases will be examined to continue this pilot in preparation for the grounded theory study. These four additional cases will further test the methodology and explore trends across different course sections, with different instructors and varying levels of initial confidence and incoming research preparation.

First Case Analysis

The first case to be analyzed in the pilot study is Penelope. The name Penelope is a pseudonym used in place of continual reference to a code number.

Participant background. Penelope is a 55-year-old female student in the PhD in Education program that had no research as part of her bachelor's curriculum and had completed a Masters and EdS that both included theses but received no formal research instruction prior to the doctoral program. She was a student in the Fall 2008 doctoral course in research design.

Instructor/course context. Her course was taught by a very experienced instructor who had been employed by the university for several years and had taught the course several times. The course environment showed timely feedback. Feedback included both a score and written comments on each assignment. The course is a standard format that has been in place since 2003.

Discussion analysis. Across weeks 3, 6 and 11 the student showed regular interaction and good conceptual understanding. Penelope gave middle to high quality evidence throughout all discussions but often supported claims with only a single piece of evidence. The highest evidence per claim ratio was in week 11 with a score of 1.3.

Assignment grades. Penelope received the highest overall score in the course. Her total points for the course were 95/100. Scores on 5 points assignments ranged from 4.5 to 5. The lowest score came in week 8 for misapplying an analysis technique to a qualitative study.

RSES scores. In comparing initial RSES scores with end of the course RSES scores, Penelope showed increases in several areas as well as decreases for several items. There were items that showed decreases within each of the three factors of the instrument but the majority of these decreases were in factor II: Implementation. For this factor 13 out of the 20 items showed decreases ranging between -1 and -10.

Course expectations questionnaire. Penelope reported an eagerness to learn and good confidence in her capabilities. She identified time as a potential obstacle in the course due to her full-time work.

Course experience questionnaire. Penelope reported that she learned a great deal but the course was much more challenging and time consuming than she had expected. She also reported that more feedback would have been helpful. She reported gaining much knowledge and confidence in qualitative research.

Instructor rubric. The final assignment is a research plan outline. The assignment was evaluated by the instructor for understanding of concepts and the alignment of concepts. Penelope rated a 5 for conceptual understanding and a 5 for alignment because all concepts were aligned perfectly into a well-planned study.

Findings in Relation to the Research Questions

1. What aspects of the course experience contribute to the development of necessary research skills?

Based on analysis of interaction in the course environment as well as what the student reported, it would seem that training on basic research design as well as information on qualitative research within this course was good for the student's skill development. Also, it seems like the student used the discussions well to demonstrate conceptual understanding and critical thought on key concepts and research planning.

2. What aspects of the course experience interfere with development of necessary research skills?
Based on the student's success in the course and her ability to develop a well-aligned study, no aspects emerged as interfering with the development of research skills.

3. What aspects of the course experience contribute to a student's research self-efficacy?
It appears that the information in the course and text books for planning a qualitative study was helpful. The student reports confidence in planning such a study at the end of the course.

4. What aspects of the course experience interfere with a student's research self-efficacy?
While the student was successful in the course, it seems that the high amount of work and rigor in the course combined with limited time available for working on assignments was somewhat of a stressor. Also, the RSES scores indicate that experiences in the course caused the student to question her abilities in implementing a project. It seems like she may have learned more about what is involved in planning and implementing a study and that made her reassess her level for implementation. While she did decrease, her actual scores were all high, ranging from 90–100 of a scale from 1–100.

5. What role did personal factors play in this self-efficacy development (learning styles)?
The only personal factor might be the student's own expectations for her learning and her stressors related to time limitations.

Summary

Examining this initial case confirmed that the elements of this study are useful for understanding multiple factors relevant to the development of research skill development and research self-efficacy for students in the first core research course. Interesting findings from this case include the student's stressors related to course requirements in combination with the high level of success the student showed in the course. It is also interesting that the student reported decreases in overall confidence in study implementation. This may indicate that the student now knows more about what is involved and is, therefore, more conservative in her ratings. It is also interesting that while this is a general research design course that provides information on both qualitative and quantitative approaches, the student reports comfort and confidence in designing qualitative studies. These trends will continue to be explored across the four additional cases in preparation for the grounded theory study.

Upcoming Grounded Theory Study

This case study pilot study is helpful for understanding students' course experiences, refining procedures for the grounded theory study, and gaining experiences in working and relating the various data sources. These initial results are interpreted cautiously, informing mostly in the use of tools for data gathering for this population. The subsequent grounded theory study will be conducted in a truly inductive manner. Findings from the case study can point to areas for consideration but will not be used to theoretically ground the subsequent study, because in grounded theory, findings must emerge from the data. A grounded theory study with at least 20 subjects is needed to properly address these research questions and develop a substantive theory that can inform online instructors, university administrators, and additional research within the continuum of inquiry on this topic. The new University Participant Pool will easily facilitate the gathering of participants. In the interpretation of the grounded theory study, after findings have been processed and reported, findings will be considered in relation to initial case findings to see if trends have been confirmed.

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COLLABORATIVE LEARNING AS PEER REVIEW IN ONLINE AND DISTANCE EDUCATION

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Abstract
This paper draws upon findings from an analysis of the written feedback produced by a group of Swedish University students acting as peer reviewers. The study aims to identify what type of feedback the students provided for each other, in order to gain some preliminary insights into if and how peer review preceded by collaborative criteria processing could contribute to learning. The two dominant feedback patterns were "reinforcing" and "suggestive" while "corrective" and "didactic" were less common.

Introduction

The study reported in this paper derives from a distance course in a collaborative project between three departments of Education in Sweden with the goal to implement and evaluate peer assessment as peer review in our online courses. We chose to implement formative peer assessment, "assessment for learning," arranged as peer review preceded by a discussion of the criteria. The different steps are designed to serves as tools to enhance student learning.

Previous analysis of data from this course shows a high student engagement in the peer review activities. A majority of the students found participating in peer review highly valuable for their learning process and their understanding of scientific knowledge building (Liljeström, 2008, in press; Liljeström, Hult & Stödberg, 2008).

In this paper we will share more of our experiences of how peer assessment can work as a tool to enhance student learning. We will begin by offering a brief background to the decision to implement and evaluate peer assessment on our distance and online courses. We will also describe some of the principles of our design of the peer assessment element and the context in which our model was put in use. Finally we will offer some findings from the implementation in the Special Needs Teacher Programme. Data for this study was collected from a message board facilitated in FirstClass, with a focus on the nature of how the students approached the task of peer review:

- What kind of feedback did the students provide for each other?
- Were the comments limited to narrow details or did they open up for reflection and discussion?

Background

The sociocultural approach to cognitive development has gained ground in recent years and is often present when setting the scene for online and distance learning. Simultaneously, current international educational discourse raises the demand for extremely fine-grained approaches to measuring student achievement in combination with “a strong social drive to help learners, some with histories of spectacular ‘unsuccess,’ to obtain qualification” (Sadler, 2007). Also, the focus of assessment is shifting from assessing the reproduction of knowledge to higher order skills (Dysthe, 2004), in agreement with the expected role of higher education as producer of “self-regulated learners” (Steffens, 2006) and by helping the students develop useful tools for lifelong and “sustainable” (e.g. Boud, 2003) learning. A shift that reflects a new view of society “the society of tomorrow will require people who are flexible and able to continue to acquire new knowledge and learn new skills” (Dysthe, 2004, p. 3).

Measuring up to the demands listed above, while at the same time trying to set the scene for learning based on sociocultural theory is challenging enough in on-campus education. The teachers are often restrained by limited resources when carrying out educational assessment with large study groups. This also often means designing teaching and learning tasks for a highly heterogeneous mixture of students with regard to age, life situations, and study backgrounds. Some students enter a course with a “world view” so different from the views within the academy that they have trouble identifying what they are supposed to achieve when, for example, writing an academic text (Bizzell,1986; Hayes et al., 1986). These students may need a great deal of support and guidance to be able to crack the codes for how they are supposed to approach their assessment tasks.

While facing the same combination of limited resources, large, heterogenic study groups and internal and external demands, teachers of online and distance education also very seldom, if at all, get to meet their students face to face. Many of the online students are alone in their studies, wrestling with trying to figure out what they have to learn and perform to pass their exams. As they seldom or never visit the campus, they don’t have access to artefacts and contact with staff members and others who represent the academy and the institution providing their education. This might make it even harder for this category of students than for campus students to develop an understanding of the academic tradition within which they have to communicate when doing their coursework. Therefore it is important to develop strategies to support online and distance students to become familiar with what learning at university level means, thus helping them to direct their studies towards successful learning results.

As previous studies of assessment have shown a strong relationship between assessment and what and how students learn (e.g. Becker, 1968; Miller & Parlett, 1978) a fundamental conclusion is that assessment is essential to student learning. This has also served as a starting point for our search for helpful tools to support student learning.

Formative assessment can help the students understand how to direct their learning towards expected learning outcomes. However, warnings should be raised about the current trend of formative and criteria-based education which at worst could create more teacher-dependent students and reductionist learning where the intended learning is displaced by procedural compliance (e.g. Sadler, 2005, 2008, 2009; Torrance, 2007).

Peer review, when preceded by discussion and interpretation of the criteria to enhance the students' ability to give relevant and qualified feedback, seemed to be a possible way to overcome these risks. The idea of learning through collaborative activities such as interpreting, negotiating and applying criteria to support each other's learning also seemed to correspond to sociocultural learning theory.

Reviewing the work of peers might reduce the risk of replacing learning with procedural compliance, since the students will face a variety of approaches to solve the same task. Previous studies of peer assessment have shown that engaging students in formative peer assessment sustains the idea of autonomous, independent and self-directed learners who take responsibility for their own personal and professional development and direct their learning towards successful achievement (e.g. Anderson et al., 2001; Bloxham & West, 2004; Boud, 2002; Higgins, Hartley, & Skelton, 2002; Lorraine & Stefani, 1998; Macpherson, 1999; O'Donovan et al., 2004; McLuckie & Topping, 2004).

Peer-review Design

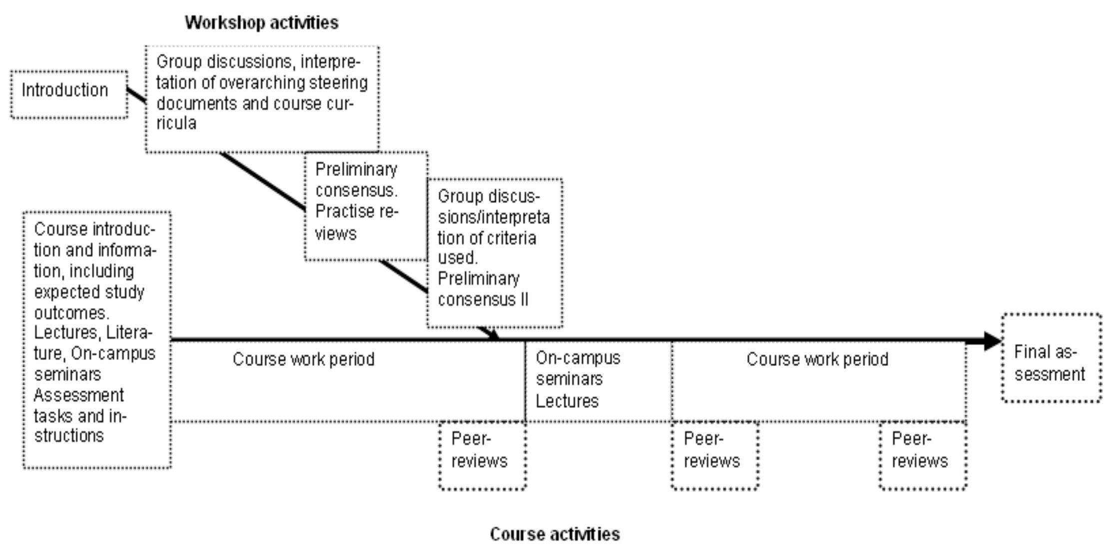
The students were prepared for peer review through asynchronous, written communication organised as workshops. Since the study programme was delivered using FirstClass, they were familiar with this platform from earlier courses. At this stage of the project it was the concept of peer review preceded by discussion and interpretation of the criteria that we primarily wanted to test. We designed the workshop so that it would not interfere too much with the original structure of the course or the two pre-planned assessment tasks.

The students were already assigned to smaller study groups varying from 4–8 participants. Each group had their own discussion forum.

The pre-planned assessment task was to outline a pedagogical issue of interest for their future profession, and to plan and conduct a field study on this matter to be presented in the form of a written 10-page research report. One task was also to create a portfolio of literature and lecture comments including a self evaluation in which they discussed their learning process.

The only adjustment made to these tasks was that we asked the students to take into account the workshop discussions (see Figure 1) in their self evaluation, and exemplify how they and others had contributed to the learning process. The purpose of this was to stimulate participation in the workshop without setting up rules for how many postings they had to contribute with. We wanted to see if the task itself could provide sufficient motivation to keep the students active in the workshop activities.

Figure 1: Workshop and Course Activities



The ideas behind the peer assessment were introduced briefly at the course introduction and further instructions were carried out in the workshop at the beginning of the period of course work. The students were tutored with questions aimed to challenge their understanding throughout the workshop. As shown in Figure 1, the workshop began with an initial discussion of course criteria in the light of the Higher Education Act and the Higher Education Ordinance, which can be described as overarching steering documents for all Swedish universities with the official expectations for general (generic skills) and programme specific (professional skills) outcomes of the university studies. The ambition was to stimulate the students to interpret and negotiate the meaning of these documents in depth, with the goal of reaching a preliminary consensus of which criteria they found valuable to put in use when performing the peer reviews.

In the next stage, the students individually reviewed two example texts written to correspond with the instructions these students had received when writing their own reports. The texts were authored to resemble student essays. Both had strengths and weaknesses to give the students plenty of issues to debate.

Text one was authored in a purely referential style with a weak ‘author’s voice’. It was based on studies already conducted on the research subject but with no clear purpose as to why these were referred to. Text two was written in an argumentative style in which the ‘author’s voice’ was present. It also referred to previous studies already conducted on the research subject but connected them to issues such as general trends in society. Some comparisons with studies made in other fields were also mentioned as a part of the chain of argumentation.

The students posted their individual reviews in the workshop and discussed similarities and differences in their reasoning. After this stage they had the option to modify the criteria they had chosen for their peer reviews to correspond with their new insights. Finally, the students applied these (possibly) new insights in reviewing a journal article which was part of the course material and had a final discussion about what they had learned from this, as a conclusion to the training in the workshop.

The students reviewed their peers’ work in progress on three occasions. The first review was carried out on a draft for a literature or lecture comment, as writing these comments was part of their task to create their portfolio. The next review was on preliminary plans for their research study, and the last one was on the drafts for the final report of the results from their research studies.

Method

Data was collected from message boards in a 10-week distance course called Developmental Work, Leadership and Evaluation which was carried out spring 2008. The students, who were spread out over all parts of Sweden, gathered at the university on three occasions, at the start, in the middle and at the end of the course. Although they all had a teaching exam and were studying to further their qualifications, these previous study experiences varied in length and content, as their professions ranged from preschool teachers to college teachers and their ages varied from late twenties to fifty plus. Only three of the students were men.

The data used in this paper was collected from the two peer reviews at the end of the course, where the students reviewed each other's preliminary plans and the final drafts. We decided to use the categories Reinforcing, Suggestive, Corrective, and Didactic, inspired by the framework created by Chi (1996) as used by Tseng and Tsai (2007) to categorize the students' feedback to each other in this first approach in order to capture some of the nature of these comments. In our version these categories were used as follows:

Table 1: Categories of Analysis

	Description
Reinforcing	In different ways, reassuring that the product meets the requirements.
Suggestive	When it is pointed out that something is incomplete rather than incorrect, and includes suggestions for areas of improvement, thus alerting the recipient that there is a problem without telling them exactly what the problem is. Such feedback can be in the form of hints.
Corrective	If it is pointed out that something is completely wrong, e.g. the design of the report, the content, the usage of theory, references etc.
Didactic	A more lengthy explanation concerning errors or inadequate information provided. Lengthy explanations with a lecturing tone are adopted to direct the students to the right track.

The principle for the determination of coding units was that each time the topic changed, a new coding unit started. The authors of this paper calibrated their coding principles before and during the analysis, by discussing concrete samples from the data collected and how they should be categorised.

We used these categories as a means of getting an overview of the data and the feedback patterns. In addition to this pre-determined approach we also evaluated their comments in a more qualitative way, by paying attention to how the feedback was formulated and received. For example, if it opened up for discussion and reflection. We have also used some data from the workshop to shed light over the overall context in which the feedback was given and to understand more of the function of the feedback.

Findings

The analysis of the data collected from four study groups reveals interesting feedback patterns as we can see in Table 2.

Table 2: Feedback Patterns

Group	Type of feedback				
	Reinforcing	Suggestive	Corrective	Didactic	Total
1	78	66	5	1	150
2	18	27	2	2	49*
3	66	43	18	3	130
4	94	49	34	15	192
Total	256	185	59	21	448

*the number of comments is low because the students in this group lived in the same area and also met face to face to discuss the assignment.

As Table 2 shows, the students gave each other a lot of reinforcing feedback. Often this kind of feedback was given in a short, general way: “This also looks good.” However, on many occasions they also gave more lengthy explanations to their peers, for example:

> *Good clarity and you have pointed out a few aspects which are important for good developmental work. You have connected to previous research in a relevant way and connected to your own research.*

Sometimes these types of reassuring comments seemed to fill a function to ease the stress some of the students felt about their ability to meet the requirements of the assessment task. Also, by discovering that their peers’ approach resembled their own they appeared to gain self-assurance about their own ability.

The analyses also show that the students gave each other feedback of a more suggestive nature, for example:

> *The problem, as I see it, is that PBS (author note: problem based school development) could become rather large and hard to limit. If I were you I would find out what’s already been done and focus on a problem in the school field that they are working with.*

There were some comments with a corrective tone. This type of comment ranged from, for example, pointing out misspellings or that a word used was improper to structural issues, to remarking that a description of method appeared in the findings section of the report. However, as shown in Table 2 this type of comment was relatively sparsely used.

It was clear that some students had more confidence than others in how to write a report in a fashion that would correlate to the explicit and implicit expectations of this kind of assessment product. Some of these students’ feedback could clearly be classified as “didactic” in its nature. For example, one of them colour marked a segment of a text to illustrate different weaknesses in it and explained in depth how this text could be improved.

Although this quantitative analysis gave us an overall picture of the peer review patterns, we have found that it did not fully capture all dimensions of the students' feedback and the processes that were triggered. One interesting observation was that on some occasions the students' comments were more reflective and formulated as a subject for discussion with the other students, rather than a single comment to one student. One example was when a student was insecure because she felt that they had contradictory instructions from tutors on how to describe the aim of their reports. When she raised this question she received a lot of responses which eventually led to consensus in the group.

Another interesting pattern was that since the students' read all comments, not just the ones aimed at their own report, they sometimes objected to someone else's statement and thereby started to discuss a certain issue. We also noticed that reading their peers' reports meant that they reflected on their own report. A reinforcing comment was often accompanied by a remark that reading this report had made the student aware of what she should revise in her own report.

The report assignment was designed to give the students' experience of their future task, to identify, evaluate and report on the effects of developmental work in schools from the perspective of the special needs education field. In some comments we could see that the feedback was not limited to the task itself, it also opened up discussions on how work with the report could become a tool in their future profession.

Conclusions

Firstly, although we did not specify the amount of feedback postings each student should present, we can conclude that the activity was overwhelming. Apparently the students found the assignment and peer review process inspiring.

Not very surprisingly the dominant feedback pattern was the 'reinforcing' type. This is, to our experience, a common finding on students commenting each others work. The great amount of this type of feedback could be due to social reasons, not wanting to hurt or upset their peer. Another reason could be that the students are insecure about their own ability and knowledge in these matters. It is also possible that the insights they gained from the criteria discussions and peer review preparation improved their initial work with the reports so that they fulfilled most of the requirements. This issue requires more attention in future research.

Tseng and Tsai found in their study that reinforcing and suggestive feedback seemed to support the quality of the students' work, while corrective and didactic feedback seemed to work in the opposite way. As could be seen in our study both corrective and didactic feedback is sparsely used, while the amount of suggestive feedback is almost as large as the reinforcing feedback. According to the findings of Tseng and Tsai the students' feedback patterns would indicate that they enhanced each other's performance. This was also indicated in the students' evaluation of the peer review element. Previous analysis of data from this course has shown that the students engaged intensively in the peer assessment activities and that they found this element valuable for their learning (Liljeström, 2008, in press; Liljeström, Hult & Stödberg, 2008). Teachers on the course also reported that participating in the workshop activity seemed to have supported especially those students who had failed to pass one or more course exams previously in the programme.

One of the risks that has been pointed out with formative and criteria based assessment is that it could trigger students' reductionist learning focussing only on fulfilling limited criteria and details, e.g. formalities like flaws in the references. However, the results from this study indicate that participation in the workshops and peer review process did not produce many comments with this approach. As the results have shown, the peer review element seems to have stimulated more than just a simple check that the reports fulfilled explicit criteria. This is demonstrated by the richness of the discussions both with regard to issues that had to do with carrying out research and reporting its results and to how they could put these insights to use when approaching similar tasks in their future profession. This could be an indication of sustainable learning in Boud's (2002) sense.

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THE EPISTEMOLOGY WAR: WIKIPEDIA, WEB 2.0, THE ACADEMY, AND THE BATTLE OVER THE NATURE AND AUTHORITY OF KNOWLEDGE

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Abstract

This paper reports on the preliminary findings of an empirical research project that investigates the attitude of academics (or faculty) towards Wikipedia and how their attitudes impact on their use of Web 2.0 for educational purposes. The research data has been obtained via an online survey of academics predominantly from the University of New South Wales campuses in Canberra (ADFA) and Sydney as well as from other universities in Australia and abroad. The findings to date indicate that some academics are well informed about, and embrace Wikipedia, and by extension Web 2.0 social networking applications and services for the purposes of learning. Yet Wikipedia tends to provoke strong opinions, primarily negative and proves to be a highly divisive and controversial issue. While quite a few respondents occupy the middle ground and display a cautious if not somewhat curious attitude towards Wikipedia, those with a negative opinion appear to hold them much more strongly than the few who indicate positive opinions. The paper makes an important contribution to the educational Web 2.0 literature by providing empirical data that highlights a considerable degree of apprehension, if not hostility towards what is perceived to be Wikipedia's disruptive influence on traditional knowledge construction processes and the authority of academia. Despite, or perhaps because of, a long history of online learning, and notwithstanding the appropriateness of a critical approach, these results point to a problematic acculturation of academia into Web 2.0's worldview and practices.

Is Wikipedia the Site Students Love and Academics Love to Hate?

Over the last few years the use of Web 2.0 social networking applications such as wikis, blogs and micro-blogs as well as services such as Facebook, YouTube, LinkedIn to name but some and a host of combinations or mashups have take the internet by storm. The participatory Web 2.0 social networking revolution is producing a paradigm shift in the way peoples around the globe use the internet. Not surprisingly the literature also indicates that innovative academics (or faculty) are increasingly embracing social networking media for the purposes of formal learning (Allen, 1999; Anderson, 2007; Chowcat, Phillips, Popham, & Jones, 2008; Eijkman, 2008, 2009 forthcoming). However there is also evidence, mostly anecdotal, to suggest many academics are anything but sanguine about the value of social networking for formal learning and research practices. And much of the opposition centres on Wikipedia — the public face of Web 2.0 and its more open and democratic approach to collaborative knowledge construction (see for instance Baker, 2008; Manion-Fischer, 2007; Waters, 2007).

There is some emerging evidence of academics using Wikipedia in support of innovation in learning and research (see for example Alexander, 2006; Childs, 2007; Kamel-Boulos & Wheeler, 2007; Selwyn, 2008). However the literature, and much anecdotal evidence gleaned from casual conversations with academics in staffrooms, hallways, and faculty pronouncements, tends to suggest that the popular mood about the student use of Wikipedia is one of scepticism if not outright opposition. It is invariably claimed that this is because the sources and accuracy of its information are uncertain and therefore of doubtful value for scientific and scholarly research. Citing its open 'review' processes it is also open to criticism for lacking 'proper' academic scrutiny. Wikipedia seems generally to be seen as *the* representative of the 'cult of the amateur' (Keen, 2007).

Consequently the use of Wikipedia as a research tool by students in undergraduate education is a hotly debated subject. And the debate about Wikipedia is itself highly problematic on a number of counts. Although some discussions have hit the digital airwaves (Childs, 2007; Waters, 2007) they are with few exceptions negative (for an example of an exception see Parry, 2008), rely on anecdotal rather than hard empirical evidence (see for instance Magnus, 2001 and Waters, 2007) and seem unaware of the quality assurance processes that are built into Wikipedia (Viegas, Wattenberg, & McKeon, 2007; Anthony, Smith, & Williamson, 2007). In addition most discussions and debates about Wikipedia focus on its content and, should its knowledge construction process be considered at all, such discussions are inevitably geared to issues around the accuracy of its content. To complicate matters further, when pressed, many academics admit to their own use of Wikipedia as a research tool. They justify doing so by citing their professional ability to determine the truthfulness of its content.

But why make a fuss? Why not acquiesce to conventional academic wisdom about Wikipedia's inadequacies compared to reliable, tried and tested peer review processes and sleep comfortably at night knowing that our treasured ways of knowledge construction and its products are safe and secure? As a matter of fact this paper and the research project it reports on is not particularly interested in issues around the truthfulness of Wikipedia's content. Rather the interest lies specifically in Wikipedia

I maintain that the real issue is not its content — for when all is said and done even 'respectable' scientific knowledge published in academic peer reviewed publications is often hotly disputed and if not disproved then displaced by new paradigms (Kuhn, 1970). No the issue, though mostly hidden behind the veil of content, is that Wikipedia, as part of the new wave of post-Web 1.0 social networking media, represents a new, more transparently democratic or egalitarian knowledge construction process. It is a knowledge construction process that displaces the centrality and power arrangements of traditional knowledge processes in which academia (until now) reigns supreme.

The point is that Web 2.0 provides higher education with a very different knowledge construction paradigm. And, based on a participatory rather than information-centred platform Wikipedia represents the most highly publicised, if not iconic example of a Web 2.0 wiki; a social knowledge production application in which anyone can contribute, shape and reshape the knowledge landscape.

As Ugoretz (2006) puts it, all social software tools

> . . . share a common theme — good or bad, they all grow out of the recent and revolutionary change in the structure of knowledge, information, research and criticism which has been enabled by the internet. The arena of online interaction and communication which the internet provides — the ability to rapidly publish, categorize, and distribute information and opinion —has allowed the growth of tools which put users, people, in control of the distribution and content of information in ways that are decentralized and non-hierarchical.

Even though the heated debate in academia is about Wikipedia's capacity to generate academically trustworthy knowledge in reality it is essentially a debate about epistemology and power; it's about how academics view the nature of knowledge, how it ought to be constructed, and who is to have power and authority over this process.

This paper, drawing on preliminary data from an empirical research project, explores how the epistemological assumptions of academics influence their approach to Wikipedia and by extension to other Web 2.0 applications that democratise the production of knowledge and its authority.

Wikipedia as a Case Study of a Digital Macroshift in the Making

Wikipedia is a free, Web-based encyclopaedia that, using a 'Wiki' technology, enables anyone with internet access to add to and edit its knowledge content (Wikipedia, 2009). Wikis, as one example of Web 2.0 social networking software and as demonstrated by Wikipedia, have the potential to enable our students to much more easily engage in peer collaboration and evaluation in the construction of knowledge and to do so with far less authoritative input from academics. This is because Web 2.0 is built on, and therefore provides higher education with, a very different knowledge construction paradigm. Based on a participatory knowledge sharing rather than one-way read-only information-centred platform, Wikipedia, as an exemplar of Web 2.0 social media, embodies a recognition that all knowledge is socially constructed. Wikipedia represents the most highly publicised example of a Web 2.0 social media application — a social knowledge production application in which anyone can contribute, shape and reshape the knowledge landscape. The use of Wikipedia in undergraduate higher education is a contentious issue primarily because of its allegedly problematic nature of its content and its popularity among undergraduate students who use Wikipedia as a readily accessible research tool.

However the real issues lie deeper than its content. Wikipedia is symptomatic of the educational challenge inherent in Web 2.0's reconfiguration of knowledge production. Wikipedia, as a representative of this paradigm shift embodies an invitation to reconsider and reconfigure our web-based educational practices. For better or worse, we are entering a new era in academic research practices (Eijkman, 2008). Web 2.0's participatory platform dissolves the *modernist* epistemic framework in which knowledge, grounded in the objective world, is *ipso facto* universally true and can be pronounced as such by its academic guardians (Rorty, 1980). The production of knowledges through social interactions within global, de-territorialised, transcultural and self-organising Web 2.0 enabled networks underlines the *postmodernist* approach to knowledge construction (Eijkman, 2009 forthcoming). Such democratically oriented interactions will increasingly demonstrate that knowledges are culturally and historically contingent and grounded in culturally specific social contexts rather than in universally applicable empirical realities (Audi, 2002). It also means, as is clear in Wikipedia, that the authority of knowledge *also* increasingly resides in dynamic multi-dimensional networks *as well as* in the (previously exclusive) halls of academia.

Whilst both the conventional and postmodern Web 2.0 paradigms have their strengths and weaknesses, these are not the immediate concerns of this paper or the research project. The new knowledge production processes that Wikipedia and Web 2.0 embody are certainly not without its challenges, peculiarities and difficulties (see for example Fister, 2007). That is not in dispute. The point however is to raise awareness of, and respond to, this paradigmatic shift in an informed way. This is what is at stake in the battle over Wikipedia. This paper marks a beginning by obtaining empirical data about academics' attitudes to Wikipedia and the impact of these attitudes to Web 2.0 forms of knowledge construction. This project takes Wikipedia as a point of departure for examining the linkages between the assumptions of academics and their approach to Wikipedia as a potential indicator of their likely approach to the deployment of Web 2.0 social media in undergraduate learning and teaching.

The Research Method

Anecdotal evidence about academics' attitude to Wikipedia suggests that they do not believe that the social construction of knowledge and the egalitarian peer review processes increasingly enabled by Web 2.0 social media is capable of generating academically acceptable knowledge. It appears that academics tend to believe that students' use of Wikipedia — and by extension similar Web 2.0 collaborative writing applications — is likely to increase the difficulty of "finding the Truth in a Web of Deceit' (Magnus, 2001). It is this hypothesis and its implications that this research project attempts to ascertain.

Hence this research project aims to contribute to the Web 2.0 education literature by addressing two questions. How do the epistemic assumptions of academics and their levels of knowledge about Wikipedia (a) affect their disposition towards Wikipedia as a Web 2.0 site for social knowledge construction, and (b) by extension, frame their approach to the wider take-up of Web 2.0 social networking applications for learning and research in undergraduate education?

Data collection is by way of a web-based survey instrument (SurveyMonkey) using a predominantly quantitative question bank with opportunities to contribute qualitative responses. Regarding the reliability of Internet data collection methods, Gosling, Vazire, Srivastava and John (2004) in their analyses of six preconceptions about Internet samples and the quality of their data compared to traditional methods found that

> the data provided by Internet methods are of at least as good quality as those provided by traditional paper-and-pencil methods . . . . Web-questionnaire results generalize across presentation formats, do not appear to be tainted by false data or repeat responders, and are, so far, consistent with results from traditional methods. In short, the data collected from Internet methods are not as flawed as is commonly believed. (p. 102)

A review of the survey by academic colleagues and two Wikipedians was undertaken, a pilot survey carried out and ethics clearance obtained. The questionnaire was appropriately modified following both the review and pilot survey to ensure the effectiveness of the research methodology. Subsequently research data has been obtained via an online survey of academics predominantly from the University of New South Wales campuses in Canberra (ADFA) and Sydney as well as from other universities in Australia and abroad.

It is envisaged that this predominantly quantitative data will be complemented with extended qualitative information that draws on a grounded theory methodology (Strauss, 1990). Hence a number of semi-structured interviews with a small sample of academics will aim to provide more in-depth information from academics who (a) strongly oppose the use of Wikipedia by students, and (b) who use Wikipedia creatively in their undergraduate teaching.

Results and Discussion

The availability of the online survey was publicised at UNSW@ADFA and UNSW in Sydney in mid-March 2009. Other universities in Australia and overseas were also invited to participate. To date this has been problematic due to the apparent requirement for local ethic approvals despite ethics clearance from UNSW. Fifty-four respondents have completed the survey as at April 12, 2009. It is noted though that on average at least 4 to 6 respondents regularly skipped most questions. The reason for this is not clear. Though the sample size is still small they at least begin to give an indication of the issues and possibly broad trends. Given the length of the questionnaire (53 questions) and the limitations of the paper only key questions will be dealt with. Copies of the data will be available at the conference and from the author on request.

The discussion, following the questionnaire, covers eight themes: demographic and background information; attitude to and experience of students' use of Wikipedia; School or Faculty's approach to student use of Wikipedia; own knowledge of Wikipedia; own interactions with Wikipedia; workplace culture regarding Wikipedia; the wider implications of social networking for higher education; and own teaching practices.

In terms of demographics, of the 54 respondents 32 were from UNSW@ADFA, 16 from UNSW, and 4 from other universities. Age distribution reflects the general demographics of academia with 6 (11%) being between 26–35 with the bulk (36 or 67%) falling in the 36–55 age range. Females (n = 10 or 20%) are somewhat underrepresented. Respondents covered the range of disciplines except for medicine. In terms of length of teaching experience 11 or 20% are early career teachers with less than 5 yrs experience. Weekly Internet usage tended to be quite high with 18 reporting 10–15 hrs per week, 16 used it 15–20 hrs per week and 20 used the Internet for 20 or more hrs per week. Of the 54 respondents, 40 used some form of Web 2.0 social networking media of which 33 (82.5%) used Wikis including Wikipedia. Demographically respondents appear to be quite representative of the general academic population in the English-speaking world and many seem well connected from a Web 2.0 point of view, at least in terms of their general if not always educational use as is revealed in their responses to later questions.

In terms of their attitude to student use of Wikipedia (Question 9), out of the 46 respondents who had an opinion on this the majority (34 or 68%) approved its use but only as a 'research starter'. Two (4%) did not consider Wikipedia a problem at all while 5 discouraged its use and another 5 strongly disapproved and actively opposed its use. The qualitative responses about their attitude towards student use of Wikipedia were insightful both from a positive as well as negative standpoint:

> *Wikipedia is excellent in many areas, esp. mathematics and the more mathematical fields of science. I always indicate that students should go well beyond Wikipedia in their search for supporting materials, but accept they will use it.*

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> *This is wiki specific — a group of imminent experts writing a closed wiki entry on Constitutional Law, for example, would create the BEST textbook available. Not so many examples of this in Australia.*

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> *It's a very mixed bag, but the problem is that students often use it as a sole source.*

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> *I say that they should distrust every word written, and treat everything as potentially wrong or deliberately slanted or accidentally uninformed.*

Given the responses to Question 10 about how respondents feel about how students use Wikipedia it is perhaps helpful to categorise student usages in what may be termed 'low stakes-low risk' and 'high stakes-high risk' uses. For example, respondents were much more accepting of 'low stakes-low risk' activities such as for the initial scoping of a question or as a general research starter. However the levels of concern rose considerably in line with student uses of Wikipedia that were increasingly deemed 'high stakes-high risk' such as for citing facts and as a serious source of information.

As to the strength of their attitude to student use of Wikipedia and the attitude in their workplace generally, the answers to question 11 (Table 3) indicates a slightly positive inclination towards student use of Wikipedia personally and in the workplace generally though still with a reasonably strong negative tendency. Interesting is that 11 respondents (22%) recorded 'no opinion' to this question. It may be useful to interpret this slightly positive approach to student use of Wikipedia at an individual level in light of respondents' cautious attitude towards 'low stakes-low risk' usages. It also appears that respondents tend to view attitudes about Wikipedia in their workplaces as tending towards the negative (52%) rather than positive (20%). Even when looking at changes over time, as in question 12, attitudes towards Wikipedia both individually and collectively have remained remain quite polarised.

Although some respondents had a quite positive attitude towards Wikpedia and their students' use of it and many were cautiously accepting, the vast majority did comment on issues regarding reliability and accuracy of information though quite a few did not necessarily see that as a problem. However most of the qualitative comments are informative in that, with few exceptions they indicate the need for a critically accepting approach rather than an outright rejection. For example:

> *It's no worse than many other internet resources, all need to be taken in context and with a balanced, critical view.*

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> *The problem is lack of depth; but on mathematical issues (functions etc) it usually gives a very good overview and introduction to a field.*

In terms of having experienced serious problems with students' use of Wikipedia, out of the 35 respondents who answered Question 16, only 1 person (3%) reported an 'extremely serious' problem, 5 or 14% reported at least one incident they considered 'very serious', 16 (46%) 'moderately serious' and 13 (37%) reported 'non serious' problematic incidents.

At a personal level, in response to real and/or perceived problems with student use of Wikipedia (Q. 18), 3 respondents (8%) banned Wikipedia, 4 (10%) discouraged its use, 30 (79%) urged use with caution, and, 1 (3%) took no action.

Yet given the level of controversy and issues surrounding Wikipedia, institutional responses, whether by way of guidelines, policies and/or sanctions do not necessarily follow. Responses to questions regarding School or Faculty policies and sanctions (Questions 19–27) indicates that problems, real or perceived, has not translated into formal discussions, policies, or sanctions. Very few respondents (8 or 16%) reported formal School level discussions having taken place and only in one instance did a respondent indicate that consensus enabled a school guideline to be formulated. Yet while many 22 (45%) believe their school ought to have a guideline or policy about Wikipedia (though 25 (51%) disagree), at this point in time none of the respondents' schools appear to have yet formulated a policy on Wikipedia.

As to sanctions against its use 22 or 63% of respondents opposed sanctions outright, 11 (32%) supported moderate sanctions and only 2 (6%) strongly supported sanctions. This indicates that reports of sanctions (e.g. Jaschick, 2006; Waters, 2007) in the U.S. while somewhat sensationalised (As one respondent noted: *"Typical US ham-fisted approach*") are themselves rare even on that continent as they are remain similarly atypical here in the antipodes.

In terms of respondents' own knowledge of and interactions with Wikipedia, all but one of the respondents has used or uses Wikipedia for some purpose or other with one respondent noting that "I myself contribute to several in my expert capacity." Most (33 or 94% out of 35) regard Wikipedia as 'mostly accurate' while only 2 (6%) found it 'mostly inaccurate'.

Around half the respondents (e.g. 26 or 60% out of 43, with 11 skipping question 33 altogether) indicated that they have not accessed any of the Wikipedia pages that provide information about how Wikipedia operates other than to access content. Yet it appears from responses to Questions 33, 34, and 35 that a good number have acquainted themselves with the workings of Wikipedia. Even though out of the 46 who answered the question 37 or 80% did not know how Wikipedians rate articles for quality the following responses are indicative of a deeper interest in Wikipedia and its quality assurance processes by a sizable minority:

- 3 have donated to Wikipedia
- 4 have contributed a new article
- 5 have edited an article
- 3 have contacted Wikipedia
- 2 have written to a Wikipedian or written on a discussion page
- 4 know someone who has contributed to Wikipedia by writing or editing an article

The main points that seem to emerge from questions regarding the wider implications of social networking for higher education respondents is again a sense of polarisation. To begin with, while many respondents saw Wikipedia's strengths in its content, for example as lying in its rapid updating of a broad range of information, only 3 respondents referred in some way to Wikipedia's new and readily accessible collaborative way of creating, sharing, and recording knowledge (Parry, 2008). In terms of possible improvements to Wikipedia the vast majority of respondents focused inevitably on accuracy and predominantly by strengthening its authoring and review processes — the latter by re-instating "the experts" with their "stamp of approval." On the other hand 6 respondents advised desisting from any changes via comments such as *"None. It functions differently to an* *encyclopaedia, with different advantages and disadvantages."* And *"Why do we need to?"*

In terms of its potential for formal learning 13 respondents (out of 27) indicated that it has potential even beyond a 'first port of call' for assignment research. For example *"Having students write wikis is a great way for them to 'put their money where their mouth is.' As a research collaboration tool between academics, it also has a number of advantages (bringing community together)."* Another 5 respondents saw no use for Wikipedia in formal learning at all.

These responses are not surprising given that most (28 or 60%) don't know any colleagues who might use Wikipedia for learning purposes (Q. 41) another 15 were emphatic about not knowing anyone who used Wikipedia. Yet, while only 4 or 8% answered in the affirmative some of their examples were interesting.

> *Yes, I do. I ask students to write a wiki entry for evaluation.*

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> *They ask students to create their own 'Wikis' on a subject relevant to the course. A first draft is prepared. The student then edit it. I understand this process mimics how a Wikipedia page is created.*

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> *I have invited students to consider the requirements for a reviewed 'featured article' standard contribution, to describe the difference between this and the normal (more or less unreviewed) standard, and to try to get a contribution accepted at this higher reviewed status as an alternative to writing a case study for assessment in class.*

Respondents were also split regarding their perceptions of the threat posed by social networking tools to conventional ways of constructing academic knowledge (Q45). Though 21 (52%) did not consider these a threat at all, 18 or 44% considered them either somewhat or a considerable threat to conventional knowledge production.

This polarisation is further confirmed in their responses to Question 46, which asked respondents to rate their response to Wikis as a potential collaborative writing tool in higher education. While 25 or 59% saw wikis as "An interesting development that potentially opens new possibilities for learning and teaching" 16 or 38% see Wikis as a somewhat or seriously problematic development that will provoke considerable change in the role of educators and/or undermine conventional ways of learning, teaching, and about the authority of knowledge."

These responses would seem to confirm a flow-on effect regarding either their positive or negative view of Wikipedia. It may also be indicative of some academics being still immersed in a traditional individualistic culture while others are embracing the social turn in learning theory (Eijkman, 2009 forthcoming). It may also suggest that academics are increasingly aware, even if at an implicit level of the shift in power arrangements in the knowledge construction process (Eijkman, 2009 forthcoming). This is confirmed when the responses to other questions are factored in. For example in relation to a collaborative or individualistic culture, the responses to Q 47 indicate that most respondents never or rarely adopt a participatory stance and engage in negotiations with their students around, for example, learning outcomes, course content and assessment criteria. Only a relatively small number of respondents indicate a level of participatory thinking as a regular feature of their teaching practice. Also, the strong push to suggest 'improvements' in Wikipedia by increasing the role of experts and those with qualifications as proposed by most in Q 43 seem to indicate an implicit understanding of the shift in the balance of power towards 'the people' (Lipczynska, 2005). Interestingly, and perhaps as the I result of polarisation, all those critical about or opposed to Wikipedia seem, by implication at least, to ignore the reality that even these 'qualified experts' are regularly embroiled in academic disputes (see also Kuhn, 1970). While not naïve about Wikipedia (although this was strongly questioned by one respondent) these uncomfortable facts seem to be conveniently swept under the carpet in the attempt by some to paint conventional ways of knowledge construction as apparently being made in heaven.

Responses to Questions 49, 50 and 51 also indicate that some (6 or 14% out of 42) respondents still 'do not like' online learning and that those who do use online learning respondents are still predominantly information rather than communication oriented in their use of the internet (34 or 81% and 6 or 14% respectively. This ratio is reflected in respondents' approach to Web 2.0 applications in their teaching. While 14 out of 43 have used blogs, wikis or other Web 2.0 applications or services in their teaching, 11 or 26% have not but would like to try them, while 16 have indicated that they have not used any of these and do not expect to use them.

Conclusion

This paper reports on the preliminary findings of a research project on Wikipedia as a case study of postmodern knowledge production facilitated by Web 2.0. The level of misconceptions about the way Wikipedia operates and of polarisation evident in the research results supports the contention that the Wikipedia debate signals a paradigm war. Web 2.0 social knowledge construction processes embody the threat of a macroshift in formal learning and research. It represents “a process of societal evolution in which encounters with the system’s limits of stability initiates a bifurcation — a process of rapid and fundamental change in complex systems” (Laszlo, 2001, p. 9). Wikipedia seems to provoke divisive debates precisely because academics implicitly at least realise that it invites a radical transformation of pedagogic and research practices in higher education — and hence of traditional academic power and authority arrangements.

Interestingly though, problems regarding student use of Wikipedia, whether attitudinal or actually experienced, does not necessarily translate into concerted action at an institutional level. However, if the trends indicated thus far continue in further responses to the questionnaire, they do signal that educational designers are likely to fight new battles as we shift into a post-Web 1.0 educational world. These trends confirm once more that the real problem in implementing sound and informed use of Web 2.0 is the battle over hearts and minds and not technology.

I concur fully with David Parry’s intent to

> . . . make a more controversial claim: It is irresponsible for educational institutions not to teach new knowledge technologies such as Wikipedia. Wikipedia, or more generally the networked archival structure it represents, alters the way in which we create, share, and record knowledge, and thus has rather significant effects on how we approach education across all disciplines, and specifically in technology and science. Students and teachers alike must understand how systems of knowledge creation and archivization are changing . . . [and how] the new software changes the rules of expertise. (2008)

Hence, we as educators have a responsibility to learn to engage with this macroshift and bring all our critical sensibilities and capacities to bear on these developments and promote new and sound ways of constructing knowledge — albeit likely to be in radically different ways.

Note: The results reflect the data set as at 12 April due to the closing date for paper submission. The subsequent conference presentation and paper will reflect the results of the full data set at the close of the survey on 31 May

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THE EFFECTIVENESS OF AN INTERACTIVE COURSEWARE USING THREE DIFFERENT STRATEGIES

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Abstract

This paper examines the cognitive effects, in terms of the gain scores and time-on-task of a computer courseware using collaborative and mastery learning strategies. A total of 262 Form Four students from four Malaysian schools interacted with two Matrices courseware: one with mastery learning elements (used in CML and CCML strategies) and another without mastery learning elements (used in CCL strategy). This study showed that, CCML and CML were the effective learning tools. If the time allocated for the learning process is longer, CCML would be the most ideal strategy otherwise CML is generally preferred in the learning process.

Introduction

With the advent of information and communication technology (ICT), educators take opportunities to harness the power of computer technology in helping students to learn mathematics. For example, multimedia presentation allows the learners not only to read and to observe but also to listen to the discussion in the learning process. Hofstetter (1995) reasons out the usability of multimedia in his research report that student retain only 20% of what they see, 30% of what they hear but 50% of what they see and hear and as much as 80% of what they see, hear and do simultaneously.

Using computers to help students to learn mathematics through the use of courseware is not uncommon to the Malaysian students. There are a number of researches done in Malaysia pertaining to the use of multimedia in learning mathematics. Nor Azan Mat Zin (2009) found in her study that the courseware which matches students′ learning styles to instructions has improve students' learning gains compared to students under mismatched of learning styles in using the courseware. Zurina Muda and Ros Emiliana Kartina Mohamed (2005) developed a courseware to introduce basic mathematics knowledge for preschool students. Mastery learning has been added lately in the use of multimedia for the learning of mathematics to make the learning more interesting (Norjihan Abdul Ghani, et al., 2006). It is also learned that mastery learning can be conducted more convincingly and flexibly through multimedia. However, the success of a courseware using mastery learning depends on the design and development of the instruction and also the approach used in conducting the courseware. Therefore there is a need for more studies to examine various designs and approaches that can complement a courseware performance. This paper focuses on the development and the investigation of the use of a courseware employing three different strategies.

Literature Review

In mastery learning all learners attain the required learning objectives. The basic mechanics of mastery learning lies in the five basic components of mastery learning: the learning objectives, instruction, formative assessment, feedback (includes correctives and enrichments) and the summative evaluation of competent learners (Guskey, 1989). Among these, *instruction* and *feedback* are the most important. These two components are crucial because students need to attain the required concepts before they can proceed to the higher level of learning units (Bloom, 1968, 1974). In a mixed ability classroom, teachers often have difficulties in monitoring the performance of students from different ability levels and the grading process takes up a lot of time. The complexity of this task was acknowledged by Boggs, Shore and Shore (2004) when they identified four obstacles which must be overcome when applying mastery learning: 1) creating multiple versions of each test; 2) grading multiple versions of tests for students at varying stages of the course; 3) scheduling time for students to take several versions of tests, if needed, to attain a certain level of mastery; and 4) teaching students who are at different learning objectives.

Modern computer technology has enhanced the administration of mastery learning. Mastery learning incorporated with cooperative learning strategy proves to be effective in delivery a lesson. Bork (1999) and Cohen (1991) noted that a well-designed mastery learning instruction within a cooperative learning situation provides a better guidance for students in their learning. The cooperative features cater to meet diverse needs of students through team activities. For instance, students are fully engaged and they help each other in clarifying misunderstandings and correcting learning errors in order to achieve a criterion-referenced standard.

Methodology

The sample for this study consisted of 262 students aged 16 years old randomly chosen from four suburban secondary schools (known as schools *A*, *B*, *C* and *D*) in Seberang Perai. For each school, three intact classes were chosen randomly. School *A* was randomly assigned to the Computer-assisted Cooperative Learning (CCL) treatment, schools *B* and *D* were assigned to the Computer-assisted Mastery Learning (CML) treatment, and school *C* was assigned to the Computer-assisted Cooperative Mastery Learning (CCML) treatment. The number of students in CCL, CML and CCML were 77, 81 and 104 respectively. All students had not been exposed to the topic of Matrices.

The researcher has developed a courseware entitled "Matrices" by using Macromedia Authorware 5.0 as the authoring tool. A series of templates were created through rapid prototyping. There were two sets of courseware used in this study. The first courseware was designed with mastery learning elements, which was used in the CML and CCML strategies. The second courseware was designed without mastery learning elements, which was used in the CCL strategy. Before conducting the experiments, the courseware was field tested.

Gain scores and time-on-task were taken to investigate the effectiveness of the mentioned strategies. Before the experiment was conducted, all the samples went through the entry test on basic knowledge on Matrices. Students with score 80% and above in the entry test were allowed to proceed in the experiment without undergoing through the activities to strengthen their prior knowledge. Students who achieved less than 80% were required to go through the interactive activities to strengthen their prior knowledge.

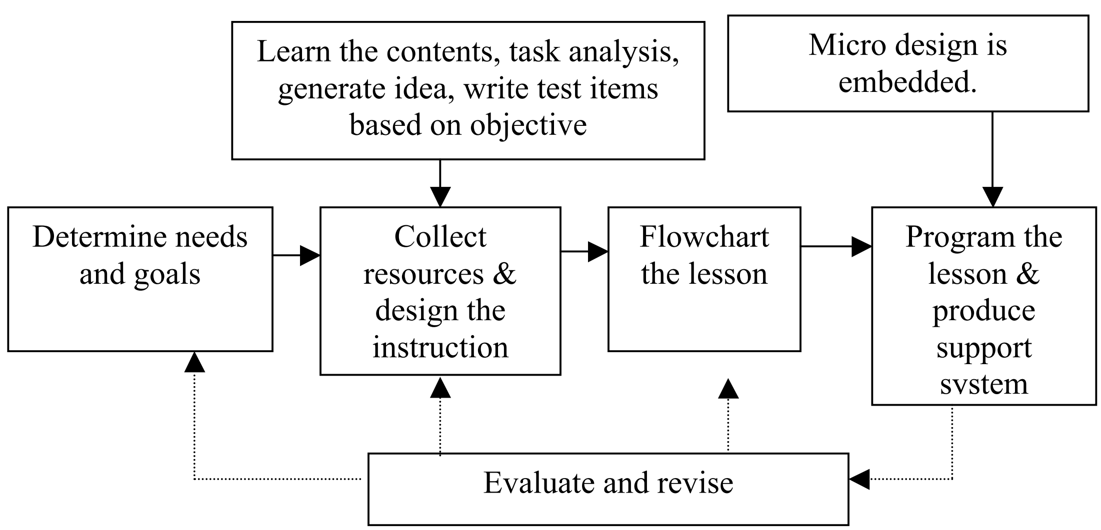
Data was collected over four months. On the first day of the data collection, students were given a briefing on the learning strategies. They were given a pre-test on *Matrices* and it was followed by a lesson on *Matrices* and *Equal Matrices* on the second day. After the lesson, the students were given the first formative test through the computer. The subtopics covered in the whole process were (1) Matrices and Equal Matrices; (2) Addition and Subtraction on Matrices; (3) Multiplication of a matrix by a number; Multiplication of two matrices; and (4) Identity Matrix, Inverse Matrix and solution of simultaneous linear equations by using Matrices.

The whole lesson on *Matrices* took four to six hours to finish. Students took a test after each subtopic. The differences of the three treatment groups in terms of presentation of the lessons, team function and individual improvement were noted by the researcher. Students in the mastery learning condition (CML) completed all formative tests or quizzes independently. Students who failed to meet the required performance level received supplementary instruction and corrective activities immediately after each question until the requirement was met. Students in the cooperative learning condition (CCL) and the cooperative mastery learning condition (CCML) groups underwent all designated cooperative learning activities. They completed all tests independently. CCL received no corrective activities but CCML students who failed to meet the required performance level received supplementary instruction and correction activities immediately after each question until the requirement was met. For CML and CCML groups, at the end of a test, extra corrective activities were given to those who could not achieve the satisfactory level of 80% as evaluated by the computer. In CCML group, each student must wait until all members in the group have achieved the level of 80%. Those who successfully achieved 80% and above were encouraged to help those who have yet to achieve 80% of the score.

Courseware

The steps to design the courseware were adopted from the Alessi and Trollip's instructional design model (1985). Figure 1 shows the process of the macro design according to the Alessi and Trollip's model. The procedures of 'determine needs and goals', 'collecting resource and design the instruction', 'flowchart the lesson' and 'program the lesson and produce support system' are evaluated and revised throughout the whole process.

Figure 1: The Steps in the Macro Design



Gagné's nine events of instruction (Gagné, 1985; Gagné, 2000) in Table 1 were referred to organize the learning conditions in the micro design courseware. Keller's ARCS model (Keller & Suzuki, 1983) was adopted to include motivational elements of instruction to enhance learning. The model incorporates motivational strategies in the area of learner's attention, relevance, confidence and satisfaction. More importantly, the entire system of instruction was tailored using the mastery learning approach.

Table 1: Incorporating the Conditions of Learning (Gagné, 1985) and Motivational Strategies (Keller and Suzuki, 1983) into Instructional Situations

Conditions of Learning	**Instructional Situation**	**Incorporating motivational elements using ARCS model**
1. Gaining attention	Graphic and video is emphasized to present an introductory scene.	Attention: Strategies for arousing and sustaining curiosity and interest.
2. Informing the learner of the objective		Relevance: Strategies that link to learners' needs, interests, and motives.
3. *Stimulating recall of prior learning (enhancement of cognitive prerequisites)	Hyperlink	
4. *Presenting the stimulus material (enhanced cues)	Cues	
5. *Providing learning guidance (ideas of cueing, organizing and student participation)		
6. *Eliciting the performance	Quizzes	Confidence: Strategies that help students develop a positive expectation for successful achievement. Satisfaction: Strategies that provide extrinsic and intrinsic reinforcement for effort.
7. *Providing feedback (corrective activities)	Feedback for every question. Corrective activities are provided for those who have not mastered the knowledge. Enrichment activities are provided for those have mastered the knowledge.	
8. Assessing performance	Test on Paper	
9. Enhancing retention and transfer	Activities	

* This represents the most important components in mastery learning

Results

The following results are reported based on the two hypotheses in this study.

Hypothesis 1: There are no significant differences in the dependent variables among the students in the CCL, CML and CCML strategies.

H1.1 There is no significant difference in the gain scores among students in the CCL, CML and CCML strategies.

H1.2 There is no significant difference in the time-on-task among students in the CCL, CML and CCML strategies.

Descriptive Statistics on Gain Score for the Three Learning Strategies

The descriptive statistics on gain scores for CCL ($Gain_{CCL}$), CML ($Gain_{CML}$) and CCML ($Gain_{CCML}$) are shown in Table 2. It can be seen that the mean of CCML was the highest, which was 49.40. CML with the mean of 42.79 was the second highest; while the mean of CCL was the lowest, which was 31.47. Thus, $Gain_{CCML} > Gain_{CML} > Gain_{CCL}$.

Table 2: Descriptive Statistics on Gain Score for CCL, CML and CCML

	CCL	CML	CCML	Total
Mean	31.47	42.79	49.40	42.09
N	77	81	104	262
Std Dev	19.206	19.678	17.849	20.164
Var	368.884	387.218	318.573	406.578
Skewness	0.832	0.581	-0.030	0.285
Median	28	37	50	40

These results showed that $Gain_{CCML}$ was the highest and had the least variability, with the smallest value of variance as compared to CCL and CML. These indicated that mastery learning in CCML could raise the level of students' achievement, with less variability among them. Thus, CCML gave a better distribution in gain scores as compared to CML and CCL.

Descriptive Statistics on Time-on-task for the Three Learning Strategies

Reported in Table 3 are the descriptive statistics on time-on-task for CCL ($Time_{CCL}$), CML ($Time_{CML}$) and CCML ($Time_{CCML}$). It can be seen that the mean of CCML was the highest, which was 4.71 hours. CCL with a mean of 3.90 hours was the second highest, whereas the mean of 3.70 hours was the lowest. Thus, $Time_{CML} < Time_{CCL} < Time_{CCML}$.

Table 3: Descriptive Statistics on Time-on-task (in hours) for CCL, CML and CCML

	CCL	CML	CCML	Total
Mean	3.90	3.70	4.71	4.16
N	77	81	104	262
Std Dev	0.771	1.030	0.784	0.973
Var	0.594	1.061	0.615	0.947
Skewness	0.182	1.261	0.427	0.285
Median	4	3	5	4

MANOVA in Analyzing of the Effect of Learning Strategies on the Dependent Variables (Gain Score and Time-on-Task)

The results of the MANOVA test (Table 4) showed that the Wilk's lambda of 0.549 was significant, $F(4, 516) = 45.032$, $p < 0.05$. Thus, *Hypothesis 1*, which states that the population means on dependent variables (i.e., gain scores and time-on-task) were the same for the three groups, was rejected. The multivariate Eta Squared indicated that 25.9% of multivariate variance of the dependent variables was associated with the group factor.

Table 4: Multivariate Tests of the Effect of Learning Strategies on the Dependent Variables

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
strategies	Wilks' Lambda	.549	45.032	4.000	516.000	.000	.259

Using multiple univariate ANOVAs, a follow-up approach was conducted. Two ANOVAs were conducted, one for each dependent variable (i.e., gain scores and time-on-task). The results of the univariate ANOVAs were shown in Table 5. The univariate ANOVA for gain scores was significant, $F(2, 259) = 20.155$, $p < 0.025$, likewise the univariate ANOVA for time-on-task was significant, $F(2, 259) = 36.066$, $p < 0.025$. Both results showed that there were significant differences of gain scores and time-on-task among the groups. Therefore, Hypothesis 1.1 and Hypothesis 1.2 were rejected.

Table 5: Univariate Tests of the Effect of Learning Strategies on the Dependent Variables

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Gain Scores	14291.342	2	7145.671	20.155	.000	.135
	Time-on-task	53.863	2	26.932	36.066	.000	.218
Intercept	Gain Scores	437568.203	1	437568.203	1234.189	.000	.827
	Time-on-task	4336.984	1	4336.984	5807.944	.000	.957
Strategies	Gain Scores	14291.342	2	7145.671	20.155	.000	.135
	Time-on-task	53.863	2	26.932	36.066	.000	.218
Error	Gain Scores	91825.639	259	354.539			
	Time-on-task	193.404	259	.747			
Total	Gain Scores	570219.000	262				
	Time-on-task	4782.000	262				
Corrected Total	Gain Scores	106116.981	261				
	Time-on-task	247.267	261				

Since ANOVAs for both dependent variables yielded significance result and the factor contained more than two levels, additional follow-up tests were performed. To be consistent with the above analyses, each comparison was tested at the alpha level for the ANOVA divided by the number of comparisons. Thus, the significant level used was 0.008. The Levene-test Equality of Error Variances (Table 6) showed that there were equal variances among the groups in gain scores, but unequal variances among the groups in time-on-task. The pairwise comparisons using Bonferroni approaches were used in the follow-up analyses across the pairwise comparisons in gain scores. The result indicated that there were significant differences in gain scores for the two pairs- CCML with CCL and CML with CCL. Dunnett's C approaches were used in the follow-up analyses across the pairwise comparisons in time-on-task since the homogeneity test in Levene-test gave the significant level of 0.007 ($p < 0.05$), which showed that there were unequal variances among the groups. Table results indicated that there were also significant differences in time-on-task for the two pairs- CCML with CCL and CCML with CML.

Table 6: Levene's Test of Equality of Error Variances

	F	df1	df2	Sig.
Gain Scores	.677	2	259	.509
Time-on-task	5.043	2	259	.007

The Effect Sizes of Learning Strategies on the Gain Score

Effect sizes (Table 7) of CML and CCML towards CCL were studied because there were significant differences between CML and CCL as well as between CCML and CCL. The results showed that the effect size of CML towards CCL was 0.5603, which was moderate. This means that an individual learner in CML have a 0.5603 standard deviation increase. The effect size of CCML towards CCL was 0.8778. Therefore, effect size of CCML towards CCL was stronger if compared to the effect size of CML towards CCL.

Table 7: Effect Size

	Effect size
CML towards CCL	0.5603
CCML towards CCL	0.8778

Discussion

There were significant differences in independent variables of gain scores and time-on-task across the learning strategies. Generally, there were significant differences in gain scores across the learning strategies. The effect size in gain scores suggested that the CCML strategy had more positive effect than the CML strategy. These results supported the findings from past researches that cooperative mastery learning produces better results (Akinsola, 1996; Krank & Moon, 2001; Laney et al., 1996). Furthermore, these results were consistent with Mevarech's (1985) and Okebukola's (1985) findings that cooperative learning has positive effects in the application of Student Team Achievement Division (STAD) approach and even better effects if STAD was combined with mastery learning.

Although the CCML strategy had better results in the gain scores, it showed no significant difference in the gain scores between the CCML and CML strategies. In this case, the contribution of the CML and CCML strategies were equally important in terms of the gain scores in which both learning strategies had mastery learning. In other words, mastery learning plays an important role in the gain scores. This explained the essential role that the component of mastery learning plays in terms of organizing a systematic and more structured instruction in order to guide students. However, incorporating cooperative learning could strengthen the role of mastery learning. Additionally, this study found better effect size when the CCML strategy was used indicating that students in cooperative mastery learning groups were well guided in the designed mastery learning environment.. This is consistent with Okebukola's (1985) findings that cooperative learning could strengthen students' performance. Also, this finding supported Mevarech's

(1991) view that mastery learning has been successful in producing gains in achievement. Mevarech (1985) such programme the cooperative mastery learning. In terms of time-on-task, the CML strategy played an important role to increase gain scores and decrease time-on-task. The major finding is the students in the CML and CCL strategies spent shorter time-on-task compared to the CCML strategy. The results were consistent with past researches (Mortimore and Sammons, 1987).

Conclusion

Although mastery learning (systematic work) was the most important instructional method to make students succeed, it is better when supported by cooperative learning. The findings of this study showed that mastery learning built-in with cooperative learning features improves the gain score of the students. The CCML strategy was found to be the most effective learning strategy in this study because it caters for students who are socially reserve and also those who seek peer guidance during the learning process.

Zimmerman (1998) noted that the more time-on-task is made available to the student, the more activities and learning processes are involved and acknowledged that time is a critical factor but it has little direct impact on students' performance. Essentially, students must be provided with activities and instructions that cater to their needs and abilities, engaging them so they will continue to build on what they have learnt. This study has shown that the CML and CCML strategies can provide those catalytic moments when students are absorbed in instructional activities that are adequately challenging, yet allow them to experience success. From the practical aspect, this study showed that both learning strategies, CCML and CML were effective learning tools to students. The conclusion is that under the mastery learning instruction, it is the cooperative features that cause CCML to give a stronger effect size than CML in the gain score. On the aspect of the time-on-task, CML took significantly less time and therefore is generally preferred in the learning process based on the result of better gain scores as compared to CCL. However, if the time allocated for the learning process is longer and unrestricted, then CCML would be the most ideal strategy.

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ENHANCING LEARNING AND SOCIABILITY IN PROVINCIAL SCHOOLS USING VIRTUAL REALITY TECHNOLOGIES

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Abstract

Students in provincial, difficult-to-access schools often face the problems of disinterest in the educational process, limited learning challenges, even social marginalization. The work proposed in this paper focuses on the applicability of a secure virtual world platform to isolated schools on remote Greek villages that allows the students among the schools to communicate and share knowledge. We aim to investigate whether the virtual platform manages to actually expand the schools' community, and to awaken the participants' social and learning interests. In this paper we evaluate various virtual worlds and technologies based on cost, security, customization and maintenance requirements. The open source OpenSimulator Virtual World server meets those criteria. We also propose a framework of simple activities, like a virtual photo gallery, that encourages students to capture, exhibit, exchange and discuss content pertaining to their local history and culture and to design the evaluation process to be performed as the next step of our research.

Introduction

In countries with unique and varied geographic morphology, such as Greece, it is common to observe large urban areas on the on one hand and small isolated communities on remote mountains or islands on the other. These isolated communities are usually separated from others and urban areas by sea or bad transport infrastructure, which makes physical communication among them problematic. This isolation has the largest impact on school infrastructure and the number of students in each class. Young people in such small classes (and communities in general) are often disadvantaged in terms of learning, communication and cultural exchange opportunities. Their communication and social skills might lack encouragement due to small social networks and their learning abilities are not challenged, due to restricted access to information sources, such as libraries and online virtual learning and information environments. Access to information over the Internet, though usually available, also requires motivation, specialized skills, and lacks the direct contact of synchronous communication. Given that there are over 200 hard-to-access secondary schools (and a large number of primary schools) in the Greek district, the significance of addressing the aforementioned isolation phenomenon becomes evident.

To this end, in this study we investigate the applicability of a Virtual World (VW) as a platform for learning (Roskilde University, 2008), socialization and cultural exchange and enrichment between groups of students in remote areas. The aim is to use immersion into a realistic, collaborative, interactive environment, in order to virtually 'bring together' distant, sparsely populated school communities. Thereby, we aim to increase the total number of class participants, as well as the level of educational standards, to improve communicational aspects of the communities, to assist in local cultural exchange, to provide more learning challenges to students and to strengthen their social skills. This is achieved by a series of activities within the Virtual World, designed and implemented by the class teacher, that aim to encourage student participation, communication and learning (Landry, 2008).

Virtual worlds have been proposed in the literature to aid educational activities (Dieterle, in press). There are printed and electronic periodicals that are dedicated to this specific purpose (East Carolina University, 2008). Shaffer (2002) used virtual reality to increase the physical and educational level of response of his students to visual stimuli. Virtual reality (VR) worlds have been proposed for teaching mathematics and geometry (Kaufmann et al., 2000), history (Jacobson, 2008), astronomy (Barnett, 2005), for training disabled people (Lanyi et al., 2006; Adamo-Villani and Wright, 2007). Several EU projects1 2 3 4 have focused on cultural exchange programs within educational settings and have offered the respective web-based ICT tools.

These approaches focus mainly on the effect of the employed technology on the learning process, rather than its impact on the students' socialization patterns. They view the underlying technology as a tool for aiding the educational activity. In the current proposal, our primary interest involves the detection of changes in the students' social behavioral skills after immersing themselves within the virtual world through a personal avatar. The VW platform is not just a tool, but a medium through which community members come closer. It has been observed (Landry, 2008) that students who are intimidated to participate in a traditional classroom find it easier to share opinions and cooperate in an online environment. Are they more challenged to exchange ideas and search for information? Are they more talkative? Do they use different vocabulary and linguistic structures than the ones they use in the traditional classroom? The intensification of their learning interest is viewed as a side-benefit of the online interaction process. Another side benefit of the virtual platform is that it encourages collaboration between schools, enabling educators to easily share teaching best practices and content across local and global borders.

The Virtual Environment

In the past few years, the increased Internet penetration and the large increase of broadband speed have been accompanied by a flourishing of Online Virtual Spaces, either in the form of videogames (Massively Multiplayer Online Games), or Virtual Worlds which can support socialization, communication, collaboration and education for their inhabitants. Some Virtual Worlds are also mature enough (and possess the required critical mass) to provide business opportunities. In a Virtual World, the user is represented by her avatar (virtual presence) which appearance can be customized accordingly. A large number of avatars can co-exist in a Virtual World. A Virtual World can be specialized, as in the form of Virtual Chat Rooms, or have a broader scope and allow any type of interaction between the users/avatars. Apart from communication, an avatar can be involved in item creation and selling, real estate, tourist attractions etc. Of the non-game Virtual Worlds, the most popular in terms of media exposure, is probably Second Life.

A Virtual World is usually hosted centrally on a server computer (or many). A user can have access to the Virtual World through a client program which must be downloaded and installed locally. Some Virtual Worlds allow access through a web browser as well. The server streams virtual world data (models, sounds, avatar positions and actions) continuously to the client which renders a view of the Virtual World.

Virtual Worlds Review

Virtual Worlds have been used to host Virtual Classrooms[5 6 7 8] in several cases, in an attempt to augment the student's learning process. Classroom participants can create their personal avatars, which can walk around the classroom, chat and interact with other avatars.

Our work is also based on a Virtual World. The Virtual World to be used must meet a specific set of requirements

- **Customization**: We would require the Virtual World to be programmable, and to allow item creation/modification, in order to develop the socialization/collaborative activities.

- **Free to use and develop for**: It would be desirable for the Virtual World to support not only free access, but free modification/customization as well.

- **Security**: All Virtual Worlds should provide a safe environment for socialization and communication. Due to the sensitive subject of our work (the users will be students), the Virtual World must support authenticated access.

- **Low maintenance cost**: The Virtual World maintenance cost (i.e. cost of service, or server cost) should be as low as possible, in order to be sustainable in the long-term. We expect that most of the positive effects of the proposed system might need more than a few weeks time to be measurable.

An evaluation of Virtual Worlds has been performed based on the above requirements to determine the most suitable for our purposes. Table 1 summarizes the results for several popular, commercial, Virtual Worlds.

Table 1: Commercial Virtual Worlds Features

Name	**Accessed via**	**Fee to develop**	**Programmable**
Active Worlds	Client	Yes	Yes
Muse	Browser plugin	Free up to 8 people	Yes
There	Client	Yes	No
Second Life	Client	Yes	Yes
Forterra	Client	Yes	Yes
Worlds	Client	No	Scripting

Most of the examined Virtual Worlds are free to access (after a simple registration process), but require a fee to modify and develop for. Second Life is probably the most customizable in terms of programmability and content creation but requires purchase of virtual land before development can commence (as do most of the other Virtual Worlds). Muse seems promising since it is geared toward the creation of Virtual Spaces for collaboration, with the added benefit that it can be accessed via a Web Browser. On the other hand, in its free version, it supports only 8 people simultaneously in a Virtual Room, which is too restrictive for our purposes. There are many more commercial Virtual Worlds in the market although most of them are either not customizable/programmable, or use bitmap graphics and are not really in 3D (Habbo Hotel).

We also performed an investigation on Open Source Virtual Worlds. In contrast to commercial VWs, open source VWs are free to use and modify, although they may require greater technical knowledge. In this type of Virtual Worlds every user can have access to the Virtual World source code, and can host her own version on a private server. Other users can access the custom VW via the Internet as well. The user (owner) has full access to every aspect of the world and can modify it according to her needs and given application. Current Open Source VWs are broadly based on two platforms, OpenSim[10] and Croquet SDK.[11] OpenSim is an open source VW server which attempts to clone the functionality of the Second Life Server application. Croquet SDK can also be used to develop VW applications. Contrary to OpenSim and Second Life, it is not based on the traditional client-server architecture; rather the VW is distributed among the World participants. OpenCobalt[12], which is a VW viewer based on Croquet SDK, is a very promising application and was our initial choice for our VW application. During our tests though, it proved to be unstable, and rendered the world at a relatively low framerate, even when running on a local machine. Thus, we chose to base the VW application on OpenSimulator instead.

It is worth mentioning that Open Source VWs in general are constantly under development and most of them have not reached beyond Alpha, which means that they may be unstable and contain bugs. The distributed technology of Croquet/OpenCobalt is very appealing because it eliminates the need for maintenance of a central server that hosts the VW. Also, and this is very important for remote, isolated areas, the Virtual World will still function on the local network, even if broadband connection fails (or if it not present altogether). We intend to review Croquet/OpenCobalt technology again in the future.

Security and Legal Issues

Several important security and legal issues arise when virtual worlds are used by under-aged students. Teachers are often discouraged to adopt or propose the use of virtual worlds in their classes due to the inappropriate content for minors. These problems can be overcome by using virtual worlds that are suitable for children and teenagers.[10] The present study will focus on the use of virtual worlds that take special care to ensure user authentication, password protection, strict licensing, chat monitoring. During an initial trial phase, students will undergo a tutorial about acceptable word usage for chatting. Most importantly, teachers will be monitoring the virtual interaction the whole time.

Methodology

In the present study, the Virtual Environment will not function as a simple virtual chat room, but will be used in combination with online socialization and learning activities. More specifically, students, in cooperation with the responsible teacher, will choose a theme (cultural, historical, or scientific) of their interest and use the Internet to locate digital photographs related to the theme, and also organize field trips to collect their own shots. Virtual photo galleries will be set up in the virtual environment using media uploading, in order for the students of the schools to exchange their snapshots. Discussion groups coordinated by the teacher will be held in order for information, ideas and opinions to be exchanged among the members of the virtual classroom community. Thereby, a flow of information and cultural goods is achieved. Students will be encouraged to capture, exhibit, exchange and discuss content that pertains to their local history and culture.

The virtual classroom will be installed in at least two secondary schools spread over the island of Corfu. The world will be employed by tutored teachers over a period of several months as an in-class as well as an extracurricular (after-class) activity. The experimental framework is comprised of the following phases:

Phase 1: Installing the Virtual World

The needs of all community members are specified and analyzed. Initial questionnaires are handed to the educators and interviews are conducted to determine the students' social and learning skills. The virtual world is then installed in the selected schools. Participating teachers and students become acquainted with navigating within the world, manipulating its features, components and content.

Phase 2: Interacting with the Virtual World

In cooperation with the teacher responsible, students select a topic of their interest. Photographic material related to the topic is collected, either online or by students' actual field shots. The pictures are then uploaded to the virtual platform and posted on the virtual photo gallery (Figure 1). Discussions among the students, coordinated by the educator, follow, allowing information exchange and cultural content flow. Interaction sessions, students' behavior and chat text, their moves and choices are monitored over a period of several months and recorded for processing.

Figure 1: Sample Virtual Photo Gallery, with Many Participants

Phase 3: Processing the Interaction Data

Recorded interaction sessions are linguistically analyzed. More specifically, chat text will be processed to identify changes in vocabulary richness, in usage of linguistic expressions and syntactic structures, at the beginning and at the end of the interaction period. Vocabulary richness is estimated by dividing the chat text size by the number of distinct words appearing in the chat text. A calculation of the part-of-speech (pos) distribution of the words in the chat text at the beginning and at the end of the interaction period is performed. Keyword and key-phrase spotting is used for the identification of swearwords, inappropriate language use, anti-social behavior or a cooperative mood and their change over the time period of interacting with the virtual world. Chat text is anomalous. Expressions are very often incomplete, noisy, unstructured and ill-edited. Several approaches have been proposed to deal with chat text, such as using a classic language model derived from standard text to detect chat text anomalies (Xia & Wong, 2006), or machine learning (Knoblock et al., 2007), or latent semantic analysis for topic detection (Schmid & Stone, 2008). Forsyth (2007) describes the characteristics of chat text, and addresses issues like pos tagging and dialog act recognition.

Apart from the process of chat text analysis, quantitative metrics, like the number of chat sessions each student participates in is estimated, in order to determine changes in social behavior.

Phase 4: Experimental Evaluation

Chat text processing results are evaluated. Changes in the linguistic patterns employed by the students, as well as their willingness to participate in the virtual community (estimated by the number of chat sessions they participate in) are detected. The effect of the interaction on the students' willingness to socialize, learn, cooperate and search for information is tested. The students' sociability is evaluated. How talkative are they? How cooperative? Do they solve tasks better alone or in groups? Do they show more interest in learning on a virtual platform? Do their learning skills improve? In particular, we aim to evaluate whether the subjective perception of "social presence" is enhanced by the use of online virtual worlds.

For this purpose, novel research methods are employed for the study of online virtual worlds, such as virtual ethnography, which puts the avatar of the observer (researcher) into the virtual world, in order to record (either manually or using screen capture for post-analysis) the behavior of other avatars.

In addition to virtual ethnographic methods, direct contact with the involve parties will undoubtedly also prove beneficial. Interviews will be carried out to test the students' impressions, problems, skills and talents, and the way they were affected by the virtual classroom. Questionnaires will be handed out to collect user data for evaluating the interaction and its side effects. Teachers will give their personal feedback on the platform's impact on their students' way of approaching and speaking to others, their way of thinking, their interest in learning and gathering information, their ability to cooperate.

Discussion

The expected benefits from using the virtual platform concern both the teachers and the students and they offer opportunities for informing educational policy for educational establishments in similar regions.

Regarding the teachers, they will be given the opportunity to cooperate with the students in investigating their abilities and capabilities, complement their traditional teaching practices and experiment with novel, cooperative learning schemata. Traditional educational mechanisms might be adjusted and updated for the particular case of rural schools.

Regarding students, rules of behavior within the virtual environment will need to be set, allowing students to improvise, create and explore in their own individual ways. They will learn to interact, communicate and socialize, cooperate, search for information and in particular strengthen their learning skills. They will learn to expand their horizons, talk about issues and read about matters that were beyond the scope of their limited, traditional classroom activities.

Conclusion and Further Work

We presented our on-going research on using Virtual Worlds as socialization and learning tools for remote and isolated communities, such as those found at the many small islands and villages of Greece. Our choice of OpenSimulator as a Virtual World server and the open source nature of its viewer application will allow us to create and customize a safe environment, which will support teacher designed socialization and learning activities. In the first instance we proposed a photo-collection and gallery activity which will promote cultural exchange between two or more separate communities of students.

Our next step will be to allow access to the Virtual World to two or more remote schools and collect data about its use in order to determine whether the virtual platform actually manages to expand the schools' community, and to awaken the participants' social and learning interests.

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Notes

1. European Schoolnet (EUN) provides major European education portals for teaching, learning and collaboration and leads the way in bringing about change in schooling through the use of new technology. http://www.europeanschoolnet.org/ww/en/pub/eun/about/euninfo.htm
2. myEUROPE is a Web-based project which involves a network of more than 8000 schools. It aims to help teachers raise their pupils' awareness of what it means to be a young citizen in Europe http://myeurope.eun.org
3. In Classroom4EU students across Europe share opinions on two questions: What would you want other young Europeans to know about your country? and What do you think all young people in the EU should know about Europe? http://classroom4.eu/
4. ETwinning is a virtual meeting point for the exchange of information between schools http://www.etwinning.net
5. Project Wonderland: Toolkit for Building 3D Virtual Worlds. https://lg3d-wonderland.dev.java.net/
6. Whyville Online Virtual World. http://www.whyville.net
7. Second Life. www.secondlife.com
8. The River City Project. http://muve.gse.harvard.edu/rivercityproject/
9. Teen Second Life. http://teen.secondlife.com
10. OpenSimulator. http://www.opensimulator.org

11. Croquet. http://opencroquet.org/index.php/Main_Page
12. OpenCobalt Virtual workspace browser and toolkit. http://www.duke.edu/~julian/Cobalt/Home.html

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ICT IMPLEMENTATION IN THE IRANIAN EDUCATIONAL SYSTEM AND ITS PERCEPTION BY THE EFL TEACHERS AS A BENEFICIAL TECHNOLOGY

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Abstract

This study investigated factors that may influence the attitudes towards information and communication technology (ICT) by Iranian teachers of English as a foreign language (EFL). The Diffusion of Innovations (Rogers, 1995) and the theoretical relationship between attitudes and behavior introduced by the Theory of Reasoned Action (Ajzen & Fishbein, 1980) established the theoretical framework. A multi-sections survey in English language was administered to the EFL teachers in the cities of Qazvin, Takestan, Abhar, and Zanjan for the scholastic year 2007–2008. A sample of 120 was utilized. The study showed that Iranian EFL teachers had positive attitudes towards ICT. Iranian EFL teachers' perceptions of ICT attributes from highest to lowest in mean scores were: observability, relative advantage, complexity, and compatibility. Home was the place most EFL teachers had access. It was also found that age and teaching experience had a negative correlation with attitudes, whereas qualification had a positive correlation with attitudes. 67% of the total variance in Iranian EFL teachers' attitudes towards ICT was explained by the four main independent variables of the study: attributes, cultural perceptions, competence, and access.

Introduction

According to Rogers (1995), an innovation can be defined as "an idea, a practice, or object that is perceived as new by individual or other units of adoption" (p. 11), and diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (p. 10). The notion of attitudes is central to the concept of adoption, thus, culturally-related perceptions may have a strong influence on attitudes that ultimately lead to adoption decisions. In the context of innovations designed for educational systems, teachers are assumed to be major stakeholders in making such adoption decisions (Spiegel, 2001).

The Theory of Reasoned Action (Ajzen & Fishbein, 1980) asserts that individual behavior is rational and based on a systematic assessment of the information available to them in a certain situation. Thus, an individual's behavior — in the case of this study, the use or rejection of ICT — is determined by his or her intentions to perform the behavior, and this intention is influenced jointly by the individual's "attitudes and subjective norms" (Dillon & Morris,1996, p. 6).

Attitudes are thought to be composed of cognitive, affective, and behavioral elements. *Cognitive* refers to the perceptions of the attitude object, *affective* refers to feelings towards the attitude object, and *behavior* refers to the response to the attitude object (Ajzen, 1988).

In school settings in developing countries, where teachers effectively function as primary “change agents”(Chin & Hortin, 1994, p. 83), such factors may play a significant role in the extent to which teachers carry out the responsibility of utilizing technology for instructional purposes, and ultimately, for development.

This problem is highlighted by the fact that Iran, as a developing country, has embraced ICT in education as a means to progress and modernization. Despite the importance of both ICT and EFL instruction in all Iranian public and private schools, there is little research specific to the locale to inform such an importance. Thus, two dimensions exist with regard to ICT in Iranian schools: the human factor and the innovation itself.

Literature Review

Pelgrum (2001) sought to conduct a comparative international educational assessment of ICT integration that would include contextual factors that might explain the variations among the countries.

Shelly (1998) conducted a study investigating the adoption and use of electronic e-mail by K–12 foreign language teachers. She used Rogers’ (1995) five stages of adoption — relative advantage, compatibility, complexity, trialability, and observability. A national study was conducted by Turnbull and Lawrence (2002) in Canada to examine the beliefs, attitudes, and experiences of French second language (FSL) teachers in relation to their use of technology in FSL education.

In 2000–2001, Christensen and Knezek (2001) conducted a study of teachers’ attitudes, skills, and access to computer tools in Laredo, Texas. The researchers found that the teachers’ competence and confidence in their computer use correlated with their home access. A qualitative study by Granger et al. (2002) explored the implementation of ICT in four public schools in Canada. The purpose of the study was to learn about the factors that contributed to the successful implementation of ICT by teachers in the classroom.

Definition of Terms

Attitude

"A psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly & Chaiken, 1993, p. 15). In this study, attitude toward ICT was defined as the degree of favor or disfavor towards the existence of ICT in Iranian schools. It consisted of three components: affective, cognitive, and behavioral (Ajzen & Fishbein, 1980).

Innovation Attributes

Rogers (1995) has identified five attributes of an innovation which determine the degree of its adoption: (1) relative advantage; (2) compatibility; (3) complexity; (4) observability; and (5) trialability. In this study, perceived attributes of ICT are operationally defined as the degree of relative advantage, compatibility, complexity, and observability of ICT perceived by Iranian EFL teachers. The fifth attribute, trialability, was not included in the study since EFL teachers in Iran have not had the chance to experiment with ICT before it has been placed in schools by government decree.

Cultural Perceptions

In this study, cultural perceptions refer to the extent to which Iranian EFL teachers perceive ICT use to be consistent with the cultural context of the Iranian society and public schools.

Teacher Characteristics

The demographic variables of gender, age, qualifications, school level, teaching experience, computer training.

Research Questions

1) What are the attitudes towards ICT among Iranian EFL teachers?

2) What are the perceptions of Iranian EFL teachers in regard to
   - ICT attributes?
   - Cultural perceptions of ICT?
   - Computer competence?
   - Computer access?

3) What is the relationship between the attitudes toward ICT among Iranian EFL teachers and their perceptions of each of the independent variables (including teachers' characteristics)?

4) What is the proportion of the variance in the dependent variable (attitudes toward ICT by Iranian EFL teachers) that can be explained by the independent variables?

Purpose of the Study

The primary purpose of this study was to explore factors that might influence the attitudes towards information and communication technology (ICT) by Iranian teachers of English as a foreign language (EFL). Specifically, the study sought to determine the extent of relationship between the attitudes towards ICT by Iranian EFL teachers and a number of related variables, including the teachers' perceptions of the attributes of ICT, culture-related perceptions of ICT, competence in using ICT, and level of access to ICT, as well as a variety of teacher characteristics, such as demographic characteristics.

Population

The target population for this study was Iranian EFL teachers in the cities of Qazvin, Takistan, Abhar, and Zanjan. The researcher chose to focus on these cities because they represent the urban side of the provinces in which the ICT infrastructure has been installed more rapidly than other districts and that there is almost a unified system of managing schools in Iran in respect to teachers and their pedagogical duties. Also, these cities were more convenient in location to the researcher in terms of access and delivery of the survey.

Methodology

Sample

Rea and Parker (1997) have stated that "in certain cases, [as in very small populations] . . . a sample size of 50 percent of the population size has been determined to provide the required accuracy" (p. 121). Given that the population size for this sample was 240, a sample size of 120 was appropriate for the purposes of this study. The researcher used "a table of random numbers" (Graziano & Raulin, 1997, p. 214) in selecting this sample. Each subject in the population of 240 was assigned a number, and then 120 numbers were selected randomly.

Instrumentation

The survey, which for the purposes of this study was known as the ICT Survey of EFL Teachers in Iran, contained six sections, each of which represented one of the variables examined in the research questions. These sections were labeled: 1) Attitudes towards ICT; 2) Perceived Computer Attributes; 3) Cultural Perspectives; 4) Perceived Computer Competences; 5) Perceived Computer Access; and 6) Teacher Characteristics.

Validity

Face and content validity were established for this instrument with the help of a panel of experts consisting of three psychology experts, two bilingual experts, one measurement expert, and four population experts (Iranian teachers). This panel evaluated the instrument both before and after it was used and necessary modifications were made.

Reliability

The reliability of this instrument was established using the data from a pilot study that was carried out with 30 subjects in the population. After altering some items, the Cronbach's alpha coefficients for the actual study were verified to be acceptable.

Data Analysis

The data were analyzed using both descriptive and inferential statistics. Descriptive statistics were used to describe and summarize the properties of the data collected (Gay & Airasian, 2000), and inferential statistics, including both Pearson and Spearman correlations and multiple regression analysis were used to explore relationships between the variables in the study. The Statistical Package for the Social Sciences (SPSS) was used in analyzing the data in order to determine relationships between the independent and dependent variables.

Results

Research Question One: What are the Iranian EFL Teachers' Attitudes toward ICT?

Table 1: Frequency Percentages on the Attitude Scale (N = 120)

Item	Computer Attitude Scale	Percent (%)				
		SD	D	N	A	SA
1	Computers do not scare me at all	3.3	8.9	4.4	43.1	40.3
2	*Computers make me feel uncomfortable	37.2	41.6	6.9	11.3	3.0
3	I am glad there are more computers these days	4.2	4.8	7.6	45.8	37.6
4	*I do not like talking with others about computers	24.5	43.8	7.6	4.8	4.2
5	Using computers is enjoyable	1.1	5.0	4.2	53.1	36.6
6	*I dislike using computers in teaching	24.5	44.4	16.8	10.2	4.1
7	Computers save time and money	.8	6.2	5.4	45.8	41.8
8	*Schools would be a better place without computers	35.8	39.1	16.3	6.6	2.2
9	Students must use computers in all subject matters	4.8	16.0	29.4	35.3	14.6
10	*Learning about computers is a waste of time	52.3	36.3	7.4	1.9	1.7
11	Computers would motivate students to do more study	3.1	8.7	24.6	45.1	18.5
12	Computers are fast and efficient means of getting information	1.1	3.1	3.9	41.5	50.4
13	*I would never need a computer in my classroom	21.2	48.2	17.9	9.6	3.0
14	Computers can enhance students' learning	2.2	5.0	13.9	62.6	16.3
15	*Computers do more harm than good	33.9	46.0	12.4	13.8	4.1
16	*I would rather do things by hand than with a computer	14.6	52.9	14.6	13.8	4.1
17	If I had the money, I would buy a computer	2.2	5.3	9.0	32.0	51.4
18	*I would avoid computers as much as possible	36.9	47.7	7.4	5.2	2.5
19	I would like to learn more about computers	2.5	5.0	4.2	51.8	36.4
20	*I have no intention to use computers in the near future	39.1	43.0	9.9	3.0	5.0

Scale: SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree
Note: *negative items were reversed before scoring

Research Question Two: What are the Iranian EFL Teachers' Perception of Factors Related to Attitudes towards ICT?

Table 2: Frequency Percentages on the Computer Attributes Scale (N =120)

Item	Computer Attributes Scale	Percent (%)				
		SD	D	N	A	SA

1 Computers will improve education	1.9	4.7	13.2	58.4	21.8
2 Teaching with computers offers real advantages over traditional methods of instruction	3.9	6.6	22.3	48.5	18.7
3 *Computer technology cannot improve the quality of students' learning	14.3	52.9	17.4	12.1	3.3
4 Using computer technology in the classroom would make the subject matter more interesting	1.1	3.0	10.7	59.0	26.2
5 *Computers are not useful for language learning	28.1	53.7	9.6	7.2	1.4
6 *Computers have no place in schools	36.4	46.6	10.2	3.9	3.0
7 Computer use fits well into my curriculum goals	4.1	12.4	46.6	31.4	5.5
8 *Class time is too limited for computer use	3.9	22.3	14.0	41.0	18.7
9 Computer use suits my students' learning preference and their level of computer knowledge	1.7	9.9	35.0	45.7	7.7
10 Computer use is appropriate for many language learning activities	8	6.3	11.3	66.4	15.2
11 *It would be hard for me to learn to use computers in teaching	12.7	62.3	12.9	8.8	3.3
12 I have no difficulty in understanding the basic basic of computers	3.9	24.0	14.6	49.0	8.5
13 *Computers complicate my task in the classroom	14.00	49.6	20.4	12.1	3.9
14 Everyone can easily learn to operate a computer	2.5	9.4	20.7	53.4	14.0
15 *I have never seen computers at work	46.6	39.4	7.4	5.2	1.4
16 Computers have proved to be effective learning tools worldwide	2.8	4.7	10.7	49.0	32.8
17 *I have never seen computers being used as an educational tool.	30.3	47.9	8.8	10.7	2.2
18 I have seen some Iranian teachers use computers for educational purposes	1.7	6.9	8.8	60.3	22.3

Scale: SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree
Note: *negative items were reversed before scoring

Statements 1 to 5 addressed the relative advantages of ICT. Items 6 to 10 comprised the compatibility subscale. As for the complexity subscale, respondents replied to items 11 to 14. In terms of the fourth subscale of computer attributes, observability, items 15 through 18 addressed that domain.

Table 3: Frequency Percentages on Cultural Perceptions Scale (N = 120)

Item Cultural Perceptions Scale	Percent (%)				
	SD	D	N	A	SA
1 *Computers will not make any differences in our class-rooms, schools, or lives	27.3	47.9	14.9	6.9	3.0
2 Students need to know how to use computers for future jobs.	.8	4.1	11.6	53.2	30.3
.3 *Students prefer learning from teachers to learning from	5.2	21.8	41.6	26.7	4.7
4 Knowing about computers earns one the respect of others	3.9	9.6	24.2	49.0	13.2
5 *We need computers that suit better the Iranian culture and identity	1.4	5.8	10.7	49.9	32.2
6 Computers will improve our standard of living	2.8	6.9	39.4	36.4	14.6

7	Using computers would not hinder Iranian generations from learning their traditions.	3.3	14.0	19.6	52.9	10.2
8	*Computers are proliferating too fast	2.2	5.2	5.1	42.7	44.8
9	People who are skilled in computers have privileges not available to others.	1.4	3.9	15.4	56.7	22.6
10	*Computers will increase our dependence on foreign countries.	12.9	30.6	27.3	19.6	9.6
11	*There are other social issues that need to be addressed before implementing computers in education.	1.4	8.0	19.0	51.0	20.7
12	The increased proliferation of computers will make our life easier.	1.7	4.7	23.1	54.0	16.5
13	*Computers dehumanize society.	11.3	47.1	21.8	14.9	5.0
14	Working with computers does not diminish people' relationships with one another.	6.9	19.0	24.8	42.7	6.6
15	*Computers encourage unethical practices.	7.2	26.7	28.4	26.2	11.6
16	Computers should be a priority in education.	2.2	12.1	15.2	55.6	14.9

Scale: SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree
Note: *negative items were reversed before scoring

Research Question Three: The Relationship between Teacher Attitudes and the Independent Variables

Table 4: Pearson Product–Moment Correlations of Attitudes and Independent Variables

Variable	Attitude	Attribute	Culture	Competence	Access	Training
Attitude	1.00					
Attributes	.771**	1.00				
Cultural	.629**	.716**	1.00			
Competence	.504**	.478**	.312**	1.00		
Access	.398**	.393**	.276**	.505**	1.00	
Training	.171**	.159**	.059	.381**	.169**	1.00

** Correlation is significant at the 0.01 level (2-tailed)

Research Question Four: What is the proportion of variance in the Iranian EFL teachers' attitudes toward ICT explained by the Independent Variables?

Table 5: Spearman Correlation between Attitudes and the Demographics

Variable	Attitude	Gender	Age	Experience	Grade Level	Degree	Training Type	ICDL
Attitude	1.00							
Gender	-.025	1.00						
Age	-.135**	-.282**	1.00					
Experience	-.149**	.338**	.828**	1.00				
Grade level	.064	.007	.052	.066	1.00			
Degree	.147**	-.028	-.054	-.063	.173**	1.00		
Training type	.011	-.027	.106*	.134*	-.034	.035	1.00	
ICDL	.165**	.081	-.089	-.071	.132*	.141**	.159**	1.00

*Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed)

Discussion and Findings

Findings from the survey data (Table 1) showed that Iranian EFL teachers had overall positive attitudes towards ICT in education, with an overall mean of 3.98 and standard deviation of .626. The high means for the three subscales of this attitude (affective, cognitive, and behavioral) is a further confirmation of these positive results.

The participants' perceptions of the observability of ICT (Table 2) were quite positive. On the other hand, the Iranian EFL teachers' perceptions of complexity and compatibility were the least positive among the four measured attributes of ICT. This finding is consistent with the results of a comparative international study by Pelgrum (2001), in which the difficulty in integrating ICT in instruction was reported to be a major obstacle worldwide. In conclusion, the highest to lowest mean scores on perceptions of ICT attributes in the current study were: observability, relative advantage, complexity, and compatibility.

The majority of EFL teachers in this study reported that they had moderate competence to much competence in using computers.

Home was the place most EFL Iranian teachers (75%) had access to computers. Furthermore, only one percent of the respondents in the current study reported that they had access to computers in places other than school and home, such as Internet cafés or universities.

In addition, in this study it was revealed that having an ICDL certificate increased the positive attitudes of Iranian EFL teachers towards ICT (Table 5).

In addition, it was evident in this study that the younger generation of teachers was more computer-oriented because they were in contact with computers during their school years as students and pre-service training in the universities.

It was found that teaching experience correlated negatively with the Iranian EFL teachers' attitudes towards ICT ($r = -.14$, $p < .01$).This finding indicated that teachers who had less teaching experience had more positive attitudes towards ICT. It was shown that teachers' educational background had a positive relationship with their attitudes towards ICT ($r = .14$, $p < .01$). In this study, gender was found not significantly correlated with Iranian EFL teachers' attitudes towards ICT. Similarly, the grade level that EFL teachers teach was not found to be a significant characteristic that might affect the teachers' attitudes towards ICT (Table 5).

Recommendations

1) The methodology used in this study may be used to repeat this study to collect data about EFL teachers in other parts of Iran whether urban or rural.

2) This study is a quantitative study in nature, and a multi-part survey is the sole instrument to collect data. It is recommended that qualitative research be conducted, targeting the same population, to provide further information. Future research may examine other factors that may be related to such attitudes, such as self-efficacy, peer influence, administration support, and parents' involvement with schooling.

3) The current study employed a cross-sectional method to gather data on EFL teachers in Iran at a single point of time. It is recommended that future research be of a longitudinal nature in order to provide a more detailed description of the phenomenon and to capture other factors that may play a role in influencing EFL attitudes towards ICT at a deeper level.

Conclusion

This study identified the factors that might influence the adoption and implementation of ICT by EFL teachers. Because of this pioneering study, the policy makers in Iran will be more informed in their future endeavors regarding the factors that impede or facilitate the implementation of ICT and its adoption rate by Iranian teachers through out the country's educational system.

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DEVELOPING A PEDAGOGICAL FRAMEWORK FOR ICT USE IN LANGUAGES CLASSROOMS

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Abstract

This paper will examine the potential of classroom-based technologies from the perspective of foreign language teaching. Drawing on research conducted with final year teacher–education students and recent work in this area by Baumgartner (2004), Bartlett-Bragg (2004) and others, this paper will outline a theoretical framework for the use of ICT in language classrooms. This framework will take account of learner readiness, appropriate pedagogical frameworks and the linguistic resources that learners have at their disposal. The use of available technologies in Languages classrooms among a group of final year teacher education students and their supervising teachers is examined. The results of the research are used as a starting point for a discussion about the essential features of a pedagogical framework for languages teachers.

Introduction

The last decade has seen a huge increase in the availability of computer-based technologies to teachers of second and foreign languages. The potential of these technologies has been recognised by many teachers, but the development of a pedagogiocal framework within which this potential could be fully realised, lags behind the provision of hardware in most institutions. Calls for a 'theory driven CALL' (Levy, 1997) have been around for some time and researchers such as Cuban (2002) have devoted considerable effort towards reaching an understanding of why it is, for example, that teachers in the 1990's were making good use of computers in their homes, but not in their classrooms, even when these were available in abundance (Cuban, 2002, p. 155). The lack of an integrated approach towards the use of technologies in teaching has been a recurring theme in the literature. As recently as 2006 the European Schoolnet ICT Impact Report stated that despite a dramatic increase in teachers ICT skills, "teachers have not yet embraced new pedagogical practice . . . more time is needed to achieve wider impact on teaching methods" (Balanskat et al., 2006, p. 44). The British JISC (2003) update also makes the observation that pedagogical issues have been "of secondary concern" (JISC, 2003, p.1) when it comes to the effective use of elearning tools. According to other researchers, even where ICT use is more common, this is often practice driven and situated, meaning that teachers are applying what seems to work without reference to a theoretical framework or consistent approach to methods (Deaney, 2004), although this research also reports that such practices do seem to change teaching practice on small but incremental basis. Given the distance from the target culture and the lack of opportunity for most students to use the target language outside the classroom, it is vital that foreign language teachers make effective use of available technologies. It has become obvious even to the most skeptical, that ICT has the potential to greatly enhance the opportunities for real language use in and beyond the classroom.

This paper examines the use of available technologies in Languages classrooms among a group of final year teacher education students and their supervising teachers. The results of the research are used as a starting point for a discussion about the essential features of a pedagogical framework for languages teachers. The research involved 28 final-year students in a teacher education degree and examined their use of technologies during their practicum. The different availabilities of ICT and access patterns in each school were accounted for and lesson plans were analysed in order to describe at the pedagogical frameworks implicit in the plans and to assess the degree to which languages and technology outcomes had been integrated into their lessons. Finally, the role of the supervising teacher as an influence on ICT practice was examined. Sources of data included:

- an online discussion board 'Technology and Your School' where students made at least two detailed postings each during the course of their practicum;
- students' accounts, supported with lesson plans, the integration of at least two different computer based technologies into their teaching while on practicum; and
- surveys of students after the practicum asking them to report on their experiences.

This data was analysed using axial coding methods (Strauss & Corbin, 1990). The key headings that emerged from this analysis were:

- patterns of availability and access;
- technology choices;
- target groups;
- lesson outcomes as an indicator of integration of technology with the lesson; and
- the influence of the supervising teacher.

Patterns of Availability and Access

Students reported the availability and access patterns in their host schools through an online discussion board that had been set up for this purpose. Students provided detailed accounts of the hardware available as well as access issues and level and quality of use within the school. Although a basic pattern of availability was present, major differences emerged in relation to each of these aspects. There were widely differing accounts of the availability of computers in the schools and the ease of access to them. There were also contrasting accounts of the sophistication of applications and the confidence of staff in using computers. The following three examples give a clear picture of the range of availabilities reported:

> *S11: North High School has around 50 computers in the library and computer lab for students and one in each staff room. Each computer is connected with Internet as well as intranet. Students and staff members can communicate with each other. Each student has a password and log-in account. The students frequently made use of Internet in doing their homework, assignments and research, while some of the teachers encouraged them to use computers. Each teacher has got an e-mail address and the students can freely ask questions via e-mail.*

> *S9: The teachers can use the computer lab for class if s/he has booked in advance. One Chinese teacher actually made use of the computer lab in his class, and use PowerPoint slideshow in teaching some words and providing cultural information to the students. I did not find any particular program other than Microsoft Word, but the teachers are allowed to install some in case in need. Regarding the school's technology policy, the students and teachers are encouraged to use the facilities effectively in order to provide comprehensible lessons and enhance learning efficiency.*

> *S23: The College has an intranet system. Teachers and students use e-mail to communicate with one another. However, they are changing the system next year and they will be using MOODLE. (LMS) However, they do not plan on calling it MOODLE, as some of the schools which already have it in the area gave it a name which was relevant to their school community. All students and staff have to login to use the computers. The system is filtered so that students do not have access to all sites.*

In three of the 28 schools, students used their own lap-tops in class, however the dominant pattern was a centralised computer lab that teachers had to book ahead in order to gain access. Maintenance and breakdowns were recurring themes. School intranets were present in 19 of the schools. All students reported desktop computers in staffrooms with internet access. Despite some practical issues, there were no availability or access issues preventing the use of ICT in a lesson, provided forward planning was used. Apart from issues such as the number of working computers available to a class, one of the main preoccupations of the student teachers was classroom management. The issue of ‘control’ was addressed through a number of forums and is also evident in the lesson plans presented. The following is representative of these concerns:

S22: Nothing to report yet! The kids are so naughty here that I'm afraid to take them into a computer lab! A number of things might go wrong, eg, they'd disappear en route to the lab, they'd try to nick anything not bolted down, they'd try to access porn websites without a doubt, they'd start playing music from their i-pods and phones etc. It's a shame, because I've had loads of ideas of how I could use technology in my classes. Maybe I can think of things to do with the ESL class (YR 11) as they're a really nice bunch of kids.

Which Technologies did the Student-Teachers Choose to Apply?

The students were required to provide two lesson plans demonstrating the use of computer-based technologies in the Languages classroom. In each case, they were asked to show that the target language use in the lesson was enhanced through the application of the technology. The analysis of the 56 plans revealed the following choices of technologies:

- lesson involving students creating PowerPoint with audioclip (19)
- guided web searching (11)
- webquests (3)
- e-mail projects (7)
- weblogs — introducing their class to a real audience in the target country (4)
- uploading pictures to Flickr with comments in target language (1)
- identity card using MS Word and colour/texture/insert picture function. Hyperlinked to another page (1)
- students create own wikispace (2)
- Internet research leading to PowerPoint presentation in class (6)
- Skype — interview student same age in target country (1)
- video project — (1)

PowerPoint presentations using the target language were by far the most popular choice, followed by guided web-searching and email projects. These technologies involve high level of control and direction on the part of the teacher and are product rather than process oriented. Those technologies that are more conducive to constructivist approaches to teaching were far less popular. Few of the projects involved synchronous real communication in the target language. It is interesting that the discussion board was effective in the formation of a learning community among the students. The student teachers used the discussion board as a means of exchanging ideas with each other and posing questions about the integration of technology into their lessons.

S22: Wow! You're going technology mad! I love it! It must be that Generation Y gene coming out!! I am so going to nick your idea of an internet treasure hunt for culture. I'm sure you've thought of it already, but what about contemporary Italian music? All that dodgy Il Divo stuff, etc! Maybe, if the class is beginners and has done food, you could do an Italian restaurant search of say Milan, and do food/and price comparisons, including showing them how the on-line money converter works. I don't know, it's kind of hard to imagine what they'll be interested in. Oh, or you could do a short research topic on famous filmstars, or sports stars, and if they're yr 7 & 8 get them to make a mock celebrity magazine page sensationalising the person with maybe the headline in italian at least. I hope that's something anyway. Let me know if you think of anything else though, as i think you're onto something here!

The Target Groups

The student-teachers were all undertaking placements in secondary schools in Sydney. The students they were teaching ranged in age from 12–18 and demonstrated varying levels of technological skills. The snapshots of the target groups provided by the student teachers confirmed what is already known about generation Y and digital literacy. As a group, they are not as digitally literate as many would believe. They are very good at technologies that are useful to them in a social or personal sense, such as Facebook texting and mp3 players, however they are much less adept at transferring these skills to applications that have an educational purpose. They require explicit and detailed scaffolding to use these in classroom settings. The schools with intranet provided more opportunities for students to use technology as a part of their daily routine:

S6: There are around 80-100 computers situated here at South High. Computers are kept in the library, the staff room and computer labs. Access is available for all staff and students in the school with individual logins allocated to all users. Computer programs were not used within the classroom on a regular basis, but a computer lab could be booked for a lesson with the following language software available: Chouette; Otimo; Sugoi and NJ Star. The school has an intranet, with a common H network drive being available to all students and teachers to access and save their work. Each user, including students, receives their own X drive in which they can save any personal work.

The Integration of Technology in the Lesson

The analysis of the lesson plans revealed a strong preference on the part of the teachers for a pedagogical model that involved predetermined products and a tightly controlled process with the teacher as 'expert'. A lesson plan that included outcomes for both Language learning and the development of technological skills was taken as one indicator of successful integration of language and technology in a lesson. Only 10 of the 28 student-teachers produced lesson plans with outcomes for both language and technology. Only 7 of the 28 demonstrated an awareness of the level of scaffolding required for the chosen technology. This was evidenced by the focus on the linguistic outcomes and the lack of modelling of the application of the technology on the part of the student-teacher.

The Role of the Supervising Teacher

For all the student teachers, the role of the supervising teacher was extremely influential in determining which choices would be made in relation to technology. Only 12 of the 28 students reported that their supervising teachers were regular users of computer based technologies in their day to day teaching. The discussion board made clear the differences in attitude and patterns of use:

> *S11: Internet is often used by high school students for the research. Primary school students usually use computers to type their writing. Every teacher seems to be comfortable with using computer technology. When they have a problem with using computers, they always assist each other. The school put an importance on using computer technology as much as possible. In primary school classes, ICT skills are included in the unit of work so students learn to use computers through many different classes.*

> *S22: The school has three computer labs in the library so students can access to computers with their own login. Two smart boards arrived last week for language teaching and they are awesome! Unfortunately, I have no chance to use it in the classroom but tried to demonstrate with a Chinese teacher and it was amazing.*

> *S25: The computer programs such as Ni Hao game, Ni Hao Lab, Tei Hao Le, French market, Chinese Albums are used to enhance language learning. Generally, the language teachers think it is difficult to use technology in language classes. However, students are encouraged to present their assignments using technology such as power points, DVD player and so on.*

Discussion

A number of factors stand out from the results. Firstly, the choices of the student-teachers around technology were surprisingly narrow. Second, their general approach when using technology was, in general, very teacher centred. Third, the real integration of technology into the planned outcomes of the lesson was achieved in only a minority of examples. The next part of this paper will address the possible causes for this phenomena and the ways in which they might be addressed through teacher education programs.

The narrow choices of current technologies available for use in languages education. Recent years have seen a revolution in the technologies available to language teachers. The interest in CALL (Computer Assisted language Learning) has become enormous and the literature in the field is significant. The lists of CALL conferences become longer each year and more and more teachers are looking for ways to add technology to their teaching. Interactive computer based technologies are making synchronous and asynchronous communication more and more available to classroom teachers at all levels. The Horizon Report (2008) points to a list of emerging technologies that will become commonplace in the next 2–5 years. One example of this is the ready availability of mashup tools that allow teachers to create web pages that aggregate and compare data from a number of sources, including blogs, wikipedia or Google Earth or podcasts in a foreign language. Other examples include mobile broadband and collaboration webs.

It should be obvious that apart from the ubiquitous PowerPoint, teachers now have a plethora of technologies to choose from to assist their efforts to provide their students with good examples of authentic language and cultural texts in the target language. Using sites such as Podomatic.com, teachers can record and post podcasts to their own websites or blogs and students can subscribe to these via rss feed or the like. Teachers can and do make use of digital recording software such as Garageband in order to send sound files of authentic language to their students via email or the school's intranet. Even the virtual world of Second Life is being used by languages educators (Ruberg, 2008). This luxury of choice gives rise to a number of questions about appropriate and effective uses of technologies and what might be described as best practice.

The average age of teachers in Australian schools is 46 years (Albion, 2003). Most began their teaching in the age of the cassette player and slide projector and would have had no training in computers as a part of their teacher preparation. As Albion (2003) points out, it is also fallacious to assume that graduating students, as a group, are adept at integrating technology into their teaching. Nevertheless, teachers are faced with a rapidly changing classroom environment that is challenging and perhaps for some, overwhelming. Brown and Warschauer (2006), writing about the American experience, point to poor integration of technology into teaching and the inadequate preparation of student teachers in terms of effective use of technology in the classroom. These authors nominate two causes for this — firstly, the teachers limited expertise in using computers and secondly the lack of effective modelling of instructional strategies 'that incorporate technology (Brown & Warschauer, 2006, p. 600). Lack of equipment is not a problem — at least in the contexts surveyed for this paper.

Developing a pedagogical framework for ICT use in languages' classrooms
The classroom application of ICT has come a long way since Warschauer (1996) identified the so-called three phases of Computer Assisted language Learning (CALL) as: (i) Behaviouristic CALL, (ii) Communicative CALL, and (iii) Integrative CALL – multimedia. The theoretical framework Warschauer (1996) presented is not only inadequate in the face of the new possibilities for synchronous and asynchronous communication in a foreign language but also in the face of a rapid development from communicative language teaching to a kind of post-modern pragmatic eclecticism that means that there are as many teaching methods as there are teachers. The effective use of such resources requires an educational theory of technology (De Castel, 2002) that teachers can relate to their own situated work.

A useful starting point for making sense of the plethora of possibilities is to revisit the word *technology* and ask what exactly we understand to be the meaning of this term. Nordkvelle (2004) discusses the different implications of defining technology as a process — "the operating principles of any art of science" and seeing technology as an artefact — a resource or tool. For Ferre (1995), "technology is not so much *the application* of knowledge as *a form* of knowledge*,* one persistently dependent on technical skill." If we are to develop an "educational theory of technology" (De Castell, 2002) and investigate technology from the "standpoint of educational values and purposes" it would seem to be much more productive to see technology in terms of the broad, if somewhat archaic definition, that focuses on the way things are done rather than the reification of a process.

We know that teacher decision-making is often very situated and based on implicit knowledge of what seems to work in their particular classroom. The resulting gap between theory and practice is a problematic that has been addressed by a large number of researchers. According to Hatton (1997), the effects of "prior experiences" encourage teachers to "eschew pedagogic knowledge and adopt a non reflective orientation to their work" (p. 242). For student-teachers, the way to address this gap seems to be via their willingness as teachers to find solutions to problems within their own classroom while broadening the resources they normally apply to solving such problems. In other words, using action research on the integration of technology into teaching, seems a very logical way to develop a strong theoretical base for technology related choices as well as developing a positive disposition (Young, 1992) to finding out more about what is happening in their classes.

Developing a framework that takes account of students' abilities in the target language. As explained above, most of the student teachers surveyed for this project were not applying a pedagogical framework to the use of ICTs in their classes. Developing such a framework requires that the student-teachers are able to take into consideration three aspects relating to the needs of the learners. These are: 1) the model of teaching and learning; 2) learner readiness; and 3) stage of language development. The pointers for these dimensions are summarized in the following table.

Table 1: Dimensions of the Framework

Dimension 1. The Model of Teaching and Learning and the role of the Teacher (Baumgartner 2004)
Model 1 To Transfer knowledge • Teacher as the expert and keeper of the knowledge • Teachers responsibility to transfer knowledge to the learner • Results focused-production of correct answers • Communication is preset and controlled
Model 2 To acquire compile and gather knowledge • Learning as an active process, which has to be planned, revised and reflected upon by the learner • Teacher provides a learning environment where learners are able to examine the necessary knowledge to solve the presented problem or task • Presentation of predetermined problems
Model 3 To develop, to invent, to construct knowledge • Teachers provide an environment where learners can invent new things- generate new knowledge — it needs to be sufficiently complex, real uncertain, instable and unique • Teachers and learners are immersed into a situation where the outcomes are not pre-determined • Teacher becomes a coach or guide and may not be able to solve all problems • Communication is open and entwined — both teacher and learner will learn from each other
Dimension 2: Learner Readiness
LEARNER TYPE 1 • Novice learner - requires extensive support and scaffolding • Dependent learner -limited learning experience • Low experience with technology - low levels of digital literacy • Will be distracted by technology
LEARNER TYPE 2 • Some experience in self direction but needs support and guidance • Semi-dependent learner — will require support to adapt to skills required for self-direction. Use of milestones and checkpoints necessary. • Some experience with technology — limited to standard programs and will require

assistance with new software
LEARNER TYPE 3 • Highly self directed learner • Independent learner -does not require guidance • Digitally fluent - is able to transfer
Dimension 3: Stage Of Language Development (Based on Common European Framework of Reference for Languages)
BEGINNER • Works with very limited vocabulary • Uses memorized Chunks of the Language • Can understand and use familiar everyday expressions and very basic phrases aimed at the satisfaction of needs of a concrete type. • Can interact in a simple way provided the other person talks slowly and clearly and is prepared to help.
INTERMEDIATE • Can understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. very basic personal and family information, shopping, local geography, employment). Can communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. • Can describe in simple terms aspects of his/her background, immediate environment and matters in areas of immediate need.
ADVANCED • Can understand the main ideas of complex text on both concrete and some abstract topics, Can interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without significant strain for either party. • Can produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options.

In applying these considerations, the student-teachers should also be developing a taxonomy of technologies that could be applied to different stages in language teaching:

- technologies that enhance practice in the language;
- technologies that enhance simulated meaningful use of the language;
- technologies that enhance real-life and/or real-time communication.

A strong pedagogical framework for the integration of technology into language teaching will take all of these aspects into account. It will be evidenced in lesson plans that account for outcomes in terms of the language exponents to be taught and the technological skills required. It will also make student-teachers more conscious of the model of teaching and learning they are applying and of their role within that model. It also means that choices of ICTs and approaches to teaching will necessarily be broadened. It is a framework that begins with pedagogical considerations rather than foregrounding the ICTs.

Conclusion

The results of this research underscored once again the need for teacher-educators to develop an 'educational theory of technology' and model this explicitly for future teachers. The suggested framework provides the kind of resource student-teachers and teachers need when considering choices around the use of technology in the classroom. Future research could involve student-teachers using this framework in an action research project during their practice teaching periods. This would provide excellent data on the application of the framework as well the development of the students own dispositions to learning in this area.

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WHO STRUGGLES WITH ACADEMIC LITERACY? CHALLENGING COMMON ASSUMPTIONS OF WHICH STUDENTS ENGAGE IN PLAGIARISM

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Abstract
This paper reports unexpected findings arising from the evaluation of an online tutorial designed to assist students in preparing their assignments at the University of Western Sydney (UWS). The tutorial attempts to fill a gap that cannot be met in universities struggling in the current fiscal and aims to help students produce quality work free of plagiarism. Using a mixed methods approach, we found that students in general struggle to understand academic writing and referencing and that a freely available online resource is beneficial.

Introduction

Over the past two decades, the notion of what universities are and how they operate has altered dramatically. In the western world, as a response to commercial imperatives, many universities now rely on international students as a significant income stream (Bretag, 2005; Handa & Fallon, 2006) or intensify courses in order to graduate students as quickly as possible. Typically this places increased pressure on academics to demonstrate the quality of their graduates. One measure of graduate quality is compliance with the core value of academic integrity (Flint, Clegg, & Macdonald, 2006).

In assessment tasks students are required to demonstrate academic integrity. In other words, their work must be original or accurately attribute other authors. Failure to do so is considered academic misconduct, regarded by some to be "a crime against members of the academic community" (Leask, 2006, p. 183).

Such failure is frequently referred to as plagiarism and is a serious concern for universities (Alam, 2004). Arguments around plagiarism include the claim that as "a western intellectual preoccupation" (Clarke, 2005, Section 5.4), it has reached "epidemic proportions" (Miall, 2005, p. 168) and that, if left unchallenged, threatens the reputation of universities and devalues both the qualification and the educational experience (Flint et al., 2006).

Complying with principles of academic integrity is problematic and challenging to students (Nitterhouse, 2003), not least because of the contested perceptions and interpretations that students and academics have towards the concept and value of academic integrity. Studies demonstrate that the complexity and confusion surrounding plagiarism confuses the diverse range of students typical of today's universities (Given & Smailes, 2005; Hayes & Introna, 2005; Introna, Hayes, Blair & Wood, 2003; Lahur, 2004; Marshall & Garry, 2005).

Academics conceptualise student plagiarism from an idiosyncratic interpretive framework (Flint et al., 2006). That is, they use their own particular interpretation of plagiarism in deciding if plagiarism has occurred and how or whether a student should be punished. Some academics believe that students intentionally plagiarise. Others link plagiarism with language capabilities so that for example Australian academics regard students with limited English language skills as more frequent plagiarisers (Bretag, 2005).

Much of the literature on student plagiarism focuses on international students. It suggests that they are "desperate, embattled and inferior learners" (Leask, 2004, p. 185), lacking in integrity (Handa & Power, 2005) who are likely to submit written work that contains deliberate plagiarism because they have difficulty learning about and understanding the academic culture of the institution (Banwell, 2003) and are culturally inferior "others" who know how to learn only by rote and imitation and whose learning style and strategies impede critical thinking and result in plagiarism. The negativity of the language used to describe international students assumes a deficit, blaming the students. This negativity is an important issue, as it tends to colour academics' attitudes towards international students.

Although international students find it challenging to understand the demands of academic integrity (Handa & Fallon, 2006; Kell & Vogl, 2006), much of their confusion is also shared by domestic students (Pickering & Hornby, 2005). In analysing student use of an online tutorial designed to assist them in preparing assignments, we found that there was not a consistent failure to understand academic integrity on the part of international students. This made us question the accuracy of current deficit assumptions that view students from different ethnic heritage or education backgrounds as the ones most likely struggle with academic literacy and engage in plagiarism.

Our task then became finding the common features of the student experience that impaired students' ability to comply with the principles of academic integrity. With a more accurate picture of who struggles with academic writing, we can tailor our approach to assisting them. Our aim is to alleviate student concerns, advance graduate outcomes and enhance the domestic or international student experience.

Background to the Study

The authors, academics in an Education faculty, "disturbed by the poor quality of writing and referencing and incidents of inadvertent plagiarism observed in student assignments" (Kell & Gregson, 2007, p. 1) applied for and received internal university funding to develop a WebCT based online tutorial. The philosophy underpinning development of the modules is that education is better than punishment. We would prefer students to learn about academic writing and referencing rather than being penalised for poor or inaccurate work.

Get it! Write

Get it! Write is a tutorial providing students with practical, accessible advice and activities to guide their academic writing. Students are introduced to the tutorial at the beginning of each semester and are able to access it freely to help them develop academic writing and APA referencing skills. It is currently free to all students studying Education at UWS and is available on the same online platform as their coursework. At the time the research was conducted it consisted of 10 self-paced modules.

Each of the modules can be used independently or as part of a whole and students may enter or exit the program at any time, allowing them to practice skills as often as they desire. The structure of each module is similar. Each addresses a central theme followed by practical examples and templates.

Student Cohort and Patterns of Study

About 2500 domestic and international students study education (Early Childhood, Primary and Secondary) at UWS. Of these students about one third completed their undergraduate qualifications outside Australia and in a language other than English. The term international student has a particular meaning in this study. None of the students were studying under exchange arrangements. All students who have an undergraduate degree earned overseas are immigrants or have resident status in Australia.

All students preparing to teach in the Primary and Secondary school sectors complete an 18-month (or 12-month intensive) Masters degree. The Primary and Secondary teaching courses offered at UWS are coursework-only, professional degrees. Students from these programs participated in the research. The only time that majority of students come together is during orientation activities at the beginning of each semester. Data for the study reported in this paper were collected from the cohort commencing in February 2007.

Research Design

This study used a mixed methods approach to data collection. Quantitative data was collected on several occasions during 2007. At a lecture during orientation students were introduced to *Get it! Write* and were invited to attend "hands on" workshops in a computer laboratory in the first few weeks of semester. From this exercise three forms quantitative data were collected:

- an evaluative survey was completed by students in the introductory lectures;
- pre- and post-session surveys were completed by students who attended practical workshops; and
- an online survey was completed at the end of the semester by students.

Qualitative data was collected from:

- a focus group of 10 students studying Primary and Secondary education who did not attend workshops; and
- individual telephone interviews with five students who attended workshops.

All interview questions were open ended and students were not asked to disclose if they had engaged in plagiarism. The interviews were audio tape-recorded but not fully transcribed. Field notes were used to draw out themes that formed the basis of analysis. Data from the interviews reinforced and triangulated data from the surveys.

Participant Recruitment

Purposive sampling was used to recruit all students for participation in this study. As participation was voluntary some students attending introductory lecture declined. Students studying Education subjects at UWS were invited to via the School's web site, or the online platform, or at lectures and tutorials to participate in the online survey. Students who attended workshops were approach individually, via e-mail. Again all participation was voluntary. In all cases students were informed about the research and asked to give written consent for their participation: 334 students studying Primary (n = 171) or Secondary (n = 163) education responded to the initial survey (during orientation). This cohort includes students who gained their undergraduate degrees in UK and Canada as well as India, Bangladesh and Fiji. The importance of this range is that some "international" students studied for their degree in English: 10% of Primary and 8.5% of Secondary students indicated that they had gained their first degree outside Australia.

Data Analysis

In a multi-staged process that allows cross-interrogation of both qualitative and quantitative data (Burns, 1994; Kumar, 1996; Miles & Huberman, 1994) all of the survey and interview data were sorted independently, coded, and categorised to establish themes and provided "a comprehensive picture of [the students'] experiences" (Aronson, 1994, paragraph 7). This approach enables researchers to focus on one or more aspects revealed in the quantitative data and explore them though targeted qualitative data. Since a range of data was collected, this paper will concentrate on the characteristics of students who reported that they found academic writing and referencing difficult.

Findings

The most important finding was that most students struggle with some aspect of academic writing and referencing.

While responses between primary and secondary students vary, analysis of data from both cohorts indicates that the percentage of students who find academic writing difficult is significantly higher than the percentage of students whose first degree obtained outside Australia (see Table 1). It is apparent that the ability to write in an appropriate academic style is a source of tension for many students who have completed undergraduate degrees in Australia.

Table 1: Students Who Find Academic Writing Difficult

Program	N = (%)	Total who gained 1st degree outside Australia
Primary	39 (22.5%)	18 (10%)
Secondary	47 (29%)	14 (8.5

On average almost 40% of Primary students find getting started and organised very difficult or difficult and 30% of students find academic writing and formatting and oral presentations very difficult or difficult. It is interesting that fewer than 20% claim to find referencing in APA very difficult or difficult. This implies that about 80% of students in the primary program feel confident or very confident about referencing. It is impossible to know if this perception is reality for these students although anecdotal evidence from academic staff does not substantiate this claim with regard to the errors found in referencing in student assignments

Secondary students also indicate that academic writing is difficult for more than those students whose first degree was not in English. The secondary students have concerns about getting started and planning their work, are reasonably confident about interpreting the question or task but find note taking, reading and writing very difficult or difficult. Although a greater percentage of secondary students than primary reported that referencing was difficult, the majority of students express confidence in being able to accurately reference. The same comments about reality apply to this cohort.

Does Degree Matter?

Comparing results from the survey and demographic data students across programs indicated a wide range of undergraduate degrees such as, Law, Business, Nursing, Music, Recreational Therapy, Arts, Psychology and a range of Mathematics and Science. We grouped these in to four generic fields, as shown in Table 2.

Table 2: Generic Undergraduate Degree Fields of Students Who Report Academic Writing as Very Difficult or Difficult

	Secondary	**Primary**
Science	28	13
Arts	12	18
Performance/Drama	7	0
Business	0	8

For students in the secondary program there is a strong correlation between those who have an undergraduate degree in the Maths/Science area and difficulty with academic writing. This aligns with the students' comments indicating that they were rarely required to submit pieces of extended writing in their undergraduate degree.

The correlation for primary student is a little less clear. While about one third of the students who found academic writing difficult had an undergraduate degree in the Maths/Science field, almost half had an Arts degree. This is a puzzling finding which we are at a loss to explain since achieving an Arts degree requires deep reading, critical thinking and extended writing. Perhaps the reason is that some students who have graduated with an Arts degree have taken a major that does have these characteristics.

How Useful was *Get it! Write*?

This section examines at the quantitative and qualitative data collected from the online survey, the focus group and the interviews with students who attended *Get it! Write* workshops. Since there was no requirement that students participating in this phase of the study had actually used *Get it! Write*, there are some data from students who did not use the tutorial.

The Online Survey and Focus Group

Of the 25 students completing the online survey, 6 did not have English as their first language. The majority (20), including those 6, had accessed the *Get it! Write* site during the year.

In general students found *Get it! Write* was a good or very good resource. As one of the students noted, *"I have learned everything about writing assignments and referencing from Get it! Write"* (E). Others found specific aspects important: *"It provided the important tips one needs when writing a form of literature such as definition of key words in questions as well as the blue print in terms of structuring your literature"* (G).

There were several comments about the usefulness of Module 8 (Referencing). *"The* Get it! Write *website helped with APA referencing, which I had not used prior to this course"* (VG). One student directly related his/her undergraduate experiences with *Get it! Write:*

> *During my undergraduate degree I used many forms of referencing depending on the unit or discipline I was writing in (such as history). I therefore, with a simple style guide given to me, was able to adapt to the use of the APA style of referencing very easily.* (DNU)

Not all students found *Get it! Write* useful. One student comment that he/she did not know how to access the site and another commented that navigation was too difficult: *"It is very difficult to navigate — you are forced to jump through hoops to get to the information you want or need"* (P). Other students commented on the clear structure and details examples provided on the site. Another student who was a confident writer was happier using a monograph guide to APA.

Students in the focus group found other problems with *Get it! Write.* Several reported that the advice on referencing conflicted with what their lecturers *believed* was accurate APA. Others found that there was so much information on the site that they were spending time on it when they felt it should be allocated to actually writing assignments.

Individual Interviews

Students who were interviewed individually were able to respond fully and independently without being influenced by the comments of others, as may happen in a focus group. The 7 students interviewed had a greater understanding of *Get it! Write* than the majority of other student as a result of attending a hands-on workshop. Two female students had a first degree from a country other than Australia.

These students had accessed *Get it! Write* between 5 and 20 times over the year and rated it very good to excellent. This comment from a student whose first degree was not in English summed up the value that students saw in *Get it! Write*:

> *It has been more than ten years after I have got my first degree. I have not done many essay writing for a long period of time. I was worried about how to write the assignments . . . Before I did my first assignment, I read all the modules in Get It! Write. The languages and formats the program uses are very easy to understand. I follow all the steps. Even though I get a pass, my confidence has built up. When I do my second assignment, I went back to Get It Write, and went through the areas I didn't do well in my first assignment. I did better in my second assignment. I feel confident about writing assignments now because I know that I can always get help from Get it! Write program if I have problems about essay writing.* (F)

Asked the value of the workshops, all comments were favourable, ranging from developing confidence in breaking down the questions (GA), definitions of key terms (SA) to learning the importance of time management (SG). Unlike students who had not attended workshops, these students found *Get it! Write* easier to access and navigate if they were competent computer users.

In terms of developing their skills most students who attended a workshop noted an improvement in their results. AJ found there was a distinct improvement between Semester 1 & Semester 2. He felt he had gained confidence in accurate referencing: *"I was able to synthesise and analyse information better."* He attributes this to *Get it! Write*.

Discussion

Quantitative and qualitative data provide a student perspective of *Get it Write*. Although the initial design drew heavily on research that characterised students who have not studied in the dominant language as poor academic writers and major plagiarisers, the research indicates that many students find academic writing difficult. This is exacerbated if students have qualifications in disciplines that have a Mathematics or Science base.

The evidence is that *Get it! Write* can be a useful and important tool for students, under certain circumstances. Most students are introduced to *Get it! Write* by means of a lecture during orientation. This is a busy time for students when they are inundated with new ideas, new protocols and forced to make decisions about study program options. The realities of organising, preparing, writing and referencing assignments probably pale into insignificance when students are trying to arrange time schedules around study, work and families. So, it is not surprising that some students do not understand the significance of the initial lecture.

Evidence from students who attend a subsequent hands-on workshop indicated that these students access *Get it! Write* more often, find it more useful and are able to achieve higher marks for their assignments. None of them used all the modules but all of them return to the modules they find most useful. They rate *Get it! Write* more highly than students who did not attend a workshop.

Get it! Write is not compulsory nor should it be. However, some of the difficulties students had can be ameliorated to make the tutorial more student-friendly. For example, the site can be easier to navigate and have more examples, one feature that students really liked, can be incorporated.

Many students, especially those in the focus group, commented on the tensions they saw between the demands of their lecturers and the information given on *Get it! Write.* This is not so much a problem of the design of the tutorial but the way other academic understand it. The evidence from this study is that academic staff need as much education as students.

Conclusions

We thought we were writing a tutorial for the few students who were struggling with academic writing. Researching student response to *Get it! Write* indicated that it is not just students who are learning in a second, third or fourth language who struggle. Assuming that particular students will find academic writing difficult is erroneous and creates stereotypes in the minds of academics. In many ways this knowledge has strengthened the raison d'être and validity of a tutorial such as *Get it! Write.* The philosophy underpinning *Get it! Write* is evident in student's positive responses. They see it as a tool for developing their skills. It also provides them with a basis for discussing issues of writing and referencing with their lecturers. Most important it provides an opportunity for teaching rather than penalising.

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KAIRION: TOWARDS A TECHNOLOGY-BASED PEDAGOGY OF SOURCE USE PRACTICE

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Abstract

Research literature artifacts are not autonomous constructs, but elements of rhetorical processes embedded in specific times and places (Bazerman, 1988; Geisler, 1994; Prior, 1998). Specifically for academic citation practices, Cronin (1984) and Cozzens (1989) argued for a rhetorical perspective of scientific attribution, focusing on the persuasive and performative nature of the practice. This paper reports on the results of textual analyses and discourse-based interviews with 16 researchers from four different disciplines, to argue that source use practices are deeply embedded in rhetorical purpose. Based on this research, the development of a computer-based visualization framework for source use, *Kairion*, aimed at supporting this understanding of academic practices will be presented.

Background

The role of texts in the development of scientific communities has been the topic of extended discussions in many fields, especially after the 1970s when the myth of the solitary research scientist conducting experiments in the lab or recording data in the field was debunked. Latour and Woolgar (1979) went as far as to suggest that the research labs spend more time and energy in preparing articles, texts that establish their position in relation to other labs, than discovering new knowledge. However, the model of scientific activity as an enterprise chiefly concerned with the improvement of knowledge, as this is developed by individuals (Merton, 1968), still had a very strong appeal. The reason is that in this "republic of science" model, individuals are considered part of meritocratic systems where their rewards or prestige depend on the relative success of the other scientists in the community. Texts, therefore, become the vehicles to provide evidence of continuity and advancement of knowledge as well as innovation.

Such an understanding of the scientific community as an "invisible college" where scientists work and learn in small, self-regulated, merit-based scientific communities (Crane, 1972) has distinct implications about the value of texts: the crucial difference between scientists is not *how* they write, but simply *what* they write. The texts then that the individual scientist produces in his/her community are merely repositories of knowledge, which allowed for the development of the *Science Citation Index* as soon as the technology allowed the creation of large databases. The *Science Citation Index* and consequently the development of the field of scientometric analysis begin with the assumption that the meaning in scientific texts can be understood by analytically defined indicators (such as co-words or co-citations).

This assumption has been at the heart of attempts to develop both hardware and software which would support the practice of reading and writing from sources. The introduction of Tablet PCs and dedicated reading devices (Sony Reader, Kindle) into the market, as well as a number of annotation systems (Annotator, CiteSeer) and several bibliographic databases (EndNote, Refvis, BibRex) came with the promise of supporting academics access, read, take notes, store and retrieve of information from sources. However, these systems have not gained the popularity of word processors or search databases. The reason seems to be that in most of these systems texts are treated as static objects with clearly identifiable attributes, or *descriptive metadata*, which can be used to store, retrieve and make connections between them in presumably meaningful ways: authors' names, publication, date, subject keywords, quotes, and summaries are all static fields that are already embedded within the document and are even sometimes available for download through a library's database. Even one's notes about a source need to be modified and placed in the context of the project or the argument put forward in each case. It seems that the underlying assumptions about the nature of texts that the developers of electronic tools have would have to be examined more closely.

This rather limited view of texts and their relationship to each other, as it is evidenced by citation practices, has been challenged in the past 25 years by research and theory coming out of citation analysis, discourse analysis and rhetorical theory. In the next three sections I will present the most important articulations of these challenges to such an understanding of texts and citation practices in order to be able to move to the specifics of my own study.

Citation Analysis

In the beginning of the 1980s, the need for a theory of citation became evident in the field of citation analysis through the work of Cozzens (1981) and Cronin (1984). Blaise Cronin in his heavily cited monograph on the citation process in scientific communication (1984) acknowledged that quantities and frequency distributions do not provide an adequate understanding of the nature of citations and called for analyses of both the contexts citations are used and processes by which authors use them. Following Martyn (1965), he proposed that citation is not a unit, but an event, which is very difficult to lay bare as one would have to step into the author's head to understand the functional, social or political motivations behind a single instance of citation. These multiple motivations do not have to be in competition, however — at least not according to Cozzens (1981) who suggested that a theory of citation would be possible if the conversation shifted away from the traditional sociology of science and included people with different methodological orientations.

Discourse Analysis

A line of research that emerged from the field of discourse analysis is related to the identification of specific patterns in different genres as they emerge from corpus analyses. One such pattern is citation, which is of particular interest for this discussion. The work of Ken Hyland (1999, 2001, 2002) especially stands out here since he has analyzed citation patterns through several measures, including reporting verbs, integral/non-integral citations and self-mention. His conclusions were very interesting for the understanding of disciplinary practices, especially in terms of understanding the knowledge construction process of different groups and the epistemological and social conventions of disciplines. His analyses of self-mention in research articles (2001) also touched upon issues of authorial presence and the construction of identity in academic writing.

Using a similar method to analyze citations from corpora, Thomson and Tribble (2001) examined the difference between integral and non-integral citations in doctoral theses from agricultural economics and agricultural botany. They found differences not only between these seemingly similar disciplines, but also between levels of participation, where novice writers seemed to use a limited range of citation types. However, such studies do not provide any insight as to the reasons why or the motivation behind this limited use of citation types. On the other hand, more ethnographic approaches in the form of one or two case studies of graduate students writing (Connor & Kramer 1998) reveal only a very narrow portion of reality, mostly related to the motivation of these individual students in relation to their discipline or their advisor’s demands. Such a qualitative approach, however, has the potential to reveal a much richer picture of citation practices, especially if it is combined with a quantitative understanding of disciplinary methods.

Rhetorical Studies

Research in rhetorical studies has challenged the traditional understanding about texts as static repositories of knowledge and instead proposed seeing them as “virtual objects,” objects that do not yet exist except in the mind (Medway, 1996). Geisler (2001) argued that texts play multiple roles in the mind of writers including being a driving motive or a desirable outcome. When texts are mediated by electronic systems, the virtuality of texts becomes even more evident, so the opportunity to develop systems which will make this state transparent is enormous. However, focusing only on descriptive metadata limits to a great extent the potential for seeing them as virtual objects, creating meaningful attributes and connections between them, and eventually providing a context for the use of these sources in writing. These virtual, rhetorical objects transmit information, or *rhetorical metadata*, which can be equally or more important than descriptive metadata when academics decide which sources to use and how in their work.

This paper has a dual purpose: first it reports on the results of an ethnographic study of academics using citations in order to develop a rhetorical citation model. Then, it presents an example of the way this model can be incorporated into an electronic environment which will support the practices of both old-timers and newcomers in the academia.

Ethnographic Study

In order to arrive at a rhetorical model of citations, 16 academics from four disciplines (Computer Science, Chemical Engineering, Materials Science Engineering, and Humanities and Social Science) from a large research institute in the Northeast were recruited. They all provided access to at least two of their recently published journal articles to be analyzed for citation patterns and also agreed to a one-hour interview. Each interview included two parts: a typical source use narrative and a discourse-based interview, as it was originally developed by Odell et al. (1983). The typical source use narratives asked participants to tell the story of their reading and writing process when engaged in academic research. These narratives were meant to yield information similar to the typical use case scenarios that designers use to develop electronic systems. Immediately following this interview, they were asked to explain the decisions they had made to at least 15 instances of citation from their own writing in discourse-based interviews. After this model, participants were shown specific instances of source use from their own writing and were asked if using another pattern would have made a difference. All the interviews were then coded automatically for keywords (nouns) associated with either to descriptive or rhetorical metadata (Table 1).

Table 1: Descriptive and Rhetorical Keywords

Descriptive	Rhetorical
Note	Work (noun)
Title	Research
Author	Field
Abstract	Project
Keyword	Argument/Position
Date	Reader
Subject/Topic	Group
Quote	People

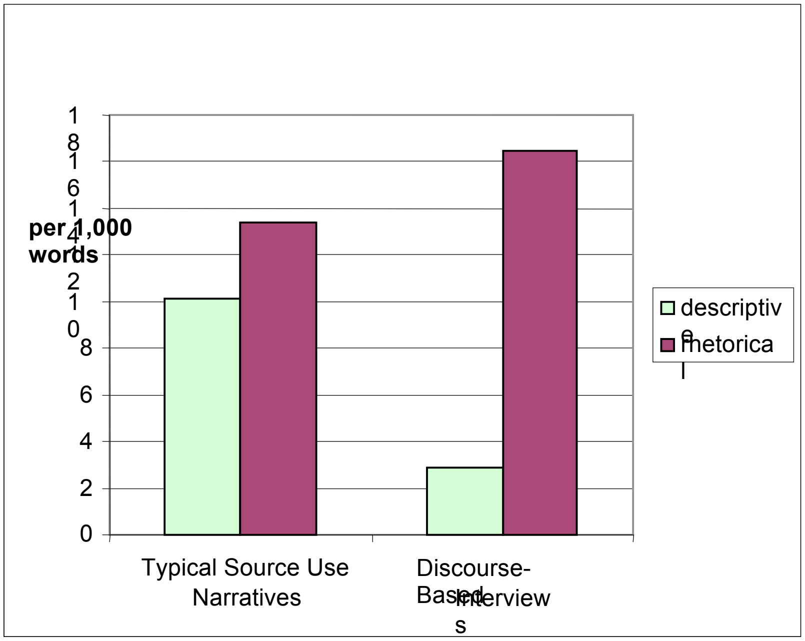
The list of the descriptive nouns was developed based on the fields that electronic systems have modeled for. For example, annotation systems focus on notes and keywords as the most important objects that the users will supposedly interact with, following narratives elicited by users about their usual strategies when reading a source. Bibliographic databases, on the other hand, focus on fields such as title or abstract, which can be downloaded very quickly from a digital library, and can become the objects of a query or search. Finally, reference visualization systems center around dates and topics in order to show the relationship between sources, often over time.

For the nouns associated with the rhetorical perspective, the assumption was that if the descriptive nouns point to a completed, objective and static view of a source, the rhetorical ones should point to the dynamic, subjective and situated perspective. In terms of an activity perspective, the source could be either at the consumption end of the spectrum (as a static object) or at the production end (as a flexible object). In between there are distribution, which divides the objects according to social laws and exchange which further parcels out the already divided shares in accord with individual needs. To capture the activity from the point of production up to the point of consumption, before the source becomes a product which steps outside the rhetorical, nouns were chosen to relate to the basic components of the activity, such as participants (people, group, reader) who do work or research in their field, and develop arguments or positions. In that sense, the rhetorical terms capture the part where a source moves from production to consumption.

The overall results from all participants pointed directly to the rhetorical nature of citation practices. In typical source use narratives, participants used 203 times words associated with descriptive metadata (a rate of 10.1 words per 1,000), while they used words associated with rhetorical metadata 269 times (13.4 words per 1,000). However, in discourse based interviews, the picture changed radically: participants used 726 words associated with rhetorical metadata (16.5 words per 1,000) whereas they used only 126 words associated with descriptive metadata (2.9 words per 1,000).

These results show that academics may be telling a different story about their use of sources when asked to reconstruct it as a narrative than when they are asked to tell the story of specific instances of the way they used sources. While in a typical source use narrative they talk about sources both as static (descriptive terms) and as dynamic (rhetorical terms) objects, in the discourse-based interviews they refer seven times more to rhetorical terms in their effort to justify their practice. This result is the first step to addressing the original assumption about the rhetorical nature of source use.

Figure 1: Overall Comparison of Interview Types



The next step in the analysis was to identify the general categories that participants used in the discourse-based interviews to explain their citation decisions. After analyzing the responses to almost 250 questions, the first pattern that became obvious was that in most instances the decisions to cite a source were directly related to the project itself in relation to the active life of the research community. Readings and consequent writings are always embedded within a context of purpose and audience, as well as a sense of the appropriate moment (or *kairos* in ancient Greek rhetoric) for the field or discipline.

Beyond the dimension of appropriate time, participants identified a big number of critical elements which compelled them to cite sources in their work. As an example, one participant described a decision to include a source like this:

> *I think in my field this is probably a fairly well-known statement by now, but you're almost referencing a source because of people like [my co-author] who look at the optimization side of things and aren't going to know this . . .*

Such a statement shows that a consideration for the audience's level of knowledge about the topic was very important, especially since this was interdisciplinary work. If this particular concern was repeated in several of the participants' responses, then I was able to formulate a general evaluative statement of the type: "This source is a good introduction to the problem for new readers/participants."

After combining all the discrete statements developed from the participants' responses, three general categories emerged, which corresponded well with the results of previous research:

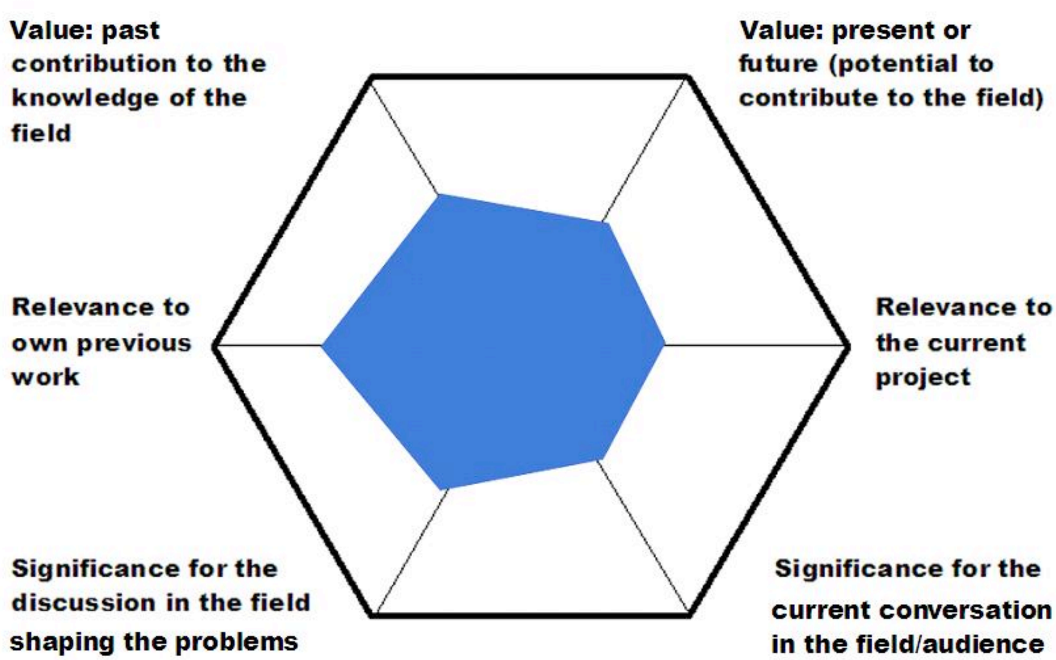
- value (contribution to the knowledge of the field)
- relevance (topical relation to the current argument/project)
- significance (role in shaping the problem for the audience /field)

All these statements in the three categories could then be modeled into an electronic system which would provide not only the descriptive dimension of a source, but also its rhetorical one. In the next section I will present *Kairion*, which stands for "the appropriate, critical" either moment in time or rhetorical consideration of value, relevance or significance which determines when and how a source will be used.

Development of *Kairion*

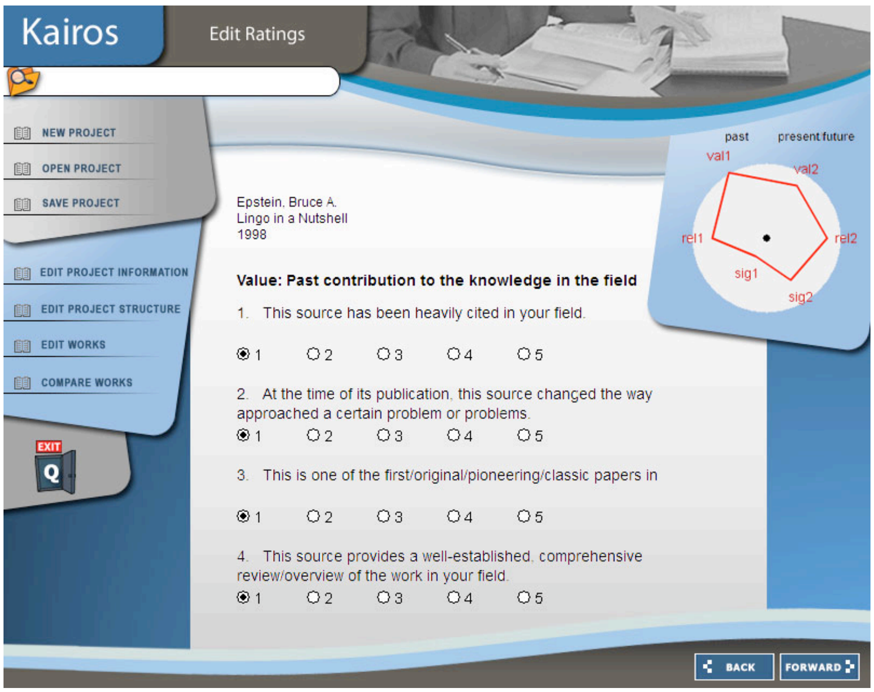
These three general categories were utilized to show an aggregate of the ratings, instead of individual data points. This way the schematic of a hexagon would be developed if the source received the full rating for all the questions in all the categories, since there are three categories presented in the dimensions of present and past time. In the following figure (Figure 2) the way the visualization was conceptualized is presented. Both the dimension of time and the three categories can be shown as data points on the hexagon.

Figure 2



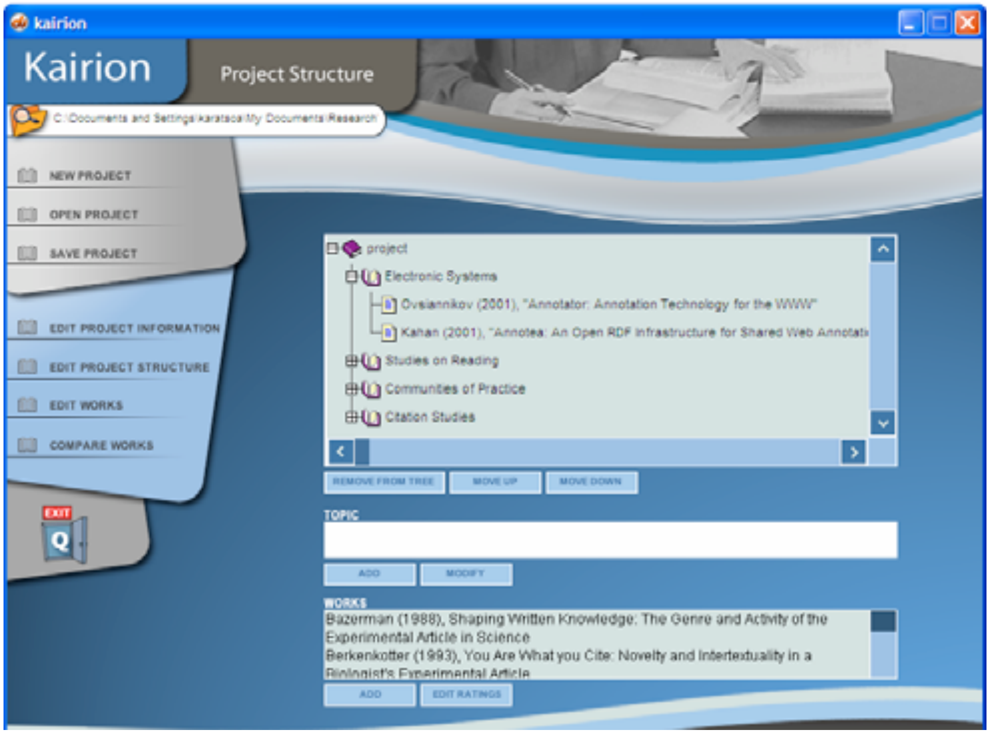
This basic model was then developed into an application where the where the user, after inputting the descriptive metadata of the source, is asked to rate it (1–5) according to the questions associated with each category. There are only four questions for each dimension of the category, for a total of 24 questions. Figure 3 shows the ratings view of the application.

Figure 3: Ratings



Using Macromedia Director and Flash technology, the hexagon on the upper right-hand corner is constructed as the user is rating the source. This visualization can then be used as a guideline as to what where and why a citation fits in the overall structure of the document or the specific argument the author is making. However, precisely because this information is difficult to recapture at a later time without going through all the visualizations of all the sources again, another view showing the works within the project structure is available (Figure 4). In this view, users can easily connect a certain type of source to their project's outline, for example connect all sources with a high past value (the "classic" sources in the field) to the background section of the document.

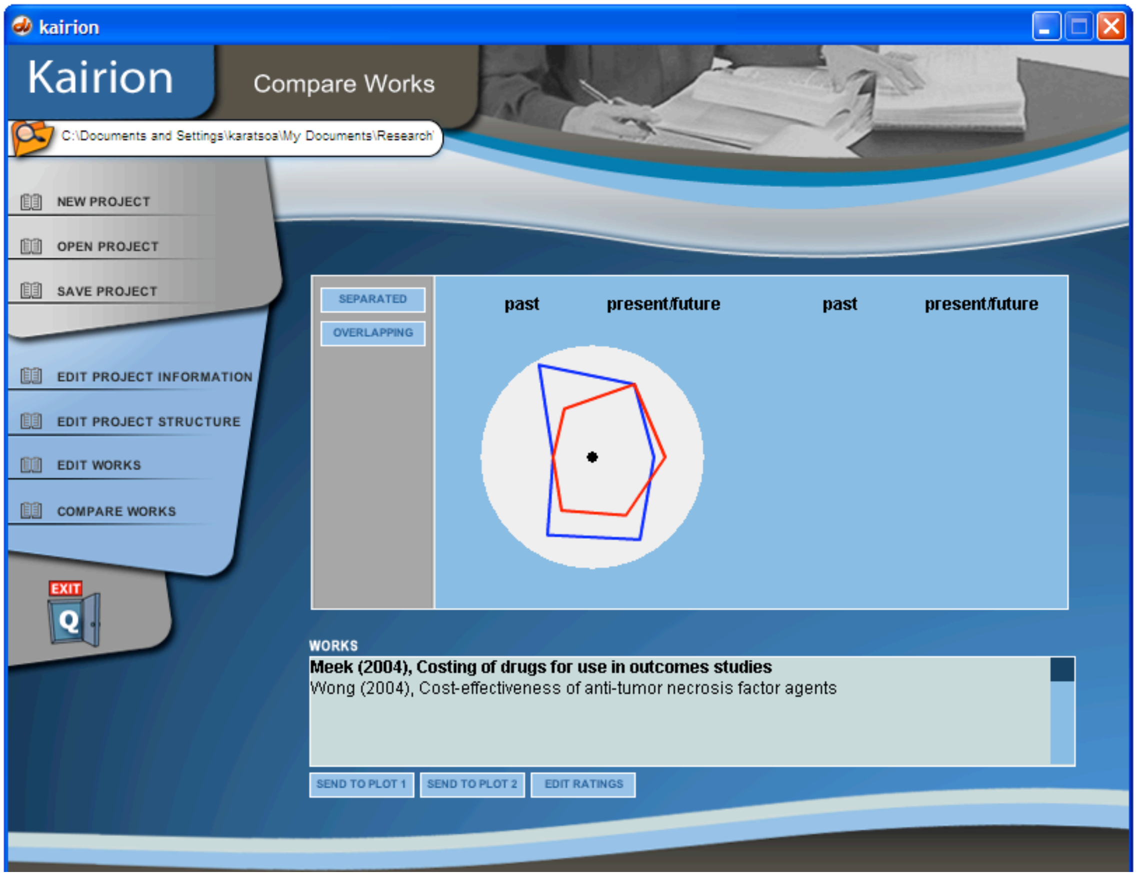
Figure 4



Finally, because very often comparisons between sources can be very useful in determining their relative importance for one of the categories, another view where two visualizations appear either separated or overlapping is available. This view can also show the differences between two readings of the same source, perhaps from an advisor/student pair, or by the same individual for two different projects.

The design and development of *Kairion*, which took much longer than the space it occupies in this brief paper, is meant to provide designers of electronic systems with a way to imagine how rhetorical metadata can be presented. In fact, this use of an interactive visual representation of abstract, non-physically based data to amplify cognition is precisely the definition of an information visualization system, in which the density of useful information must be emphasized (Tufte, 1983). This is exactly the purpose of *Kairion*: to provide academic researchers with a way to visualize, record and share the information which is most useful when working with sources. And this information is certainly not the objective, descriptive metadata that current electronic systems have focused on.

Figure 5



Conclusion

Kairion is only an example of an electronic system which attempts to visualize the rhetorical dimension of sources so that academic practitioners can make more effective decisions about the sources they will use and the way they will use them. Still in prototype phase, K*airion* would have to be introduced to users and its use has to be analyzed for the duration of a project in order to arrive at conclusions about the accuracy of the three categories and the dimension of time. An item analysis of the individual questions will also have to be performed, ideally with users from different disciplines and stages in their academic career.

The implications of such a system for individual practices are obvious, as academics very often reuse sources for multiple projects or multiple documents coming out of one project. However, for groups of researchers, a common database of rhetorical metadata where the "readings" of the different group members would be transparent has important advantages.

Finally, *Kairion* and similar systems can serve as learning environments where peripheral participants in a field will be able to see in a transparent way how full participants understand the role of a source for their work and for the field. This way, such electronic systems can serve not simply as repositories of information, but as flexible objects aimed at supporting real practices.

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SUPPORTING USER PARTICIPATION IN DEVELOPING MOBILE TECHNOLOGY TO HELP YOUNG PEOPLE'S WITH AUTISM: THE HANDS SMARTPHONE PROJECT

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Abstract
Located within the field of the development of mobile technology, the HANDS project aims to develop software to support the social and self-management skills of children with autism. As part of the HANDS project 10 young people were interviewed during the specification stage. This paper explores the methodological aspects of involving young people with autism spectrum disorders in research and argues that consulting children at the earlier stages of research can be a valid contribution to software development.

The HANDS Project: Developing a Customizable Mobile Software Solution for Young People with Autism

This paper examines methodological and practical questions related to consulting children with autism spectrum disorders (ASD) in the design and evaluation of technology developed to help them to be socially integrated. The consultation took place as part of the three-year HANDS (Helping Autism/Diagnosed to Navigate and Develop Socially) project. Formulated as a European Commission (EC) Cordis research programme 'FP7.7.22d. Challenge 7: ICT for Independent Living and Inclusion' as part of the Accessible and Inclusive ICT section of the framework.[1] Based on the multidisciplinary integration of knowledge and research in Persuasive Design (Aalborg University, Denmark), cognitive psychology (ELTE University, Hungary) and pedagogical practice (London South Bank University, LSBU, UK), the new software mobile solution aims to help the children develop the social and self-management skills they need to cope and succeed in situations that they find problematic and difficult. The project development cycle includes the following phases:

1. Specification of Functionality for Prototype 1
2. Development of Prototype 1
3. Implementation and Evaluation of Prototype 1, feeding in to:
4. Specification of Functionality for Prototype 2
5. Development of Prototype 2
6. Implementation and Evaluation of Prototype 2
7. Review and Dissemination

The innovative HANDS toolset solution integrates already existing smartphone functionalities with six new ones:

1. *The Handy Interactive Persuasive Diary (HIPD).* An interactive calendar function with the usual calendar facilities, but also with configurable/ programmable abilities and "knowledge" about situations, where the user is more likely to be persuaded to adopt a new behaviour or attitude. It is based on the concept of Kairos.

2. *The Simple-Safe-Success Instructor (SSSI).* An instructor function, which gives precise and practical advice on how to solve a problem.

3. *The Personal Trainer (TT).* A training function that simulates a problematic situations.

4. *The Individualiser (TIn).* An aesthetic customisation function.

5. *The Sharing Point (SPo).* A facility that makes it possible for the teenagers with ASD to share their knowledge, experiences and interests with other users.

6. *The Credibility-o-Meter (CoMe).* A facility to measure to what extent the HANDS toolset is experienced as being credible by the user. The measurement is mainly based on the electronic footprints left by the user on the mobile device during normal use.

Individually and together, the five functionalities allow for a customised response to the difficulties children with ASD might have. While the use of the technology is innovative, the devise of activities using the functionalities relies on existing pedagogical approaches such as TEACCH (Treatment and Education of Autistic and related Communication-handicapped Children) and PECS (Picture Exchange Communication System).

Central to the project is the notion of Persuasive Design, or, according to Fogg (2003), the use of persuasion to develop computer software whose aim is that of changing behaviours or attitudes. When applied to technology, persuasive design aims to develop software for mobile technology that is interactive, responsive, meaningful and credible. The successful persuasive outcome depends on the level of customisation and individualisation of the software potential with what the child requires, needs, or desires together with the use of microsuasion, suggestion, tunnelling, reduction, tailoring, self-monitoring, praise, virtual rewards, conditioning and surveillance.

Two further notions are pivotal in the development of persuasive technology. The first is the notion of Kairos, or the principle of presenting your message at the opportune moment. The second is the notion of intrinsic and extrinsic motivation. In either case, the development of persuasive technology requires the integration of expert academic knowledge, pedagogical practical knowledge, and the knowledge parents have of their children strength and difficulties. Most importantly, gaining an understanding of what motivates children requires rethinking the role of children from ‘testers’ of the product to consultants.

This paper focuses on the initial interviews for ‘Specification of Functionality for Prototype 1’ phase of software development, which were carried out by researchers at the London South Bank University during September and October 2008. The semi-structured interviews sought the views of five teachers, care support workers, ten parents and their children at a special school for children with ASD in England. Particular attention was given to gaining the children’s views on how the technology could have helped them and what would motivate them to use it. The paper argues that listening to the children has the potential of developing software that is meaningful to adults and children alike, but that it also offers the potential for the school to reflect on their practice and provision as a consequence of involving the children in the consultation. The paper concludes with reflection and lesson learned which might be applied to other similar situations

Mobile Technology in the Classroom: Technology and Children with ASD

London South Bank University contribution to the project is related to how the new technology would be applicable to the learning environment in relation to how it will fit into already existing practices, and also to how the use of the technology will improve children’s wellbeing and the provision made available to support them. LSBU focus is located in the increased interest in the use of mobile technology — PDAs devices, laptops, notebooks, tablet PCs, and mobile phones — in the classroom. The rationale for developing mobile technology for children with ASD lies in a number of the technology positive features, such as its portability (Perry, 2003), mobility, connectivity and customization (van’t Hooft, 2008), and social interactivity and context sensitivity (Naismith et al., 2004).

The use of ICT and technology in the field of special and inclusive education has a relatively long history, but lacking a conclusive understanding of how best to apply the technology in the learning environment. If, as Florian (2004) suggests, ICT can be a tool for tutoring, exploration, assistance, communication, assessment, and data management, pedagogical decisions on how to use the technology are, however, informed by a number of other factors such as the degree of disability

(Lewis & Norwich, 2005). Davis and Florian (2004) and subsequently Dee, Devecchi and Florian (2006), on the other hand, argue that teachers' decisions are the result of an informed combination of teaching strategies, previous experience and qualifications, personal and social attitudes towards disability, and an assessment of children's needs and potential.

Despite the increase in the number of children diagnosed with ASD, research on how technology can help them to become socially more integrated is still developing, while their involvement in research is still lagging behind. This is partly due to the fact that the atypical development of children with ASD is reflected in a triad of impairments in:

- reciprocal social interactions and socialisation;
- reciprocal communication (both verbal and non-verbal); and,
- inflexible organisation of behaviour and interests (repetitive and stereotypic activities, restricted and stereotypic interest)

(Wing & Gould, 1979).

All three impairments not only limit the quality of the child social inclusion, but they also create a set of methodological challenges in the process of consultation. Furthermore, while the triad of impairment is to some extent common to all individuals with ASD, each individual varies greatly both in degree and kind of specific impairment. The use of technology, however, has been generally successful mainly because technology:

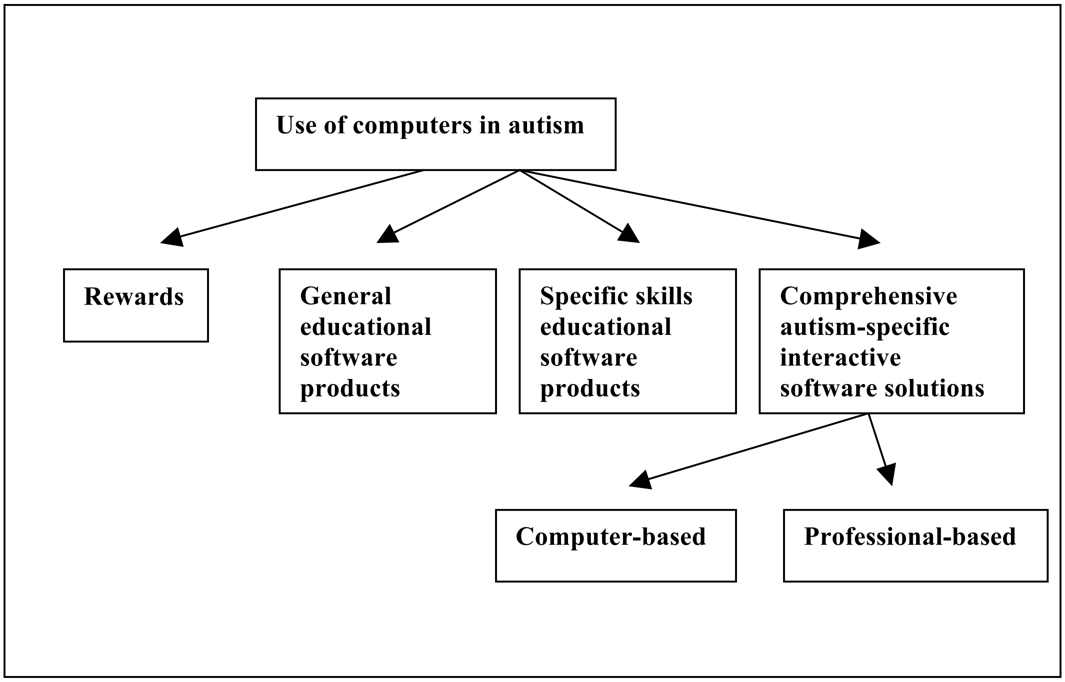
- works in a consistent and predictable way;
- provides a comfortable and rewarding environment;
- raises less social demands;
- allows the learner to control the pace of learning;
- allows for mastery learning through repetition;
- is a visually-based medium; and,
- is culturally accepted

(Gyori et al., 2008)

The HANDS project, with its collaborative and user engagement features, is an innovative approach to the field of technology and autism. This is because research in this area has been generally directed at knowing more about the nature of autistic difficulties, and in developing therapeutic solutions. In the first case, research within psychology is undertaken in the hope that this will lead to greater understanding of what strategies will be effective, and in the further development of the three main theories. The three main explanatory theories being namely Theory of Mind (Baron-Cohen, 1995), theory of Weak Central Coherence (Frith & Happe, 1994), and the theory of executive functioning (Ozonoff et al., 1991).

In the second instance, a helpful approach to map how technology has been used in relation to teaching and assisting children with ASD can be found in Gyori et al.'s "taxonomy for ICT tools in ASD intervention" (2008, p. 31) (see Figure 1).

Figure1: Taxonomy for ICT Tools in ASD Intervention



Because of the strong influence of the clinical psychology perspective, much of the research is based on randomised clinical trials (RCT), although questions have been raised about the need to involve practitioners in the research (Jordan, 1999), and there has been a call for more qualitative and naturalistic-based studies (Williams, 2006).

The HANDS project capitalizes on the mobile technology potential benefits of increasing motivation and facilitating communication and social interaction since these are some of the major obstacles to social inclusion for children with ASD. Mindful of the fact that the difference technology makes is closely related to how the use of the technology is planned and structured within the lesson; how teachers are trained and supported; and the technical support and resources available in the school (Higgins, 2008), the HANDS project has been framed as a collaborative effort. In this sense, the notion of 'user engagement' has been reformulated from one that entails consultation with the end-users of the technology at the evaluation stage, to one of participation in the development of the technological product. Moreover, the LSBU team were explicit that the notion of user in relation to a school-based project such as this must include the young people who will actually be using the software. In the end, teachers in four special schools in Denmark, Sweden, England and Hungary participated in the Specification and Functionalities Requirement phase. Parents, teaching assistants, and children were also interviewed in the school in England.

Consulting Children with ASD: Some Key Points

It is interesting to note, as Robertson (2009) suggests, that there is in the literature very little, if any, consideration the importance and challenges of consultation or student voice specifically in relation to children with autism. A review of the literature using the PsycInfo and Education Research Complete electronic indices indicated no direct references to articles on the topic from 1985 to the present. As such, this paper represents a useful contribution in that it reports on an actual example of consultation with children with autism in relation to a development directly related to learning and teaching.

Seeking the views of the children was pivotal for a number of reasons. First, because the children, being the ultimate users, are in the best position to give valuable ideas on the quality and usefulness of the educational provision they receive (Bragg, 2007; Rudduck & McIntyre 2007). Second, as Inman (2003) indicates, when consulting pupils is linked to a whole school approach, it can act as an effective democratic vehicle for valuing and responding to student voice. Third, consulting children with special educational needs is a statutory requirement as set out in the SEN Code of Practice (DfES, 2001).

To these we need to add that in the case of children with ASD their participation in the process of consultation can also be a way in which their social and communicative skills can be supported and developed. It is however important, as Fielding (2001) suggests, to avoid making their participation a tokenistic gesture. This implies the need to take what children say, and suggest seriously. In seeking their views we should also be mindful, as Arnot and Reay (2007) suggest, of the already existing power relations between adults and children and the way in which pedagogical discourse and classification of disability discourses shape the communicative and social interaction (Christensen & James, 2000; Corbett, 1996; Florian & McLaughlin, 2008).

Consulting children in general and consulting children with learning disabilities in particular is a challenging and complex activity. As Lewis and Linsday (2000) warn the pursuit of collecting valid, reliable and authentic data requires us to keep at least two aspects into consideration. The first relates to the need of facilitating both understanding and communication while the second relates to establishing conditions that are neither harmful nor overpowering for the child (Alderson & Morrow, 2004).

Researchers at LSBU approached the task of consulting the children in four stages. Mindful of the difficulties children with ASD have in social and communication interaction, two researchers spent time familiarizing with the school and the children by conducting informal observations. These included classroom observations, but also joining the children during lunch, during break time activities, or by accompanying those who stayed at the residential unit during outings and shopping, or by simply being around in the school. Second, we gathered information from the teachers about each individual child's strengths and difficulties, likes and dislikes, and how best to speak to them. Third, we interviewed the parents so as to develop an understanding of what the child wanted to be able to achieve and how the smartphone technology could have helped them. In minimizing discomfort or anxiety, prior to the interview, which took place with their teachers present and after consent was obtained from both the parents and the children, we used visual means to explain to the children what the research project was about and we allowed the children time to ask questions and interact with the researcher. The interviews lasted around 30 minutes and took place in a room in the school the children felt comfortable in.

During the interview we sought to gain an understanding of the child's knowledge and ability of using technology (that is computers, games, mobile phones or the Internet), and of what the child deemed to be their strengths and difficulties. The main part of the interview focused on gaining from the child an understanding of what he[1] thought the use of the phone could have helped them with. At the basis of this idea was a person-centred approach to the planning of provision for children with learning difficulties and disabilities (Dee, 2006). Such an approach stresses the importance of considering how through supporting the child's agency and self-determination teachers, parents and other adult can help the child achieve what he views as important for him. This approach involves to enabling the child not only to see the difficulties in achieving the outcome, but also in presenting possible ways the group can help. Involving the children in this way enabled us to gather important data on what the children thought the phone could be useful for. The data collected were then used to write user stories that the software developers could use during the development stage.

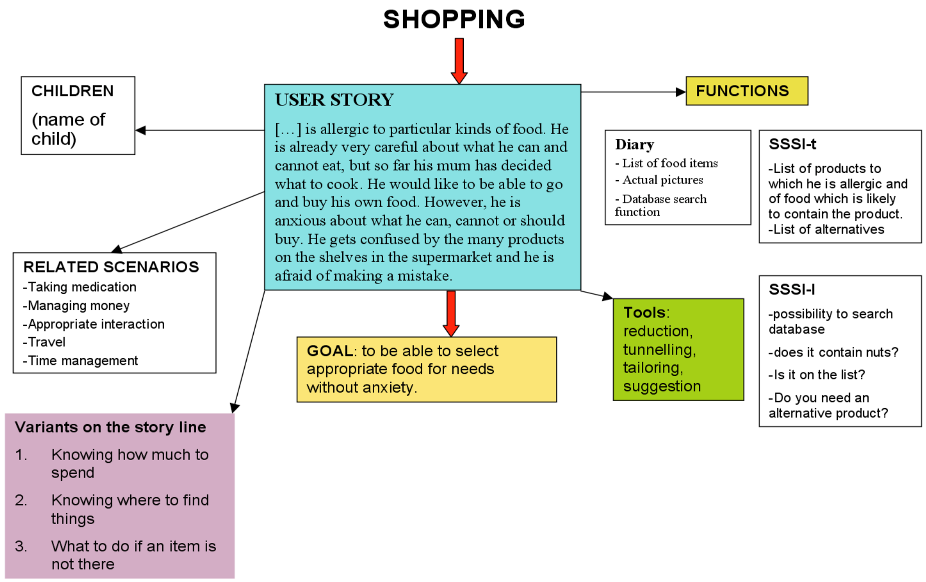
How the Children say Mobile Technology can Help Them

Content analysis was used to draw a map of what the young people saw as the main areas of difficulty and how they though the technology could help them. Analytical categories were drawn from the literature on social, communication and living skills and more specifically from cognitive psychological tests such as VINELAND, an Adaptive Behavior Profiles in Children with Autism and Moderate to Severe Developmental Delay, or SRS (Social Responsiveness Scale), or in teaching programmes and qualifications such as those provided by ASDAN, an educational charity, whose purpose is to promote the personal and social development of learners through the achievement of ASDAN awards, so as to enhance their self-esteem, their aspirations and their contribution to their community. We also looked at what practices and skills were taught and encouraged in the school. We came to the conclusion that while the literature afforded an extensive array of possible categories to choose from, none was individually helpful. This was mainly due to the fact that while the literature focuses on specific skills as units of behaviour, the objective the children wanted to achieve involved a number of integrated social skills. We therefore took a bottom up approach and let the language of the children and of the teacher portray the nature of the activities and skills involved. In the final analysis we grouped the activities in a list that included:

- managing money
- preparing for difficult situations
- understanding and managing time
- emotions and appropriate reactions
- organisation within and beyond school
- health and hygiene
- food preparation
- travel
- shopping

One significant case was chosen as exemplary for specification and functionalities purposes of each category. Below, we report the example from the ‘shopping’ category.

Figure 2: Example of User Story for Software Development Specifications



In writing the template or user story for each category we paid attention in remaining as close as possible to the child's intention. So the user story panel above reports what the child described as the activity he wanted to be able to do, what he found difficult or problematic or challenging. The goal section listed the skills and aims of the activity. These were drawn from a comparison between the teachers', the parents' and the children's interview responses and formed a summative assessment of the child's needs. The sections on the right listed how each phone functionality could have helped the child to achieve the desired outcome, while the sections on the left showed how the activity, in this case shopping, was related to other activities and scenarios chosen by other children in the group.

Lessons Learnt

The analysis of the interviews with the children, teachers and parents yielded a sizeable number of user stories. On average each child gave around two or three examples of how the phone could have helped. However, the main benefits of consulting the children were not limited to the range of stories we could have used to instruct the software developers. This final section reviews what we have learnt during the Specification of the phone functionalities phase of the research. We believe that such lessons are valuable examples of how productive involving children and children with learning difficulties in research can be.

The paper started by arguing that much of the software and technology development available for pedagogical goals is still developed outside schools. This means that user engagement, that is the involvement of teachers and children, is at best left to the stage of evaluation. This then usually focuses on the impact of technology on learning by evaluating progress in terms of measurable learning outcomes, i.e. grades or scores on cognitive tests. While, other more formative and participatory approaches to evaluation are developing, the phase of software development is still detached from working closely with those who would benefit most from the technology. In addressing these limitations, the HANDS project team at London South Bank University took a more participatory approach from the very initial stages of software development. While we cannot at this stage comment on how the software solution will work, we can, however, reflect on the lessons learnt.

From a methodological point of view, consulting children on matters related to their wellbeing and learning — listening to the student voice — is a now accepted as a valuable and important part of decision making in education. In regard to consulting children with learning difficulties, there still remains a general skeptical attitude in their abilities to offer authentic, valid and reliable suggestions. In the case of children with autism, the triad of impairment with which the disorder is characterized still shapes the perception of these children as being unable to hold a conversation, interact with others, and generally finding it difficult to make decisions. Yet, the research shows that to various degrees of interaction all the ten children were able and willing to interact, participate and forward valuable ideas and suggestions. Despite some initial concerns that the children would have suggested impossible activities or activities that were outside their abilities and reach, the children not only chose activities that were justifiable and achievable, but also showed the ability to reflect, examine and find possible solution to what they found difficult. They showed, to different degrees of complexity, sense of imagination and the ability to plan. While these might seem common sense and reasonable features of typical children, we need to consider them within the parameters by which children with autism are judged.

Conclusion

It needs to be pointed out that despite showing such positive features involving the children in the interviews required a great deal of care, understanding, and adaptation. This points to the fact that giving children a voice is not a straightforward matter. Rather it requires imagination, creativity, empathy and responsiveness on the part of the researchers. From the conceptual point of view, the task of analyzing the children's stories and examples, made us reflect on how social and living skills are classified, how they are ranked by adults and children, and how relevant they are to the practice of enabling children with autism to become included in society. From the point of view of pedagogical software development, we envisage that supporting children to achieve targets that they choose as relevant and meaningful will greatly benefit the research at the stage of implementation.

Footnote
[1] Grant number: 224216

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DESIGNING INTEGRATED ONLINE EXERCISES FOR ADVANCED SECOND-LANGUAGE USERS OF ENGLISH TO PRACTISE SUMMARISING TECHNICAL SUBJECT CONTENT

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Abstract

Effective summarising is not intuitive: it requires practising specifically-taught skills in an integrated process of reading, comprehending, note-taking, planning and writing (Johns 1988; Juan & Palmer 1998). For advanced EFL English students successfully to integrate these skills, detailed and nuanced online auto-feedback would be very useful, using a mixed collection of the auto-summarising technology that has been developed over the past decade (Endres-Niggemeyer 2000; Franzke & Streeter 2006; Sparck Jones 2007). Preliminary design thoughts are offered here, following diagnostic findings on difficulties faced by advanced EFL students in reading comprehension prior to summarising.

Purpose/Objective

To design integrated online tools with flexible, detailed, individual feedback for advanced EFL/ESL students' independent practice in summarising non-literary and technical-content materials.

Definition

For any use which avoids plagiarism, a summary is a much-shortened version of the original text which expresses all key ideas in different words using more efficient syntax within a given word limit.

Introduction

As Johns (1988) noted, ESL students need explicit, detailed instructions rather than general rules *and* practice in each step of the process if they are to master summarising. She linked the ability of ESL students adequately to summarise a reading text to its prior micro-evaluation. However, Juan and Palmer (1998) established that providing a set of

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[1] My thanks go to Dr Victor Chan for expert technical advice on this paper.

general rules did enable upper-intermediate EFL users to produce more effective summaries than advanced EFL users lacking any guidance who merely plagiarised. Sporer et al. (in press, p. 1) recommend 'explicit' cognitive and meta-cognitive strategy,[2] including questioning and summarising, as part of teaching reading comprehension: their findings suggest bi-directional rather than unidirectional links between understanding content and being able to summarise it.

The English Language Teaching Problem

English language teaching generally encourages the use of more rather than fewer words and rarely teaches the details of how, exactly, to summarise. The only summary skills specifically taught in the three levels of the *Market Leader* series used by MPI's School of Business *prior to* the final year are news headlines (Cotton, 2006, p. 112). Nor are the techniques of summarising usually explained in textbooks designed to improve Chinese students' reading and writing skills (e.g. Li, 2007). The basic rules of summarising are more likely to be explained in communication textbooks (e.g. Bovee & Thill, 2008).

Moreover, in different writing genres (especially journalism and news reports but also technical writing), in-text referencing, connectives and other linkages, text organisation, sentence and paragraph structures are often used very differently from the literary techniques taught in EFL courses, causing difficulty in understanding what is read. As Nuttall (2000) emphasises:

> The reading skill is of no practical use unless it enables us to read texts we actually require for some real life purpose . . . to discern relationships between the various parts of a longer text, the contribution made by each to the plot or argument, the accumulating evidence of a writer's point of view, and so on. (pp. 31, 39)

Finally, even where the individual elements used in summarising are taught, precisely *how* to use them may not be, nor are they often integrated as sequential parts of the overall process of summarising. So, for example, MPI's School of Business upper intermediate EFL students do get significant practice in some skills related to the summarising process: e.g., matching different expressions with similar meanings, vocabulary substitution, matching summary headings to paragraph

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[2] Based on the DIME model linking "background knowledge, vocabulary, word reading, reading strategies and inference" (Sporer et al., in press, p. 2)

contents. But these separately-taught skills are not related to one another as parts of an overall process.

It is not clear why EFL/ESL teaching English has not yet taken on board Johns' (1988) findings, but is perhaps related to allowing students to acquire summarising skills by individual effort. Foster (2003) noted how important it is to teach such skills specifically to Chinese students, who are sometimes depicted as insufficiently independent learners.

MPI Requirements

MPI's School of Business requires all final-year degree students, in small groups, to undertake research, write up, and present their Graduate Research Report orally, in hardcopy and softcopy. Probably because effective summarising skills were not included anywhere in the syllabi, past report writing used extensive copy-and-paste techniques. However, from 2009, the softcopy must be passed by *Turnitin.com* for the degree to be awarded. Our EFL degree candidates obviously must first understand read content clearly in order to be able to summarise it.

Research Subjects

The Bachelor of Accounting and Finance (BAF),[3] introduced in 2007, splits English reading and writing in the first semester from listening and speaking in the second, both skill pairs focusing on summarising. All BAF students have obtained higher diplomas in the medium of English rather than Chinese, with linguistic competence varying from bare pass to A grades, but all lack summarising skills.

Teaching preparation. BAF classes start with a PowerPoint which defines summarising, differentiates it from paraphrasing, and deals comprehensively with technique details, but students still have difficulty using these techniques[4] despite repeated practice[5] in the first seven weeks of the semester. By mid-semester most still try to read and then write directly, partly because they see step-by-step reading, note-taking and drafting process as inefficient: some absent themselves from in-class

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[3] The BAF differs from both the Bachelor of e-Commerce, where no English is taught, and the Bachelor of Management, where a skills-integrated course in Advanced-level English is taught for only one semester and students are briefly and passively exposed to model summaries of different kinds (Dubicka & O'Keeffe, 2006, pp. 35, 50, 80, 108–9).

[4] Wilkinson (2008, p. 1) confirms that "Even when models are provided, they [ESL students] don't know how to begin."

[5] 10 reading comprehension tasks penned in a variety of styles and five summary-writing exercises.

drafting. How far they have made up their initial skill deficit in summarising is assessed in the mid-term examination.

Advanced EFL Students' Problems with Reading Comprehension in Preparation for Summarising: Diagnosis

Exactly the same mid-term examination was used in two consecutive years.[6] The exam comprised two parts: a reading comprehension test based on a specialist text written (by a practising executive auditor) for a financial newspaper and edited in journalistic style with very short paragraphs; followed by a word-limited written summary of its content (not considered here).

Hypotheses

Two multiple-choice questions tested specifically-hypothesised problems in reading and comprehending the text: the first cognitive and less difficult, the second meta-cognitive and much more difficult.

- Advanced EFL students may have difficulty in recognising extensive vocabulary substitution when answering reading comprehension questions summarising three points in two separate but linked paragraphs (Q6);

- Advanced EFL students may struggle to identify an overall 'big picture' argument composed of different strands not explicitly numbered nor following literary listing conventions while including many sub-points and examples often but not systematically separated into individual paragraphs (Q12).

Testing

Question 6 summarised two consecutive paragraphs from the original by offering five possible answers. Three significantly-rephrased options covered the three individual points; the correct answer was 'All of the above'; and a distractor ('None of the above') was included. No examinees fell for the distractor, but 28% went for only one of the three individual points despite the usual attractions of 'All of the above' as a default option.

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[6] The first set of students had exited English classes before the second set entered.

Question 12 tested the student's overall understanding of the article's argument and its main points; and, if answered correctly, provided one possible framework for the written summary as the second part of the examination. The first (and correct) option[7] was an overall one-sentence summary, not presented last as a familiar 'All of the above' option. Each of the subsequent options covered one main point in the argument, summarising a number of different paragraphs using key words from the original.

Findings

Table 1: Responses to Question 6

Q6√	Q6x	Total
28	11	39

The 11 incorrect selections for Q6 were evenly distributed (three and four) over the three options.

Table 2: Responses to Question 12

Q12√	Q12x	Total
13	26	39

Only one-third, overall, answered Q12 correctly, compared to 72% for Q6,[8] suggesting that by mid-term most had expanded their vocabulary sufficiently to cope with a question in which a standard paragraph linker was used, but still could not identify an over-arching (meta-cognitive) answer delinked from original vocabulary. The 26 incorrect answers to Q12 were highly skewed even though all four options used key concept words from the text itself: 17 chose the third individual point, which superficially might perhaps have seemed most directly related to the title of the article; seven chose the first; two the second; and none the fourth, which appeared in the final paragraph.

[7] This ordering of the answer options may have been new to the students.

[8] Although the proportion of correct answers rose from 25% among the first class to over 35% in the second class, the numbers were too small for this rise to be statistically significant.

Table 3: Combined Responses to Questions 6 and 12

Year	Q6x Q12x	Q6√ Q12x	Q6x Q12√	Q6√ Q12√
Total	6	20	*5	8
Total as %	15.4	51.3	12.8	20.5
Ave RC	12.2	13.3	10.2	15.1
RC range	9-14	9-18	8-14	10-17

Although not statistically significant (phi = -0.16), the general trend was for most students (51.3%) to answer Q6 correctly but not Q12. Only eight (20.5%) got both correct,[9] hinting at a progressive sequence which would start with the 15.4% who answered both questions incorrectly but in fact passed the mid-term exam quite comfortably, with marks ranging from 62-86%, suggesting that they had specific problems with vocabulary and summarising skills but were not weak overall.

But one combination does not fit into such a sequence: the five (12.8%) who answered the more difficult Q12 correctly, but got the easier Q6 wrong. Their average mark for the reading comprehension section was 51%, compared to 67% among those getting Q6 right but Q12 wrong (also the average for all students), and 76% among those who got both answers correct. Three of these five students were among the five[10] who failed their mid-term exam, suggesting strongly that their correct answers to Q12 were probably randomly chosen or, perhaps, deduced from the way the answers to Q12 were sequenced.[11] The real sequencing, therefore, is shown in Diagram 1 below, and starts with those who missed Q6 but got Q12 right.

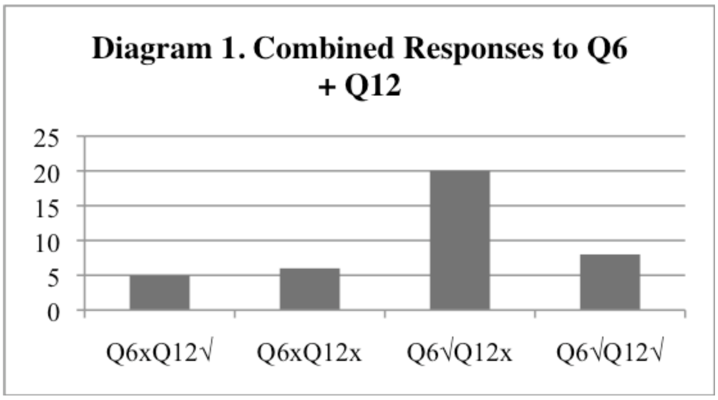
The improvement year-on-year in answering Q6, together with the students' continuing difficulty with Q12, suggests that more attention needs to be paid to the use of condensing language in understanding the 'big pictures' described in written texts. Grasping 'big pictures' may require undoing previously-taught techniques which link the understanding of overall content to specific cues such as connectors/ conjunctives, location, and paragraphing (especially of minor related

[9] Two of the eight students who answered both Q6 and Q12 correctly both had quite low overall mid-term results (64%, 58%), but advanced their final exam marks to 76% and 83% respectively, by significantly improving their final exam reading comprehension marks (50-76% and 75-90% respectively).

[10] Of the five who failed, three failed the reading comprehension section overall, including two of those who passed Q12 but failed Q6.

[11] The only other two who failed the exam overall answered Q6 correctly but not Q12.

points and examples in journalists' writing); plus understanding that authors may deliberately break grammatical rules to emphasise, attract attention, or stand out from 'normal' writing styles. Practice would be most efficient individually online.



Current Online Resources to Practise Summarising

While summarising skills may not have been taught adequately in the past, today universities have vastly expanded their proportionate intake from age cohorts and many websites teach native-speaking high school and university students how to summarise,[12] in addition to those preparing foreigners for TOEFL, IELTS and other English examinations. However, most provide only general rules for summarising and none that I have viewed offer practice in summarising texts on specialist or technical subjects written in non-literary, non-academic genres. Having attempted to summarise general-interest English texts written in standard styles, users are then invited to 'compare' their own attempts with 'model answers'[13] as 'feedback'.

Inadequacy of Current Approaches

As Endres-Niggemeier noted of SimSum (Simulation of Summarizing) which she helped develop and tested in her own introductory content analysis IT class, an effective online "tutorial system for teaching summarization to students" requires more guidance than Simsum offers, in "mixed-initiative dialogue with the students that includes short range feedback, acknowledging or refusing possibly every individual answer, and giving reasons" (2000, pp. 677–79). This level of detailed feedback is exactly what is needed for students trying to acquire summarising

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[12] Including the BBC's Skillswise *Summarising* and innumerable university websites in Australia, the USA, and the UK.

[13] Apart from the problem that one person's model answer is another's source of laughter, EFL students may be tempted to memorise those idealised as 'models'.

skills as well as IT students trying to develop search-and-delivery tools based on abstracting (and perhaps editing) information in order to summarise it.

Feedback Requirements

Even Summary Street®[14] with its KAT engine based on Semantic Language Analysis (Franzke & Streeter, 2006) which gives more detailed but only quantitative 'big picture' feedback and does not offer flexible and detailed feedback on a myriad of individual points such as vocabulary options or the use of differentially-efficient grammatical and sentence structures. If students, especially EFL students, are to develop both summarising skills and their own individual writing styles, they need nuanced feedback on their experimental writing.

What Should Online Summarising Involve?

What is needed is to design online delivery for advanced EFL students to practise sequentially the individual steps in summarising technical content accurately, and to receive useful detailed feedback on each individual step as well as the final product. First, it is vital to identify each step in summarising in order to design and choose the most appropriate design and programming strategies. Each required skill analysed below is shown in Diagram 2.

Reading

Two different types of reading skill are used, both of which can be time-limited online.

- Quick **skimming** to grasp the 'big picture' requires the reader to identify the main point(s) in limited time. This meta-cognitive understanding is then saved in a written, one-sentence condensation of what the text is about, *using original-text language* (abstracting technology could be used for feedback).
- The text is then re-presented for **detailed reading** and comprehension. Users could be encouraged to estimate and preset a personal time limit as an efficiency target, but fixing time limits externally would ignore varying individual needs.

[14] http://www.pearsonkt.com/papers/Sst_FAQ.pdf

Diagram 2: Flow-chart for Programming Automatic Feedback on Different Steps in the Process of Summarising Text

1. View original text	→	Skim: abstract key sentence	→	→→→→→→→→→→→→→→→→	→	Save key sentence
2.1 View original text 2.2 View original text	→ →	Read: answer preset questions Identify key points, definitions by auto-highlighting	→ →	Auto-FB (√ or explain x) Auto-FB (√, x, omitted)	→ →	Print questions with correct answers Save points list
3. View original text	→	Delete example text	→	Auto-FB (OK, refuse)	→	Save condensed text
4.1 View key sentence 4.2 View points list 4.3 View paragraph plan	→ → →	Paste into points list as first item Draft paragraph plan Prompt replace vocab	→ →	Auto-bar illogical sequencing Nouns, Verbs, Qualifiers	→ →	Lock and save paragraph plan Lock word stems + save
5.1 View condensed text 5.2 View locked / saved paragraph plan	→	Prompt restructure syntax: hidden subjects and verbs, passives, repetition, conjunctions / sentence structure	→ → →	Auto-highlight when identified Auto-FB (allow, or explain why disallowed) Auto-lock when word limit reached	→	Save draft summary
6.1 View original text 6.2 View saved summary	→	Check / modify	→	All auto-locks operate	→	Save and submit final summary
7. View overall auto-FB on content and language						

Comprehending Content

Questions to isolate core points and definitions can be asked in a progressive sequence, each having to be answered correctly before proceeding, as used by the University of Surrey's *Skills for summarising and synthesising*.[15] The process would be considerably speeded up by simply highlighting, underlining or clicking on the original text to identify its main point(s) and any essential definitional details, with auto-dialogue boxes explaining why each is required. Auto-feedback would also refuse to accept inappropriate selections and highlight any omissions. The list of identified core points and definitions, still using the original text language, would then be captured and saved for re-use.

Editing Original Text

Removing unnecessary text from the original could be done by deletion, with auto-refusal to delete core text explained by auto-dialogue boxes and prompts to delete if unnecessary text is retained. Highlighting could also be used to identify wordy language structures in the *edited text* that require changing. Both original and edited texts would be saved for re-use.

Planning

The one-sentence condensation from the skimming and the saved list of main points from the detailed reading would both be re-displayed in one editable window *without* the original or edited texts.

- Each main point would be allocated its own paragraph in a defined sequence (how many paragraphs would depend on the maximum summary length). While flexibility is essential, auto-feedback would disallow illogical (e.g. impossible time) sequencing and inappropriate combinations of different points in one paragraph, with auto-explanations.

- The original text vocabulary for each point would be replaced from a selection list provided,[16] with context-specific auto-feedback on each theoretically-possible choice.

- When vocabulary replacement is completed, the paragraph plan would be 'locked'. After 'locking', each paragraph may have words added or deleted but the approved point order cannot be changed and replaced

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[15] http://www.surrey.ac.uk/ELI/sa/thesis5.html
[16] Which would have to be constructed manually in advance for each specific text.

word stems cannot be deleted although their word forms can later be changed. ‘Locking’ would emphasise the importance of effective planning for efficient writing.

Draft Writing

Both the locked paragraph structure of the plan and the edited text (step 3) are re-presented in separate windows for time-unlimited drafting.

- In expanding each planned paragraph, the user will refer to the edited text. Paragraphs may vary in length, but the word total for all paragraphs counted together cannot exceed the preset word limit. When the word limit is reached, no further words will be accepted, unless existing words are deleted.

- As the user types, inefficient grammatical forms (hidden subjects, hidden verbs, repetitive parallelism, passive tenses, adverbial phrases, conjunctions) must be auto-identified and the writer prompted by auto-cue to change these structures to more efficient forms, possibly using auto-clues similar to SimSum’s *relevant-texthint agents* (Endres-Niggemeier, 2000, p. 674)

- After all amendments have been made, the final draft will be saved.

Comparing Summary with Original

Both full original text and saved summary must be co-displayed in separate windows, for the user to check that all the main issues have been included, all examples and unimportant details omitted, and that the meaning is parallel. Optional modifications could be made within a preset time limit then saved.

Assessment Feedback

The finalised summary would then be submitted for overall feedback, possibly in synoptic form similar to that of Summary Street®.

How to Provide These Requirements?

Tuzi (1997) showed how macros and forms could be used in early versions of Microsoft Word to create online testing tools, and I have earlier used Excel functions for automatic marking (Cheater, 2006), but even Microsoft Office for Mac 2008 would not do everything I want. I am not a software designer or programmer, but it seems probable that the software I want would require a combination of relatively simple techniques (auto-highlighting, auto-dialogue boxes, preset selection lists) plus abstracting techniques and older parsing (trees) within an overall framework possibly of a neural network, though I am advised that accuracy and reliability cannot be guaranteed in the current probabilistic stage of artificial intelligence techniques.

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SUPPORTING ONLINE LEARNING TEAMS USING P2P TECHNOLOGIES

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Abstract

P2P systems have become popular for file sharing among Internet users. Due to improvement on network communications and the processing power of desktop machines, there is an increasing interest in exploring P2P technologies for developing groupware tools to support eLearning. Nowadays most online learning systems are centralized web-based, which show several limitations such as maintenance cost, scalability and having a single point of failure. P2P technologies are an important alternative to develop decentralized online learning systems in which students can be more than mere clients and can use their own computational resources for task accomplishment during online learning process. Unfortunately, current P2P systems cannot be used in a straightforward way for supporting real online teams since they cannot be customized for small group purposes and there are important security issues in such systems. In this paper we will present the design and implementation of groupware tools using a JXTA-based P2P platform, called JXTA-Overlay. We build on previous work in which JXTA-Overlay was successfully used for developing a customized file sharing system. The current paper will present the design and implementation of new groupware tools for online teams of a virtual campus. The proposed groupware tools include communication tools such as messaging and rooms and tools for learning *scenario*. By using the system, the members of a small online team of students can create learning scenarios corresponding to common work projects arising in online learning; then, they can use the learning scenario to define, assign and track a set of tasks within the learning scenario assigned to the members of the group. All in all, this work is a step towards using P2P technologies in the design and implementation of decentralized online learning systems.

Introduction

The fast development of the Internet has enabled the development of virtual organizations (Foster et al., 2001), which support the collaborative activities of a community of members. Virtual organizations appear in different forms such as virtual university campuses and virtual institutions. Virtual Organizations are thus considered a new paradigm of organization of a group of people having common goals. Virtual campuses (aka Open Universities) are becoming a common approach to offer distance learning and teaching using online platforms, and are overcoming limitations and restrictions of face-to-face learning and teaching. In the case of virtual campuses, the members of the community (students, teachers, tutors, etc.) pursue academic goals collaboratively. As an example, the Open University of Catalonia (UOC: http://www.uoc.edu) offers distance education through the Internet in different languages to about 50,000 students and tutors from everywhere who participate in some of the 23 official degrees and other PhD/post-graduate programs, a total of more than 600 official courses.

An important feature of virtual educational organizations is the ability to share learning resources, such as in-class assignments and study material in the form of documents, and calendars for carrying out complex data-intensive learning activities. The objective is to offer on-demand, ubiquitous access to computing, data, and services for eLearning. Most of the current online educational institutions are still supported by traditional client-server applications (Gaudioso et al., 2003) that enable sharing among the members of the community. The issue in such applications is not to share but rather manage limited and controlled sharing just for the members of the virtual organization, which rule and decide how the sharing will take place, impose conditions on what is shared, by whom and how. The popular client-server systems have many well-known drawbacks. In such systems, the shared resources are centralized on servers and members of the virtual community (clients) access them through request protocols. Everything is done at the server side while at the client side just an interface is needed. This brings important non-functional limitations, such as lack of scalability and fault tolerance, low performance and bottlenecks as well as high costs in acquiring, developing and maintaining such applications. Indeed, in large server-based virtual organizations, such as the Virtual Campus of Open University of Catalonia, the centralized approach is rather expensive (and in some cases, prohibitive, such as when acquiring professional video and audio equipment for multimedia distribution) and not easy to maintain, requiring complex tasks, such as smart distribution of the load as well as synchronization and coordination of the resources. Besides being a single point of failure, centric approaches lack of scalability (as the campus grows up in number of users and in learning activities the performance of the system could diminish). In order to overcome these inconveniences, the most powerful and emerging alternative to client-server model to support virtual organizations is the decentralized approach, namely P2P networks. While in a centralized model, the client mainly uses an interface, in a decentralized approach the client may act as a client and a server at the same time depending on what operation it needs to perform and thus becomes a primary “actor” of the system by contributing, managing and controlling the resources.

In this work we approach the use of decentralized P2P approaches to support online collaborative learning of small groups of students. The main reasons and motivations for addressing P2P technologies are as follows. P2P technologies have appeared as disruptive technologies that allow the implementation of decentralized, therefore fault-tolerant, online learning systems. Moreover, such systems enable efficient sharing of information (through intelligent replication techniques) and direct connection in P2P fashion allows efficient file transmission as opposed to FTP approaches of centric applications. Further, P2P technologies allow for designing and implementing customized learning applications that support the needs of small groups, that is, such applications can be applications tailored to small groups of students. Unfortunately, current P2P systems cannot be used in a straightforward way for supporting real online teams since they cannot be customized for small group purposes and there are important security issues in such systems. Our approach is based on recent development of P2P technologies, namely JXTA library from Sun MicroSystems (Brookshier et al., 2002), which includes protocols for peer group management. Finally, one last motivation is that using P2P applications promotes the use of contributory systems which are built up by the contribution of computational resources by the students of the online campus.

We present the design and implementation of groupware tools using a JXTA-based P2P platform, called JXTA-Overlay. We build on previous work in which JXTA-Overlay was successfully used for developing a customized file sharing system. The proposed groupware tools include communication tools such as messaging and rooms and tools for learning scenario. By using these tools, members of a small online team of students can create learning scenarios corresponding to common work projects arising in the online learning; then, they can use the learning scenario to define, assign and track a set of tasks within the learning scenario assigned to the members of the group.

The Context: Online Collaborative Learning

Our academic context is the virtual campus of the Open University of Catalonia, where the learning goals pursued by many of the courses offered are based on the Project-based Learning paradigm (Zumbach et al., 2003). Courses based on this paradigm, such as “Software Development Techniques” in the Computer Science degree, requires groupware applications to manage small groups of 4–5 students to work collaboratively and thus share documents, source code, etc. in order to accomplish a software project. Moreover, we would like our students to be not only participants but also managers of their group space by sharing in a decentralized and collaborative way their common resources. Students will eventually form a small community having the same profile and each student is an equal participant. Thus, collaboration in a P2P system is intended to be direct between group peers, following social rules and without the restrictions imposed by institutional regulations. Full autonomy, group monitoring, confidentiality and security are also crucial in this context. By considering these aspects, the learning process may become more efficient because group peers can be aware of the status information of the preferred peers, and interact directly and share resources with those preferred peers in order to provide additional scaffolding or social support when needed.

Current Status of Use of P2P Technologies for eLearning

Popular P2P file sharing systems such as Freenet, Gnutella, Overnet, and Bittorrent are not suitable for our goals pursued in an online academic context. These systems are actually not even appropriate to support virtual organizations in general. The main reasons are found in that such systems are not pure P2P but rather hybrid P2P and server-mediated systems. Indeed, they combine nodes made up of simple computers with large servers or lists of different servers (usually called super nodes), which provide file and peer searching and indexing functionalities for direct and rapid searching and downloading of files. Most importantly, in such approaches users do not have control on information sharing and hence cannot meet essential needs in on-line collaborative learning, such as for managing a customized and secure shared environment for small groups of students.

The use of P2P technologies in the context of e-Learning has been to date little investigated. A few works have pointed out the importance of applying P2P technologies to education. Edutella (Nejdl et al., 2002), for instance, has proposed a P2P architecture for exchanging RDF-based metadata by building upon Semantic Web techniques and the JXTA middleware. Berman and Annexstein (2003) considered P2P technologies as crucial in future educational systems. In particular, they propose to integrate them in a new personal knowledge management paradigm. In Jin et al. (2004) the authors suggest to combine P2P, Grid and e-Learning for developing powerful, efficient, scalable, mobile and versatile environments. Fakas and Karakostas (2004) provide a potential application of P2P technologies to online learning by defining a peer group in P2P networks as a set of peers formed to serve common interests or goals dictated by the peers involved, such as security requirements of the peers involved and the need for status information on the members of the group. Finally, in Bulkowski et al. (2006) the authors also propose to use P2P technologies for large scale distribution of learning objects that will enable the creation of collaborative learning communities.

Peer Group Management in P2P systems: JXTA Library Support

One of our motivations is to use the JXTA-Overlay platform for developing groupware tools for supporting learning and teaching activities of small online groups. Therefore, relevant functionalities for groupware applications are provided, such as the creation of learning scenarios that a group of students can perform, task management within a given scenario (task creation, modification, etc.), task assignment to group members, acceptance/rejection of a task as well as information and statistics about learning scenarios, tasks and their realization, groups and specific members of the groups. The specificity of the groupware tools is that any peer group can instantiate them. The objective is thus to develop groupware tools that can be tailored to the needs of small groups of students. To this end, an efficient management of peer groups is very important for the overall performance of the system.

JXTA library offers a series of protocols that allow efficient management of a group of peers through the rendezvous peer (or super-peer). Thus, the library offers the "Rendezvous Protocol" (RVP) for message propagation to a group of peers. The RVP provides mechanisms that allow the propagation in a controlled and efficient manner. The RVPs work together to form a PeerView which is a list of peers who are currently serving as Rendezvous Peers. Thus, PeerView is structured in a way that enables RVP's to send messages through a PeerGroup. A PeerGroup is a key piece in the JXTA library. A PeerGroup is a collection of peers that have agreed to use a common set of services. Any PeerGroup is assigned a unique peer group ID and requires the implementation of the group services (membership, discovery, resolver, etc.). The Rendezvous Peer is central point for a PeerGroup. Each PeerGroup is identified with a unique groupID and has its own policy defining group membership. It should be noted that peers can simultaneously belong to more than one PeerGroup; the netPeerGroup is actually the first group of peers to which a peer belongs in becoming member of the JXTA network. PeerGroups provide a series of services such as discovery, pipes, monitoring, etc.

JXTA-Overlay Platform

In order to achieve the above-mentioned goals, we use the JXTA-Overlay P2P middleware (Xhafa et al., 2008) with offers a set of primitives for supporting efficient peer group management and development of groupware tools. The JXTA-Overlay project is an effort to use JXTA technology for building an overlay on top of JXTA offering a set of basic functionalities that are most commonly needed in JXTA-based applications (see https://jxta-overlay.dev.java.net/)

The peer group management in JXTA-Overlay takes advantage of the *peerGroup* entity. The basic primitives for peer group management can be used in an independent way by any P2P application that uses peer group as a unit. Thus, the *peerGroup* can be used for executing tasks in the peer group's resources as well as to support online teams of students by developing customized groupware tools tailored to the specific needs of small online teams of students for which group autonomy, monitoring, confidentiality and security are important concerns.

Groupware Tools in JXTA-Overlay Platform in Support for e-Learning

The groupware tools developed for e-Learning comprise: instant messaging, management of rooms, management of learning scenarios and task coordination among peers of a group (i.e., students of a study group) within a learning scenario.

Instant Messaging

JXTA-Overlay comprises also primitive functions for instant messaging and rooms, that is, direct communication (via text messages) among online Client peers and rooms. The particularity of this approach is that both instant messaging and rooms are instantiated within a group of peers, not only at *NetPeerGroup* (i.e. the whole network) level. Thus, instant messaging and rooms can be managed in a controlled and secure manner only by the members of a group of peers, which is very appropriate in an online academic context (see Figure 1).

Figure 1: Snapshot of Instant Messaging

Rooms

Besides the management of permanent groups, members of a group of peers can manage temporal group activity, that is, rooms for short online meeting, negotiations, etc. among members of a group. A user can create a room and invite some or all the members of group to the room. In order to create a room the user has to indicate a name and a description for the room; further, the user can select the peers to be invited to join the room. Upon sending the invitation, the peers will receive it and can either accept or decline the invitation (see snapshots in Figures 2 and 3 below).

Figure 2: Room Creation

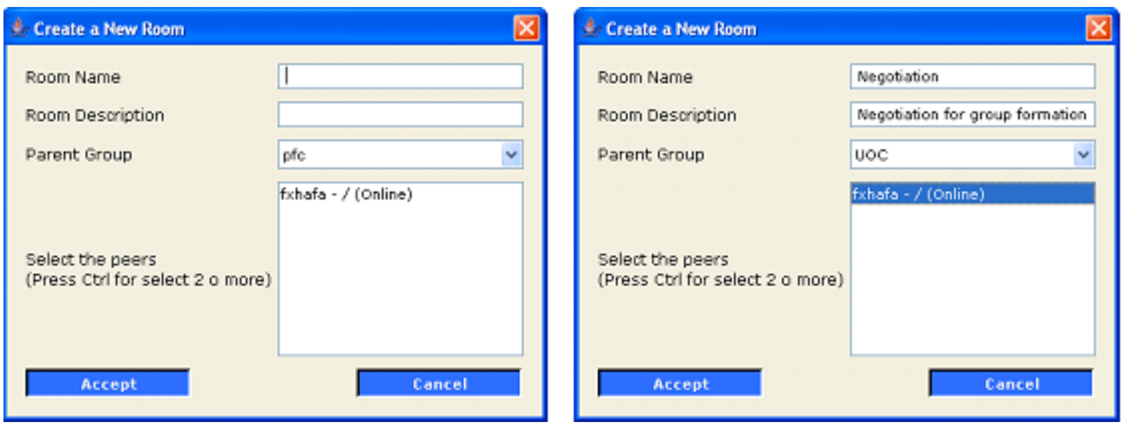
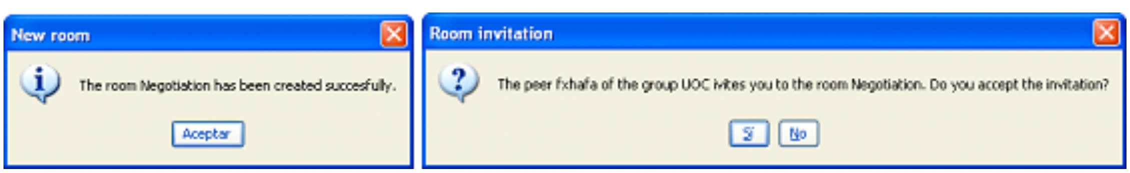
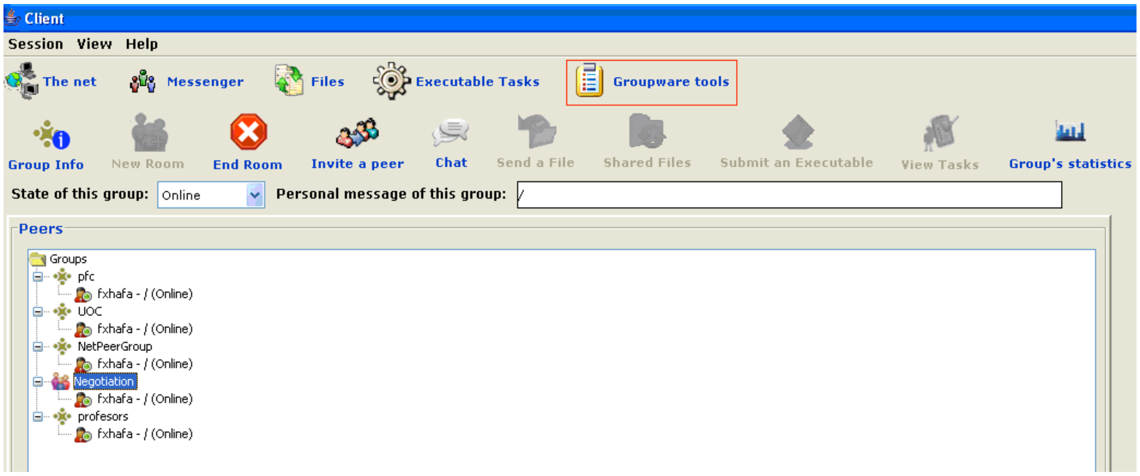


Figure 3: Confirmation of Room Creation (left); Invitation to Join the Room (right)



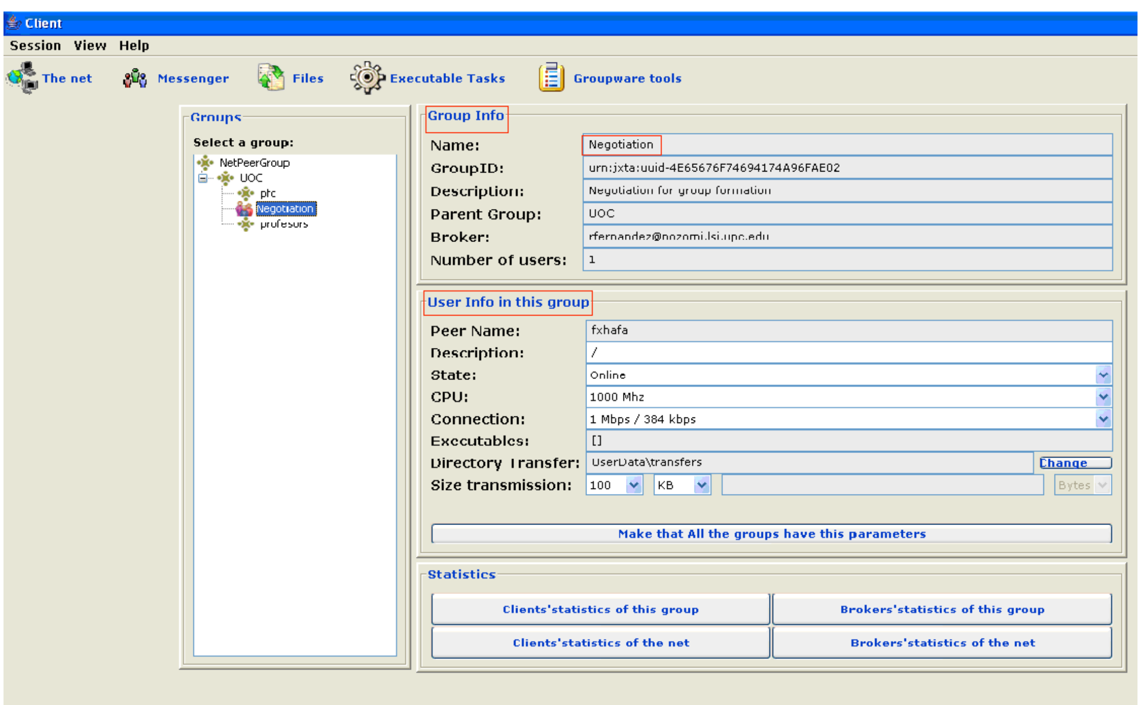
Rooms can be viewed online. For instance, the room Negotiation can be seen in the overall view of the Net (see Figure 4, under the Groupware tools).

Figure 4: View of the Net



Further, peers can consult the information relative to a room (the room negotiation, in this case) as well as the information on the peer that has crated the room including the characteristics of computational resources (such as CPU usage, bandwidth, the list of executable tasks, the chunk size used for file transmission; see Figure 5).

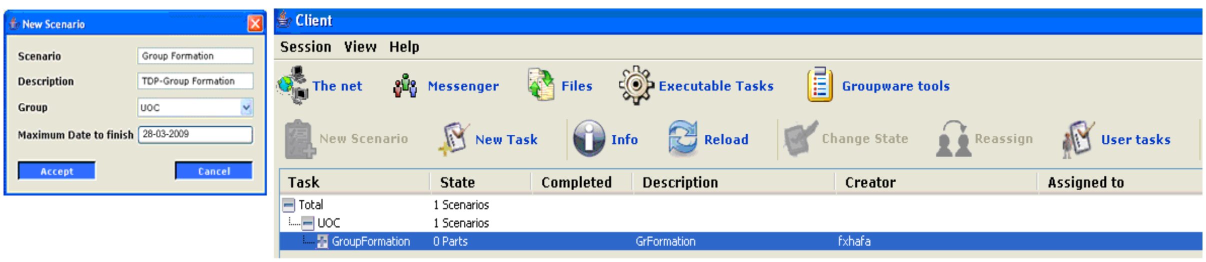
Figure 5: View of Group and User Information



Learning Scenarios

One common requirement for groupware tools for e-learning is to provide learning scenarios for groups of students, that is, the possibility that tutors and/or students could define and accomplish a learning scenario within a subject or a project development. Therefore, we defined and implemented, as part of groupware tools on top of JXTA-Overlay, a learning scenario, which in turn is composed of several (smaller) tasks. Moreover, it is possible to assign tasks to members of groups and monitor their completion within the specified time (see Figure 6: new learning scenario on the left and the view of the learning scenario in the Net). In this case, the learning scenario is called "Group Formation", which is the very first step in online collaborative learning.

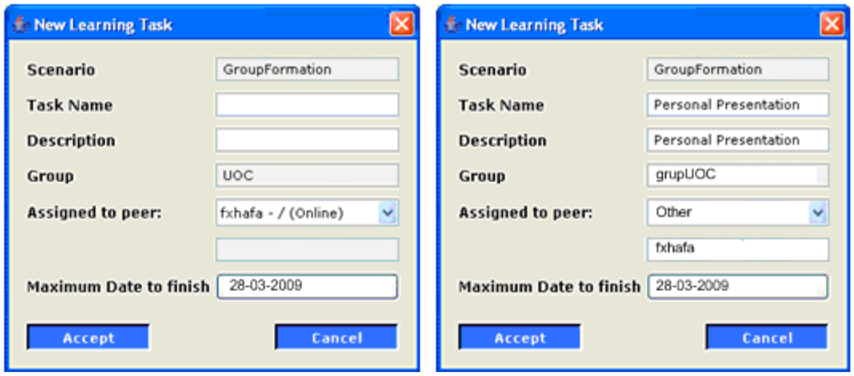
Figure 6: Creation of New Learning Scenario: Group Formation



Task Creation, Assignment and Coordination

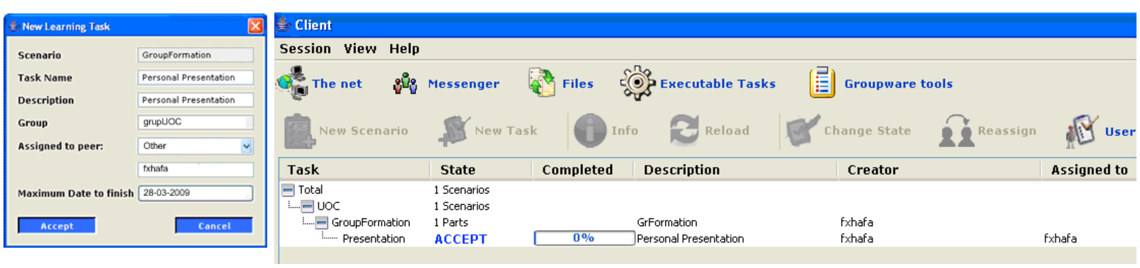
Once a scenario has been created, the owner of the scenario can create learning tasks within scenario. Thus, in order to proceed with a group formation scenario, a series of steps are to be accomplished, such as personal presentation, professional abilities, time availability, negotiation of group functioning rules, voting about important decisions, planning of the project into milestones, and so on. For each step, a task can be created within the scenario (see Figure 7 for a snapshot of the creation of a new learning task with GroupFormation scenario.)

Figure 7: Snapshot for Creating New Tasks within a Scenario. Task Creation and Assignment to a Peer within the GroupFormation Scenario



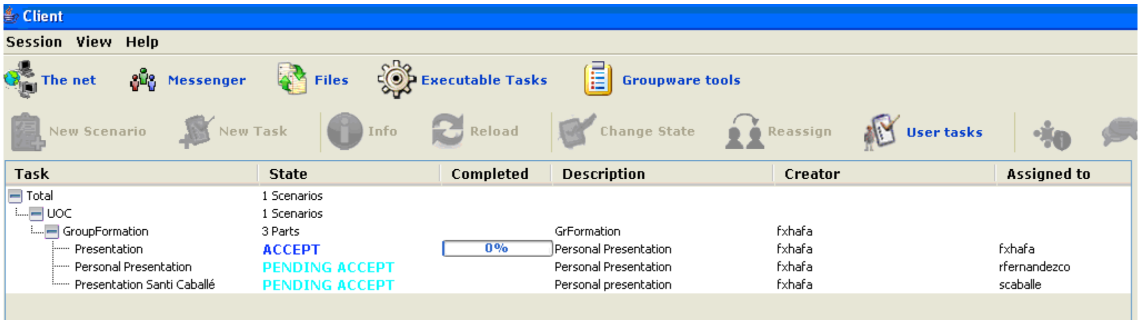
Task assignment and progress completion. Once the task has been assigned to a peer, the peer will receive a request for accepting or declining the task. A peer can be assigned many tasks and the information on the task can be seen in the Net. For instance, in Figure 8, we can see that a task *Presentation* within GroupFormation scenario has been assigned to the peer *fxhafa* who has accepted the task. Moreover, we can see the state of the task (progress completion), which is at 0% upon acceptance.

Figure 8: Status of the Task (in % of completion)



Further, we can see the state of the tasks of other peers. In Figure. 9, we can see that one of the peers has accepted the task but there are two other peers whose tasks are pending to accept.

Figure 9: Status of Tasks of Peers of the Group (in % of progress completion)



Attaching files to tasks. Accomplishing a task may need some additional information such as documents, computer programs, etc. Let us suppose that a peer would like to attach his/her CV to the task of Personal Presentation within GroupFormation scenario. In such case, the peer can attach files to a task, using the Shared files functionalities (see Figure 10).

Figure 10: Attaching a File to the Task (first step)

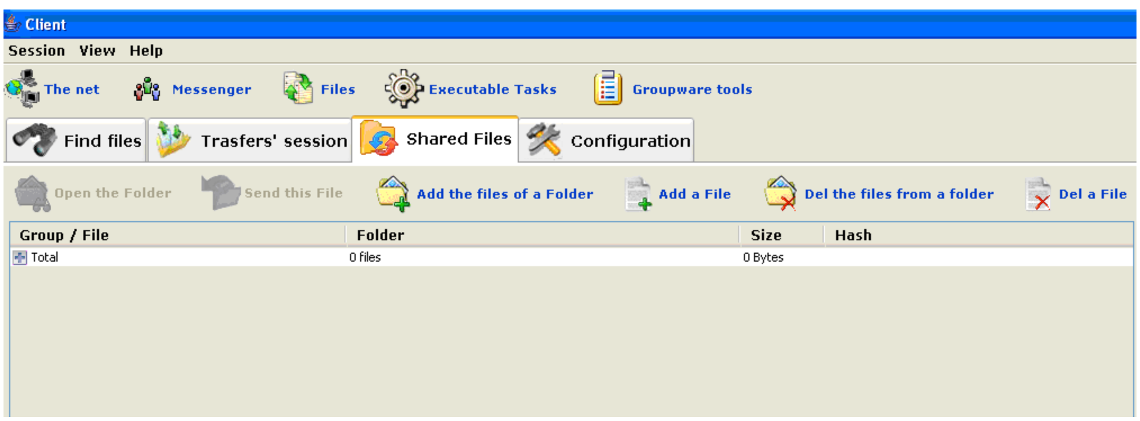
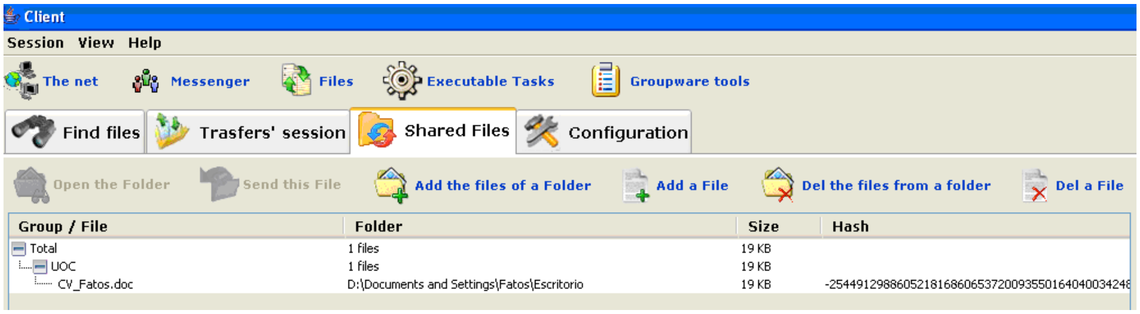


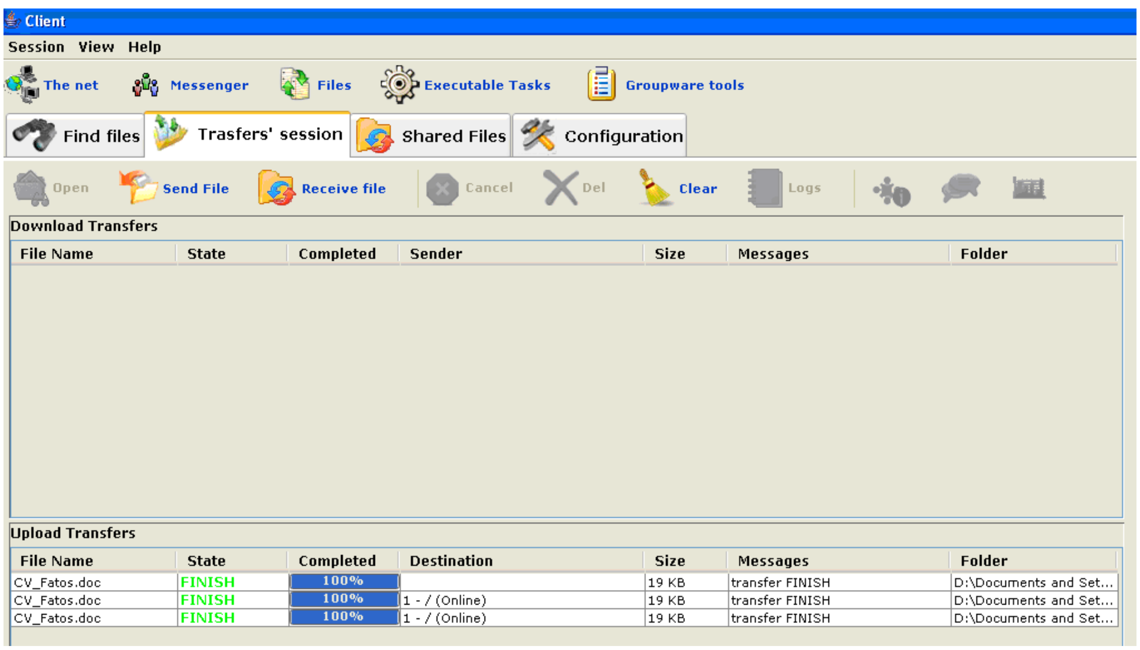
Figure 11: Attaching a file to a task (second step: file selection)

Figure 12: View of Attachment of a Document to a Task



Members of the group can also see the peers that have downloaded the attached documents.

Figure 13: Download Progress of a Document Attached to a Task



Summary and Future Work

In this work we have explored the use of P2P technologies as an important alternative to centralized web-based approaches for the development of online learning systems. The interest in approaching P2P technologies for online learning is manifold. Web-based learning systems show several limitations such as maintenance cost, scalability and have a single point of failure while P2P systems are decentralized, fault-tolerant, enable efficient file sharing and direct communication among peers. Moreover, in P2P systems, peers can use their own computational resources for task accomplishment during online learning process.

After investigating the current status of P2P systems, we concluded that systems such as Gnutella and Freenet cannot be used in a straightforward way for supporting real online teams since they cannot be customized for small group purposes and there are important security issues in such systems. For our purpose of developing P2P systems that support online groupware tools, we considered JXTA, a P2P library which has a key feature: the efficient management of groups of peers through rendezvous peer definition. To this end, we have presented in this paper the design and implementation of groupware tools using a JXTA-based P2P platform, called JXTA-Overlay (https://jxta-overlay.dev.java.net/).

The proposed groupware tools include communication tools such as messaging and rooms and tools for learning *scenario,* task assignment and management within a learning scenario. By using the system, the members of a small online team of students can create learning scenarios corresponding to common work projects arising in the online learning such as group formation, project planning, etc.; then, they can use the learning scenario to define, assign and track a set of tasks within the learning scenario assigned to the members of the group. All in all, we believe that this work is an important step towards using P2P technologies in the design and implementation of decentralized and efficient online learning systems.

In our future work we plan to evaluate the proposed groupware tools in the real context of our academic context and compare the performance of the online teams using the web-based applications vs. our groupware tools. We also plan to investigate how mobile devices can be used in our groupware tools to enable the online learning activity "anytime & anywhere."

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IT'S ALL ABOUT VIDEO CONFERENCING- TOWARDS A SUSTAINABLE E-LEARNING APPROACH IN DEVELOPING REGIONS IN BOLIVIA

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Abstract

This paper reports on the current transformation of higher education in Bolivia. The involvement of ICT, e.g. E-learning, has many facets. One is that it offers promising solutions that can help to bridge distance and provide education in rural areas. Another is that e-learning also seems to provide promising opportunities for dealing with problems found on campus. Here, we approach the motivating and initial conditions from a practice-oriented perspective and discuss the possibilities, restraints and expectations of e-learning at a public university in Bolivia. We identify factors that need to be addressed in the coming work to advance e-learning practices.

Introduction

The continuing evolution of information and communication technology (ICT) over the last decades has made an impact on higher education making it possible today to study almost anything at a distance through e-learning. ICT has not only been utilized for distance courses but it is also commonly used in a blended mode for on-campus education. The reasons for adopting ICT for education may seem to be different in various contexts although bridging time and space are commonly mentioned in the literature **(**Andersson, 2001; Salmon, 2004). Although E-learning as a concept includes an array of tools and methods the common denominator is that it is learning or training carried out thought the use of ICT (Francisco & Penalvo, 2008; Salmon 2004; Shimic, 2008).

In Bolivia there is currently a strong trend of decentralisation to enable people to stay and live in the countryside. There are many different reasons for this, one of which being migration into the cities due to the crisis in mining industries over the last decades (Hudson & Hanratty, 1989). On an economic level there have been initiatives for decentralisation with a shift in public investment since the Law of

Popular Participation was introduced in 1994. Poorer districts are now a priority for public investments while at the same time these investments have been more geographically spread than before. Public investment in social services and human capital has grown at the expense of infrastructure and production (Faguet, 2003). Consequently, an underpinning factor in all government objectives is that Bolivia's current situation embraces a social revolution. Indigenous groups are incrementally and actively given rights to participate and influence the development of the country in ways that were earlier suppressed. E-learning is in this context seen as a viable opportunity that would solve some of the problems of decentralisation and enable wider access to education in the future. The academic community can play a crucial role in this development. The case presented in this paper reflects the situation in a Bolivian public university and the aim of this paper is to present and discuss the current situation with a focus on the possibilities, restraints and expectations that e-learning carries in the current transformation of the educational landscape. The underpinning motivation implies a view in search of viable ideas and sustainable approaches that utilise e-learning.

The case presented concerns a well-established public university with more than 10 faculties and 50,000 students enrolled. It is located in one of the larger cities and the university plays an important role, exerting an influence on other universities in Bolivia.

Related Work and Framework

With few exceptions, most universities currently put large efforts into planning and facilitating learning with an aim to expand or strengthen the quality of education. One way to accomplish this is through the effective utilisation of e-learning. In Bates (1997), four of the most frequent reasons for using technology in education are identified as:

- to improve access to education and training,
- to improve the quality of learning,
- to reduce the costs of education, and
- to improve the cost-effectiveness of education.

The move towards e-learning is not easy, and in order for e-learning to function as an educational mode in higher education it is necessary that a set of criteria are met and considered. Two of the most important criteria among many others are that there is a clear understanding of the goal of the introduction of the educational mode and that a view and understanding of the prospective students' needs is established. These criteria are not specific to e-learning as they are relevant to and can be used for all education (Davis, Little, & Stewart, 2008). Introducing e-learning is not only a process of change of student and teacher practice, it is also implies an organisational change and development which affects the educational arrangement as a whole. It is therefore not easy to determine when intended effects are realised, as it is difficult to identify unintended effects that most certainly will be one of the results of such transformational processes. Thus, it is therefore important to identify the expectations and assumptions placed on e-learning within the organisation and to be aware of the individual and collectively shared knowledge and experience of e-learning. It is a situation which calls for effective approaches that will help to identify such experience and knowledge of e-learning. The implementation process of e-learning involves a reconstruction of roles among faculty members (Govindasamy, 2002).

What does the adoption of e-learning mean for the administration, the teaching practices, and the structures of the university organisation and government? Alexander (2001) states that institutions should develop a system to support e-learning:

> First, they need a plan for e-learning development, a plan which clearly identifies the reason/s for embarking on e-learning development. Without this, faculty are likely to "second guess" the reasons for the initiative, which may lead them to by-pass the significant phases of thinking about learning and what it means for their students, as they move straight to the teaching strategies they believe will address the concerns of the university. (p. 246)

Staff development is crucial, especially in times when new forms of teaching and learning in higher education are introduced. Training and discussion about these new forms are however not something that should be taken lightly. It is a matter to be recognised and taken seriously (Spratt et al., 2000). The introduction of e-learning in traditional educational settings is likely to affect the organisational landscape and its practices on many levels.

E-learning and every other form of education is embedded in a social and cultural setting (Carr-Chellman, 2005). How learning and the learning community are to be approached needs to be taken into account before planning and preparing how the adoption of e-learning will be approached. Factors such as computer and information literacy among staff and students will also affect plans and objectives. The work of recruiting knowledge concerning the limitations we can assume will be set by these factors, together with those found in the technical infrastructure and knowledge about its features, are crucial for the further advancement and implementation of e-learning.

Winds of Change in Bolivian Education

Currently, the government of Bolivia sponsors many different e-learning initiatives. The government is working hard to establish centres for educational resources and to create learning materials for TV and radio. They are also currently establishing educational portals that will be available for the public on the WWW. Bolivia is a multi-lingual country and the objective and clear intention is that these education portals and the learning materials they provide will offer these resources in at least the three most common languages. A firm objective supporting this development is to establish 1,000 centres for educational resources around the country by 2010.

The centres will provide an arena where students, teachers and the public can access information and which will facilitate local development and innovation. The intention are that these centres will provide access to computers and other expensive equipment that few people in Bolivia can afford themselves and support lifelong learning (Ministry of Education and Culture, 2009).

These educational portals are virtual spaces for public education where information, learning materials and education services will be provided. A problem which impedes the work of realising this objective and the advancement of e-learning is, however, the low number of computers and Internet users in Bolivia. In 2005 approximately 5 out of 100 people used the Internet in Bolivia (Ministry of Education and Culture, 2005; World Bank, 2009). This could however be explained by the geographical difficulties (i.e. altitude, rainforests) in building infrastructure and the ongoing expenses that follow such vast capital investments.

Another impeding factor is that the telecommunications market for foreign traffic was closed until 2001(Maclay & Reale, 2002). Despite or perhaps because of this difficult situation and history, e-learning is seen as strategically important for the education system as whole.

Higher education in Bolivia is in many respects similar to the higher education found in many other countries; there are both public, autonomous universities and private universities. The public universities are entitled to public national funds and the Comité Ejacutivo de la Universidad Boliviana (CEUB) is responsible for these universities. The ministry of education and culture supervises private universities. In the university system three different levels of study exist. The first level includes Técnico superior, Bachiller, Licenciatura, and where a diploma is awarded after 3–6 years of studies depending on the subject. The second level consists of postgraduate studies and leads to a degree of Maestría, or Diplomas de Posgrado. Third level consists of doctorado and requires a doctoral thesis.

Method

The paper reports on an ongoing case study which aims to follow the development of e-learning over a period of two years. It is the result of a development project which aims to introduce e-learning practices into higher education in Bolivia. We have aligned the study with the discussions on case study approaches (Feagin, Orum, & Sjoberg, 1991; Tellis, 1997; Yin, 1994). The qualitative data was gathered through interviews with representatives from eight faculties (out of thirteen) and three units, central to the implementation of e-learning at the university. Each faculty/unit was interviewed independently and three to eight representatives were present. All interviews were conducted in English and sometimes in Spanish during the spring of 2008. When the representative's found it difficult to explain in English what they wanted to get across, they had the opportunity to talk in Spanish with the help of a translator. The interviews were summarized after each session and transcribed. These transcriptions together with the field notes that were taken make up the main mass of data used in the analysis.

The interviews were semi-structured and the themes followed the structure focusing on the current situation, expectations, approaches, infrastructure, student situation and conditions, and finally the teachers' situation. Initially, the participants presented their work at the faculty, their current courses and educational programs, the problems they were currently facing, the opportunities they had identified, their experience of e-learning, and the vision and expectations they had concerning e-learning. This is the material from which we have derived the themes we present and discuss below.

Results

Current Knowledge and Competence in e-Learning

Current skills and experience of e-learning differs a great deal between the different faculties and educational programs offered by the university. In some of the faculties we visited we found that very few courses or educational programmes utilized e-learning. Some of these faculties had not started to incorporate e-learning in their work at all, whereas we found that some faculties do explore and use e-learning on a few courses, having quite solid concepts which they have developed by themselves.

E-learning is used mainly as an introduction to university studies and to provide students with the preparatory skills they require for their education. These courses have been packaged and distributed via CD-ROM and communication between the participants is typically managed using asynchronous text in a learning management system (LMS). There are also some distance courses delivered through e-learning techniques that connect learning centres and campus. One educational program in social science had previously used radio to bridge geographical distances and to distribute lectures to students in remote areas of the region and to campus students.

Competence and knowledge of e-learning among the staff is not shared but is rather scattered in the organisation, located in small islands where only a few teachers have experience of teaching through e-learning. There is a true interest in e-learning among the teachers, especially among those with good computer literacy. However, they do not find the support they need as awareness of what e-learning is and involves is, with a few exceptions, relatively low among deans and other administrators. A general focus and expectation which is often repeated involves the great benefits that video-conferencing is expected to provide.

Organisation

The university currently lacks a central organisational unit that could manage the development of e-learning. We found that it applies for the university as a whole including the faculties. The initiatives that do exist are managed and run by individual teachers who in their own interest and on their own initiative choose to use e-learning in their teaching. There are also some initiatives that are supported by external donor projects. This text is part of such a project. The people involved in e-learning are true enthusiasts and important resources in the process of taking the development of e-learning forward. E-learning is not a top priority at this university; in fact it is rather an invisible issue. Among administrators it is discussed as a matter of computer hardware and bandwidth, not as an issue that concerns organisational development and change of practice. Despite this fact we identified a broad consensus on the need for organisational change to enable an increase in the use of e-learning among the teacher representatives. There are of course many different opinions on how this can be managed, but almost everyone agrees that it will be a positive and necessary development for the university. Two different strategies for such development are revealed: The first of these is that the faculties should organise themselves to handle e-learning issues independently. The second strategy implies that it should be managed on a broad university level and that e-learning will be utilised in all faculties in similar ways following a common strategy and e-learning policy.

It is of course a matter of resources and there is general agreement that the need for financial support is substantial. Trust in external project resources is a driver in the process, but it also creates an unhealthy relationship. It impedes organisational commitment to the strategic development of e-learning. This is an important issue to manage if a positive development of e-learning is to be attained. Today it is difficult to allocate resources for all types of education, but in this context, the problem of assimilating e-learning is a far more crucial concern than resources that support sound development.

Another note on structural changes concerns how work with the support of e-learning should and could be organised. The teachers involved in the different educational programmes should be developing their own e-learning courses, which from our perspective is a reasonable point of departure. However, most of the participants identified the need for supporting units or services that can assist in the production of teaching materials, graphics and software for e-learning. Over time this might be a centre that is established in the different faculties through interest groups among the teachers, but in the near future, a central unit or core group of engaged people is a more realistic solution. The demand for policies concerning e-learning is high and the democratic process is emphasised. It is important for the university to tackle these issues in the near future.

Technical Infrastructure

The technical infrastructure and access to computers differs between the faculties. Some departments have both a network and access to a number of computers, while others lack both or have very old and obsolete equipment. There is currently a donor project which aims to develop the network and increase the availability of computers within the university. The university is not located in one building but is rather scattered in many different buildings in the city, which is a constraining factor in the design, implementation and maintenance of the network. The internal network has a connection to the Internet but at present it has a very limited bandwidth (about 10Mbit/s) because of the high costs associated with an Internet connection for the university. Our interviewees hoped and believed that the prices would soon decrease or at least be reduced for academia and educational institutions since they are having a negative effect on the development of e-learning.

Internet access at home is relatively rare in Bolivia. It is therefore understandable that most students use the services offered by Internet cafés when they are off-campus. There are many such cafés all over the city and they offer acceptable prices for access to Internet services. Our interviewees believed that distance students would have good opportunities to connect to the university for at least an hour per day from internet cafés, which would offer enough time to manage communication with both peers and different tutors. Bandwidth is of course a problem and makes some technologies difficult to use, but the use of text and graphics should not be a major problem. University libraries are pointed out as important resources and possible centres for e-learning. A lot of the material that the libraries have is currently digitized. It is an initiative that will provide students access to an electronic library service from internet cafés and even from home.

The Promises of E-learning

As we discussed and demonstrated above, there is a true interest in e-learning which is based on many different reasons. These many reasons for the interest in e-learning seem to a large extent to be associated with a lack of suitable buildings, problems with the completion rate of students, and the need to reach out to new student groups. The expectations of this educational mode are high and e-learning is expected to contribute to the solution of a number of problems currently faced by the university. The staff seem to have a clear idea of how e-learning can be used to improve and facilitate education regardless of if they have any practical knowledge or experience or not. Today, there are in some cases severe shortages of space in teaching facilities, which makes it difficult to carry out teaching since the lecture halls are full to bursting point. On some courses the number of students is more than 400. The staff also think that it is difficult to get lecture halls equipped to carry out all the desired education. E-learning is seen as an opportunity to improve the situation on campus and to give students access to a more flexible education.

Many courses suffer from poor completion rates because the students cannot afford to complete their studies and they are often forced to move home to their village or city and work to earn their living. The staff believe that students could pursue their studies via e-learning and thereby get their diploma. Another hope for e-learning is to reach new students that live in the countryside in order to increase the university's presence in these areas. Reducing the load on campus facilities by enabling new students to study at a distance is another benefit the staff think that e-learning could render possible.

Regarding the hope of technical solutions that could be used to conduct e-learning, the highest hopes are for video conferencing and live lectures with audio and video. The reason for this seems to be that there is a strong oral tradition in the country and at the same time a very teacher-centred educational culture. The staff also point out that since teaching is done in Spanish and not all students are literate, the use of text only could be a problem for some students. This makes videoconferencing attractive since both aspects can be easily expressed.

Discussion

Identified Needs and Possible Solutions

It is clear that e-learning is a core concept from which a lot can be expected. The situation at the university is however special. The underpinning motives for E-learning do not relate primarily to economical objectives. Rather, it is seen as a means that would give new options for dealing with current problems found in campus education and to make distance and decentralized education a feasible reality. Two crucial roles of e-learning can be identified:

- E-learning can be seen as a means of developing distance education. Because of the insufficient infrastructure in universities, working with learning centres might be a more accessible way than relying on Internet cafés and private connections. Learning/community centres might play an interesting role in the local community and perhaps could contribute to decentralisation. How the university best can serve and meet such demands is unclear and both policy and organisational matters must be considered.

- E-learning can also be seen as a means to support and facilitate campus education. Large classes and few teachers are a common problem. It means that the lack of premises is evident as well as the time a teacher can give every student. It is important to be aware that bringing only e-learning to the table cannot solve this problem. It is also an organizational problem that needs to be addressed as such and not by adding yet another burden to teachers and administrators. If a university aims to maintain quality in education it is not reasonable that a teacher has 400 students on one course. The challenge here is to identify e-Learning concepts that would efficiently ease and support campus education.

In forthcoming work the university will have to deal with a number of different applications of e-learning. It will be necessary to distinguish between these applications and be aware of their differences and similarities when addressing the challenges that implementing e-learning entails. Initiatives, applications and knowledge that already exist have a lot to offer and might be a feasible way to approach e-learning in broader terms. Since knowledge about these applications is not widespread in the organisation further work and discussion of how these can be used might be needed to achieve the goals. The potential of many of these applications lies in that they can support both campus and decentralized education since they already work in both these contexts.

Critical Factors and Concerns — Towards a Sustainable Approach

We would in the light of the aspects discussed above focus attention on factors that currently slow down the further development of e-learning. These are not necessarily issues that require an immediate solution; they are more of a kind that they should be addressed from a strategic and long-term perspective.

A critical issue is the current infrastructure, which is under development. One concern is the bandwidth that is currently low and thus a constraining factor for further development when it comes to reaching out to rural areas, especially where the use of audio-visual tools such as videoconferences is concerned. Using text based e-learning only could bar a lot of people, so the use of Blended learning, pre-packaged lectures on CD-ROM and similar solutions must be used to limit such effects. The libraries efforts to digitalize materials are interesting but suffer the same problems with text as a medium. It is surprising that the staff place such hope on this resource considering the conditions.

To improve the conditions for e-learning on campus the number of available computers needs to increase. The national initiatives with learning centres and educational portals can be key factors in enabling higher education through e-learning even if the initiative isn't directed towards higher education. Using the infrastructure provided by these centres could support the work involving people in the countryside and help them to enrol on university courses.

Currently, views on e-learning are very positive, and tools such as video-conferencing are attractive and are seen as true problem solvers for a wide array of problems. There are not many critical voices raised at this point. It is a situation which could be problematical if this gap between the rhetoric and ideas and the actual conditions is maintained. We assert that a critical voice is crucial for successful implementation and continued work in utilising e-learning.

An evaluative and reflective approach supporting the coming phases would be a promising way to avoid major setbacks. Inter-organisational collaboration is currently problematic when faculties seek opportunities to manage their work with e-learning at their own pace and on their own terms. This unfortunately hampers the establishment of a shared arena that could support development and strategic work with e-learning on a broad scale. This development will depend on the staff taking ownership of the process, which is crucial if the university aims to provide education through e-learning with a similar quality to the ordinary campus education.

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TEACHER-STUDENT INTERACTIONS AND LEARNING OUTCOMES: MOVING FROM DESCRIPTIVE TO PRESCRIPTIVE RESEARCH[1]

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Abstract

We have been researching the process of integrating technological systems in education for the past three decades, using the "ongoing" research method. The schools are our laboratory and research field. The results of each research are taken into account in the planning and formulation of the next research. This process includes three phases: conceptualization (identifying concepts), validation of the concepts, and examination of the correlation between the different learning environments. These are the basis for formulating models that will comprise a basis for analysis and making decisions in the field.

Introduction

Research has shown that a relation exists between the level of learning in the schools and universities and a country's strength. A relation also exists between education and the level and quality of life. Education today is a significant factor for ensuring society's normal existence, development and prosperity. However, major cities can afford the student the opportunity to acquire knowledge more than cities found in the periphery. A gap therefore exists between the level of learning in the major cities and the level of learning in the peripheral settlements. Students with high learning abilities who live in the cities can participate in university courses and other learning centers, whereas students with high learning abilities who live in the periphery do not have a framework which can afford them knowledge in accordance with their talents and abilities.

This reality was the basis for our research on the integration of technological systems for the advancement of students towards academic studies. Our research aims to investigate how technological systems can be used to advance populations

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[1] This article is based on results of our research which will be published in the book: *Process of Change in Education: Moving from Descriptive to Prescriptive Research*, Editor/Author: Baruch Offir, Publication Date: 2009, 3rd quarter, with permission from Nova Science Publication, ISBN: 978-1-60741-451-3.

of students who live in distant areas, to afford them the opportunity to learn academic courses and to be university students while still in high school.

Teacher–Technology Partnership

The process of change is very complex, since it must take numerous educational and pedagogical factors which are involved in the process into account. It must recognize the teachers' and students' personal attitudes, must evaluate the student's level, analyze the sociological processes taking place in the classroom, formulate an appropriate teaching method, recognize the teacher's position and status in the classroom, etc. Proper activation of technological systems in order to reduce gaps between populations is very complex, and its successful implementation depends on the understanding and control of numerous diverse and complex parameters.

We have been researching the process of the integration of technological systems in education for the past three decades, using the "ongoing" research method. Each phase of the research completes the preceding phase, i.e. each phase of research is based on data found in previous researches. This process includes three phases:

- First phase: Conceptualization, i.e. identifying concepts, out of existing scientific knowledge, which appear relevant to the environment which we are investigating. At this stage we examined whether the concepts are indeed valid for the field of the integration of technological systems in education. This stage, of the validation of the concepts, was performed by calculating the between-judge correlation (descriptive research).

- Second phase: Validation of the concepts, i.e. examining the validity of the concepts as an instrument which will enable differentiation between learning environments.

- Third phase: Examination of the correlation between various variables in an attempt to explain the differences between the different learning environments. These explanations will be the basis for formulating models that will comprise a basis for analysis and making decisions in the field (prescriptive research).

The function of the education system today is indeed complex. It must educate towards values and mold each student's behavior, afford the student the ability to crystallize his/her viewpoint and attitude while concomitantly leading him/her towards achievements and affording him/her the tools with which s/he will be able to learn and acquire a profession so that s/he will be able to earn a living for him/herself and his/her family and will be able to contribute to the society in which s/he lives. These goals are not identical, and are sometimes not compatible, since the strict and demanding educational framework which accurately evaluates and judges the student's achievements is not necessarily the same educational framework that is gentle, encouraging, educating and guiding. We must formulate a method that will help us use technology in order to achieve change in the education system, help the teacher achieve his/her aims, and afford him/her the opportunity to devote more time and attention to the students, to shape their behavior, shape their attitudes and built their personality. Thus, we deal with the integration of technological systems in the learning process.

Research on the various variables involved will enable a better understanding of how the process of change takes place in the education system. It also elucidates the factors and rules that affect this process. Integration of a technological system must enable the education system to achieve its goal of educating and imparting knowledge to the student. It must therefore take into account the abilities, feelings, attitudes, wishes, personalities and worldviews of all factors involved in the process of change, from the stage of examination, research and learning of a single variable, up to the stage where this variable becomes integrated with other variables, where together they create a body of knowledge, a model, that enables analysis and making decisions regarding the methods and modes of generating change (Offir, 1988; Offir & Cohen-Fridel, 1998; Offir & Katz, 1990; 1995; Offir et al., 1993). It will enable assessment of their effectiveness and measurement of the change's contribution to the achievement of the education system's goals.

In research that we carried out since 1978 we tried to identify and define variables from the field of psychology, which may help describe the process of activating computers in learning. These researches presented possibilities of using psychological variables when constructing a model for making decisions during the process of defining the method, a model that can help in the process of integrating advanced systems in teaching. Since 1991 we have concentrated on distance learning (DL) research. DL is an innovative system in the school, and its integration requires changes. The articles we published described variables that may assist in understanding the process of integrating DL in education.

Only in the next stage of research, when information was available on the existing variables, did the research turn to study the relations and effects between the variables.

In our research on DL we implemented the conclusions which we reached from the research data on the integration of computers in teaching which were collected in the previous phase of our research. The first studies in the field of DL dealt with the definition and identification of the different variables which influence the process of implementation of the DL method. The following studies examined the relation and influence between these variables and comprise the basis for a model which enables more effective activation of a DL system for the advancement of students who live in peripheral areas and are not awarded the teaching level which is in accordance with their needs.

The teacher's role in the education system is crucial. The teacher educates, imparts values, serves as a personal example, encourages, and creates a personal human bond with the student. The education system will never be able to discard the role of the teacher. Today, technological means, computers and the Internet can help the teacher achieve his/her goals. Educational research should produce data that can be used for guidance and direction: how to correctly integrate the technological innovations so that they will advance the education system towards achieving its goals.

Research that examines the integration of technological systems in teaching begins with descriptive research whose aim is to evaluate, measure, and identify the existing components and variables. The research must examine, investigate and describe an existing situation. The next stage, of carrying out prescriptive research, will be carried out based on data obtained from the descriptive research. Within the framework of this stage of the research we will examine the effect of changes that can be generated in the variables in a controlled manner (Offir, 2006; 2007; Offir et al., 2002; 2004; 2007; 2008a). We will focus on researches whose goal is to determine and shape the place of the teacher in the classroom in a teaching process that also uses a DL system. In the described method, the teacher from a distance concentrates mainly on high-level transmission of the learning material in an experiential manner, by presenting complex knowledge by an expert in the field. A teacher is found in the classroom, and s/he fulfils the role of "mediator" between the complex learning material and the student.

The role of the teacher in the classroom is to give the student personal attention, to encourage, to develop thinking ability and the ability to cope with problems, while the function of transmitting material is mostly transferred to the teacher from a distance. The program resembles a "logo" in the hands of the teacher. The teacher in the classroom leads the program and determines the teaching method. The integration and cooperation between the teacher from a distance and the teacher in the classroom create a situation in which the student receives high-level material and is also awarded personal attention. Research that is taking place at this stage examines the effectiveness of the teaching system. The research data that are collected comprise a basis for making decisions that will be implemented in the next stage of operating the DL system.

The research results that are related to the place of the teacher and his/her role in the classroom versus the teacher from a distance have yielded an approach and a theory that enable defining the functions of the teacher in the classroom as "mediator." The teacher in the classroom undergoes in-service training to help him/her to fulfill his/her role as mediator.

One of the main defining features of all forms of DL is the separation of teachers and students in space and/or time. This separation has a profound effect on both teaching and learning processes in a DL environment. Moore (1972) coined the term "transactional distance" to indicate the psychological and communications space that needs to be crossed when teachers and students are no longer physically present in the same place at the same time. This theoretical construct has contributed significantly towards an understanding of the special patterns of teacher-student interactions that characterize DL environments.

Method

In our research we learn how a five-category content analysis instrument was used to identify which types of verbal dialogue exist across conventional and videoconference-based DL environments. No content analysis instruments were available for use in a DL environment until Henri (1992) developed the first DL coding system in 1992. Henri's analytical framework is based on findings in the field of cognitive psychology, and enables the observer to reach a more profound understanding of the different types of dialogue that characterize the teacher-student relationship in a DL environment. Henri's instrument is very valuable in that it is derived from recent research on learning, and has served as a basis for the models subsequently developed by Oliver and McLaughlin (1996) and Offir and Lev (2000).

In these models, Henri's metacognitive category was eliminated and many of her original category definitions were expanded and revised. The instrument used to analyze verbal dialogue in this study contains the following five categories: (1) social interactions; (2) procedural interactions; (3) expository interactions; (4) explanatory interactions; and (5) in-depth interactions:

- Social interaction: The teacher/student talks in order to create and develop a social relations system. For example: Teacher: Hi Joe, how are you? Student: Fine, thank you. Teacher: Good to hear that, what are you going to do for us?

- Procedural interaction: The teacher/student dialogue serves for transmitting information concerning the requirements of the course and related procedures. For example: Student: How long should the paper be? Teacher: About two pages.

- Expository interaction: The student or teacher exhibits knowledge or talents in response to a demand from the other party. For example: Teacher: Can anyone tell me the name of this animal? Student: That is a tiger cat. This is an interaction solely on the knowledge level.

- Explanatory interaction: The teacher uses the students' responses in order to explain the knowledge and develop the lesson's content. For example (from a flute lesson): Teacher: Joe, can you play the flute? Student: (playing do). Teacher: That was good, but you must blow a little softer.

- In-depth interaction: The teacher gives constructive feedback to the student, which will cause the student to re-examine his/her ideas (reflection) and consider points for an alternative view. For example: Teacher: Can you tell me what you think was the main reason for his actions? Student: Maybe he wanted revenge. Teacher: But was this the only reason? What about the fact that . . .

Results

These categories were used to analyze teacher-student exchanges of verbal dialogue in two different contexts: videoconference-based and conventional learning environments.

First Phase: Conceptualization, i.e. Identifying Concepts

The observation instrument for recording verbal exchanges of dialogue in the classroom was developed from previous categorization systems developed by Henri (1992), Oliver and McLoughlin (1996), and Cookson and Chang (1995). Based on these theories of observation, an instrument was constructed. A lesson of 45 minutes was videotaped and observed by eight judges. The judges were asked to identify and classify the different teacher–student interactions. Category validity, content validity and an inter-judge reliability level of 0.82 were established (Offir & Lev, 2000; Offir et al., 2001; 2003).

Second Phase: Validation of the Concepts

This phase included examination of the validity of the concepts as an instrument which will enable differentiation between the two learning environments, i.e. do the concepts behave differently in the two learning environments? A total of sixty lectures, thirty transmitted via videoconferencing and thirty given by the same lecturers in a conventional learning environment, were videotaped for content analysis purposes. Our integrated analysis of verbal dialogue and nonverbal behaviors generated data that empirically validate and expand aspects of Moore's “transactional distance” theory and may form the basis for the development of theory-driven, data-based models of evaluation and staff development for DL environments.

A total of 245 subjects participated in these courses, 190 in a traditional and 55 in a DL environment. The students’ ages ranged between 18 and 40. All were studying for their BA in social sciences or the humanities. Content analysis was qualitative-interpretative, and the main interpretation that was carried out was to determine the type of interaction that took place. Five specific categories of verbal interactions were examined: social, procedural, expository, explanatory and in-depth. A MANOVA analysis with repeated measurements revealed significant differences in two categories of interactions of verbal dialogue: procedural and explanatory across learning environments [$F(5,42) = 2.41$, $p = 0.5$]. Table 1 presents the analysis of variance for each category of interaction.

Table 1: Comparison of Means and Standard Deviations for Categories of Verbal Interactions in Conventional and DL Environments

Categories		**DL**		**Conventional**	
	***F*(1,46)**	***SD***	***M***	***SD***	***M***
Social	0.10	2.51	1.92	2.13	2.12
Procedural	*5.07	2.48	3.79	1.37	2.33
Expository	0.00	4.36	5.04	4.23	5.12
Explanatory	**7.11	1.42	89.	4.19	3.29
In-depth	0.11	5.64	4.54	4.76	5.04

*p<.05, **p<.01

Procedural interactions increase, while explanatory interactions decrease compared to a conventional learning environment. Table 1 also shows that the standard deviations are large compared to the means. The data were transformed to logarithms, and a MANOVA analysis was conducted to reduce standard deviations. Similar results were obtained after logarithmic reduction of the data. The results confirm our central hypothesis which predicted that significant differences would be found in specific categories of verbal dialogue patterns across two different learning environments.

The results comprised a conceptualization of the various interactions that exist between the teacher and the student. We found that not all interactions can also be created in a DL system. The role of the teacher in the classroom is not identical to the role of the teacher from a distance. It appears that more of the teacher's roles in the classroom can be transferred to the technological system if we succeed in defining the various interactions that take place in the classroom. Indeed, if interactions are studied and investigated, it will be possible to transfer some of the roles of the teacher in the classroom to the technological system. The more sophisticated and accurate our knowledge regarding various interactions, the more flesh and blood teachers' roles can be transferred to the technological system.

Empiric evidence regarding differential use of procedural and explanatory categories of dialogue in a DL environment confirm Moore's (1993) transactional distance theory. As we described previously, this theory predicts cross-context changes in teaching and learning processes in a DL environment due to the greater communicative-psychological distance that exists when teachers are separated from their students. Although this distance can also exist in a conventional learning environment, its effect is magnified during DL, and results in a greater potential for gaps in perceptions and misunderstandings in the teacher-student relationship.

Understanding how the dynamics that characterize DL affect specific categories of verbal interactions has both theoretical and practical applications. Information regarding potential cross-context changes in teacher-student interaction patterns can assist educators in understanding the relative advantages of different learning environments and make data-based decisions regarding the compatibility of learning objectives and learning environments.

The development of theory-driven, data-based models for evaluation and staff development may help rectify the current situation in which technological changes are often adopted and implemented without an adequate educational rationale. According to Salomon (2000), recent technological development has been so rapid that some think it dictates the learning processes in the classroom, instead of first preparing an educational rationale based on theories of learning processes, with technology serving as a tool for its implementation.

Integration of a DL system in teaching requires the presence and influence of the teacher, since there is no teaching without the teacher's contribution. Distance learning is an instrument that may even enhance the teacher's contribution and may afford the teacher greater opportunities to express his/her influence. Empowerment of the teacher and clearly defining the place and method where the teacher's contribution may be most significant requires use of a unique research strategy.

The research field is the learning frameworks and the research results are analyzed and taken into account during the process of the implementation of the technological systems. Our research began with identification, definition and understanding the variables that influence the process of the implementation of a

DL system, i.e. the descriptive research stage. This was followed by an examination of the relations and mutual influences between these variables.

Third Phase: Correlation between Variables

The definition of "explanatory interaction": The teacher uses the students' responses in order to explain the knowledge and develop the lesson's content. It was found that teacher-students "explanatory interactions" decrease in DL environments. The described study was conducted in order to analyze the factors which influence the effectiveness of the "explanatory interaction" in a DL environment (prescriptive research). One hundred and twenty high school students were divided into three groups (the students studied a university course via a synchronized distance learning system). One research group received cognitive interaction, a second group received cognitive interaction, referring to the effort invested by the student and a third group received cognitive interaction referring to the student's ability. It was assumed that differences in motivation and self-efficacy would be found between the three research groups. Differences between the three research groups regarding their satisfaction from the course and from their achievements were also examined. Comparison between the research groups was performed based on three groups of parameters. One group of parameters was examined only before the intervention program, one group was examined only after the intervention program and one group of parameters was examined both before and after the intervention. The research hypotheses focused on the differences between the three research groups.

Differences in the influence of the interaction on improving motivation and the sense of efficacy were examined. The parameters in these fields were examined before and after the course. It was hypothesized that the improvement in the research groups that received statements of effort or statements of ability would be greater than the improvement in the other groups. Analyses of variance were first performed in order to examine the differences between the groups before beginning the intervention program. It was assumed that the groups would be similar in terms of the motivation components before beginning the activation of the different types of interaction. MANCOVA analyses were then performed, where the measurement performed after the intervention program comprised a dependent variable and the parameter before the intervention comprised a covariate. The findings of these analyses are presented. Five parameters were examined: internal motivation, external motivation, sense of effort, sense of importance and self-efficacy. The range of possible scores for each of these measures was 1–7, i.e. the higher the score the higher the motivation components.

No significant differences were found between the three researches groups in a MANOVA analysis for examining the differences between the groups in the measurement taken before the intervention program [$F(10, 324) = 1.5, p < 0.05$].

Thus, these groups began at a similar level of motivation. MANCOVA analysis was performed for testing the differences between the groups that took place between the two measurements. This analysis indicated a significant difference between the three research groups [$F(10, 216) = 24.46$, $p < 0.05$]. The means and standard deviations of the research groups in the five motivation parameters, as well as the MANCOVA analysis results performed for each parameter separately, are presented in Table 2.

MANCOVA analysis for each parameter separately indicated significant differences between the three research groups in all five parameters. The greatest difference was found in internal motivation and self-efficacy, followed by importance and effort. The smallest difference was found in external motivation. MANCOVA analyses were performed in order to examine the source for the differences between the groups. A comparison was made between the group that received cognitive interaction and interaction of ability and the group that received cognitive interaction and interaction of effort. MANCOVA analyses were also performed for comparing between the group that received cognitive interaction and interaction on ability and the group that received cognitive interaction and interaction on effort, as well as for comparing between the second and third research groups.

Table 2: Means and Standard Deviations of the Motivation Components in the Three Research Groups

Research groups								
		Cognitive + ability ($N = 45$)		Cognitive + effort ($N = 44$)		Cognitive ($N = 31$)		
		Before	After	Before	After	Before	After	$F(2,112)$
Internal motivation	*M*	5.86	6.31	5.88	6.61	5.54	3.87	135.56***
	SD	0.89	0.64	1.03	0.49	0.95	1.18	
External motivation	*M*	5.52	4.46	5.86	3.86	5.65	5.18	9.76***
	SD	1.41	1.62	0.94	1.52	1.15	1.52	
Importance	*M*	5.95	6.04	6.10	6.40	6.18	4.29	51.16***
	SD	1.10	0.82	0.99	0.63	0.80	1.40	
Self-efficacy	*M*	5.77	6.24	5.81	6.54	6.06	4.00	142.67**
	SD	1.28	0.75	1.03	0.62	0.69	1.03	
Effort	*M*	5.48	6.02	5.66	6.23	5.48	4.30	46.99**
	SD	1.13	0.80	0.93	0.80	1.05	1.19	

** $p<0.01$, *** $p<0.001$

Discussion and Conclusions

The present paper presents the types of teacher-student interactions that exist in a regular lesson and also defined types of teacher-student interactions that cannot be maintained within the DL framework. Recognition of different types of interactions is important, since these must be taken into account in the process of constructing and determining the method of a learning system, which integrates, advanced technological systems.

During our research we identified interactions that exist between the teacher and the student, which cannot be created in the DL method of teaching. Our project was therefore constructed such that the teacher would be able to maintain these significant interactions (Offir, 1988; Offir & Cohen-Fridel, 1998; Offir & Katz, 1990; 1995; Offir & Lev, 2000; Offir et al., 1993; 1994; 2005). Identification of the variables was performed by descriptive research, which examined the context. In contradistinction, examination of the interrelations between the variables was carried out using prescriptive research. The research results afford a model for deliberation and decision-making regarding the teacher's position and his/her contribution to the learning process. The teacher's role and the teaching method change according to the teaching and learning goals (Offir, 2000; Offir et al., 2008b).

Our conclusion is that in order to blunt the influence of negative motivation and reinforce the student with positive motivation, the teachers should use two types of interaction strategies. They should focus on the effort that the student invests, emphasizing the perception that errors and mistakes are an immanent part of any learning and advancement process. They should also afford interaction that promotes the student's self-esteem and his/her belief in his/her ability to invest effort and achieve the aim. The student must be supplied with interaction that reflects his/her achievements not only in terms of knowledge, but also in terms of effort and ability. An interaction that refers to affective processes and not only to cognitive processes increases students' motivation.

In conclusion, the potential contribution of this research is embedded in the use of an integrative approach. The model integrates between different types of interaction and learning products. Clarification of the interrelationships between these variables may contribute to the identification of components necessary for optimal utilization of the advantages of distance learning environments. This study is mainly qualitative, but quantitative tools were also used. The results produced using these tools are intended for a more in-depth discussion of the quantitative findings, as well as for exposing other dimensions in the analysis of the research questions.

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INVARIANCE OF AN EXTENDED TECHNOLOGY ACCEPTANCE MODEL ACROSS GENDER AND AGE GROUP

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Abstract

In this study, we examined the likelihood of an extended technology acceptance model (TAME), in which the interrelationships among computer self-efficacy, perceived usefulness, intention to use, and self-reported use of computer-mediated technology were tested. In addition, the gender- and age-invariant of its causal structure were evaluated. The data were collected from a self-reported questionnaire administered to 477 administrative staff of a public university in Malaysia. The results of structural equation modeling supported the adequacy of TAME. Although the TAME's causal structure was applicable to both male and female staff, age group appeared to moderate the structural relationships among the constructs of interest.

Introduction

The Technology Acceptance Model or TAM (Davis, Bagozzi, & Warshaw, 1989) is one of the most profound frameworks frequently used in studies to predict and explain the use of computer-based applications and solutions. The model asserts that the adoption of a technology is determined by the user's intention to use, which in turn is influenced by his or her attitudes towards the technology. It is very likely that the variability in these attitudinal and behavioral constructs depends on the user's perceptions — perceived usefulness (PU) and perceived ease of use (PEU). While PU indicates the extent to which the use of the technology is promising to advance one's work, PEU represents the degree to which the technology seems to be free of effort (Davis et al., 1989). This model posits that attitudes and behavioral intention mediate the effects of PU and PEU, the two constructs of extrinsic motivation.

As TAM is reasonable, simple, and robust (Venkatesh & Davis, 2000), the study on TAM has been receiving continual interest from decision-makers, practitioners and researchers. Through the years, research on the efficacy of TAM covers a broad range of settings, samples, and computing technology across knowledge domains. However, recent meta-analyses (Ma & Liu, 2004; Schepers & Wetzels, 2007; Yousafzai, Foxall, & Pallister 2007) suggest that our understanding in this area could further be enhanced if several overriding issues are addressed.

The first of these issues concerns the criterion measures used in previous TAM studies, primarily that the (i) behavioral intention to use, and (ii) use of technology were based on the adoption of specific applications. In educational settings, individual studies used either the adoption of word processors (Davis, et al., 1989), spreadsheets (Mathieson, 1991), PowerPoint (Hu, Clark, & Ma, 2003), e-mail (Shih, 2004), multimedia learning system (Saade, Nebebe, & Tan, 2007), e-learning (Ndubisi, 2006), digital library (Hong, Wong, & Tam, 2002), or learning management system (Yi & Hwang, 2003). Ma and Liu (2004) observe that the "differences in measurement items between studies tend to be the result of adapting TAM to different technologies" (pp. 61–62). Clearly, such measures constitute piecemeal approach to the understanding of technology acceptance, and are insufficient to represent the complexity of technology-based work environment. In their daily work, the administrative staff of a university use a plethora of communication systems, office systems, and general computer-based applications. It is reasonable, therefore, to extend and validate the adequacy of the TAM in an ecologically sound setting, where all sorts of computer-mediated systems and applications are accessible to faculty members.

The second issue in the TAM literature concerns the generality of the model across user populations. The literature indicates that more than 40% of the research on TAM (Schepers & Wetzels, 2007; Yousafzai, Foxall, & Pallister 2007) used students as the sample. However, results yielded from student samples are not replicable to other types of users within education communities. In fact, Schepers and Wetzels found that the user-type moderated the causal relationships within the model; on the average, student samples produced reliably superior effect sizes than did the non-student samples. Furthermore, Selwyn (2007) claims that, "the formal use of computer technology [*by faculty and administrators*] in many areas of higher education could best be described as sporadic, uneven, and often low level" (p. 84, emphasis added). It is very likely that each student sample consists of relatively homogenous users who are required, and who are in many cases willing, to try out new technology. The university administrators, on the other hand, are more diverse and more experienced, but are less inclined to adopt new technology unless it is imposed on them.

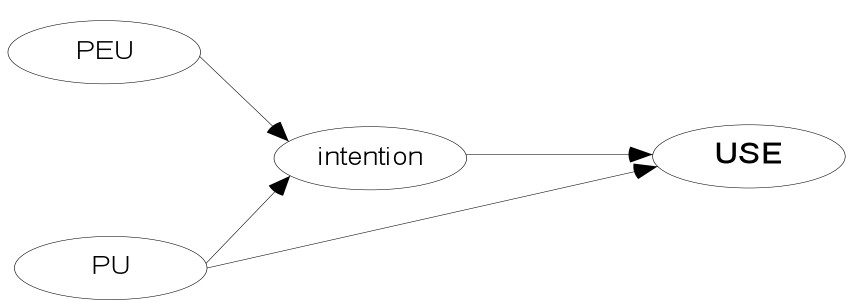
Third, although TAM is one of the most influential bases to describe technology acceptance, the empirical evidence gleaned from various TAM studies yielded mixed signals. Inconsistent results abound, both in terms of the magnitude and direction of the relationships (e.g., Dasgupta, Granger, & McGarry, 2002) among the constructs of TAM; others pointed to unreliable relationships (Lowry, 2002; Shih, 2004). One possible reason for these discrepancies is the existence of moderating variables influencing technology acceptance inconsistently across the levels of the independent variables. Unfortunately, studying the interactive effects of a third variable is a neglected area in TAM research. Of the limited number of cross-validation research on TAM, there are indications that gender (Gefen & Straub, 2000), and culture (Straub, Keil, & Brenner, 1997) moderated the expected causal relationships. Besides gender and culture, Yousafzai, Foxall, and Pallister (2007) postulate that differences in subject type, method type, technology type, and measurement of usage characteristics are likely to moderate the hypothesized relationships.

Against this backdrop, one purpose of the present study was to validate the likelihood of an extended technology acceptance model (TAME) on the data derived from the members of a university administrative staff in an ongoing computer-mediated work setting. The study extended the original TAM model by including an *intrinsic motivation* component — *computer self-efficacy*. In so doing, the study assessed the direct and indirect effects of *computer self-efficacy* on the use of the technology, via the perceived usefulness and intention to use the technology voluntarily. The second purpose of the study was to evaluate gender- and age-invariant of the causal structure of TAME. This cross-validation procedure determined whether gender and age group moderated the causal structure of the model, and thus the generality of TAME.

The Extended Technology Acceptance Model

Framed within Ajzen and Fishbein's (1980) theory of reasoned action (TRA), Davis et al. (1989) proposed a robust and simple model of technology acceptance (TAM) that would "explain computer usage behavior" (p. 983). The TAM (Figure 1) is a powerful framework because it provides theoretically valid reasons for the variability in one's acceptance and use of computer technology. The model is parsimonious in the sense it is based simply on three antecedent variables — PU, PEU, and behavioral intention — to predict use, albeit PEU has been found to be less influential and reliable. Still both PU and PEU were the factors that extrinsically motivate users to accept, adopt and use the technology (Igbaria, Iivari, & Maragahh, 1995).

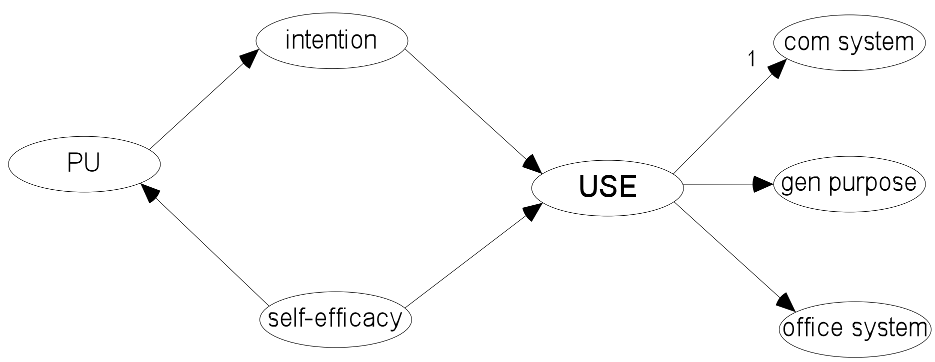
Figure 1: Technology Acceptance Model



(Davis et al., 1989)

The inclusion of an intrinsic motivation construct, most importantly the self-efficacy beliefs, would definitely provide deeper and richer understanding of why and how the technology is used (Figure 2). Bandura (1977) argues that one's sense of efficacy is one's causal judgment in predicting one's ability to perform a behavior successfully. In relation to computer usage, the belief that one can even communicate electronically with other staff members, for example, reflects a high level of efficacy. An efficacious user, in essence, believes that he or she can assess the usefulness of the computer-mediated work environment, thus bringing out positive changes in his or her *behavioral intention* and *use of the technology*.

Figure 2: The Extended Technology Acceptance Model (TAME)



Social cognitive theory indicates that as a variable, *self-efficacy* strongly affects a person's decision to attempt a task, the amount of effort put in and the degree of persistence exhibited in completing the task, and the ability to withstand difficult circumstances (Salomon, 1984). An efficacious staff member has higher comfort and confidence to attempt computer-mediated tasks, varying from using the computer applications to enhance job performance to developing a web-based learning environment. Such a user is committed to accomplishing challenging tasks involving the use of the technology simply because it is intrinsically rewarding (Deci, 1975; Deng, Doll, & Truong, 2004). Based upon these arguments, it is hypothesized that:

Hypothesis 1: Computer self-efficacy directly influences staff members' use of the computer-mediated technology.
The literature suggests that *computer self-efficacy* accounts for substantial variance in an individual's beliefs (Igbaria & Iivari, 1995) and behavior (Compeau & Higgins, 1995) in using the technology. Since an efficacious user has confidence in using the computer, it is reasonable that he or she could anticipate and appreciate the usefulness of computer-mediated technology, which in turn would determine its acceptance. Thus, intrinsic motivation also indirectly affects technology acceptance via the beliefs a person holds about the usefulness of the

technology. Consistently, several previous studies had supported the mediated effects of computer self-efficacy (Doll & Truong, 2004; Deng et al., 2004; Igbaria & Iivari, 1995). Thus in this study, it is hypothesized that:

Hypothesis 2: Computer self-efficacy indirectly influences use of the computer-mediated technology through perceived usefulness and intention to use. Perceived usefulness is one's belief that a given technology will help one to achieve one's work goals. With respect to administrative staff use of computers, it represents the degree to which the user perceives the technology would facilitate his or her performance. Data from previous findings supported the expectation that perceived usefulness influences one's intention to use, which ultimately determines the use of computer-based technology. In the current study, it is hypothesized that:

Hypothesis 3: Perceived usefulness positively influences intention to use the computer-mediated technology.

Hypothesis 4: Intention to use computer-mediated technology positively influences its use.

Method

The data for this study were obtained from 477 administrative staff of a public university in Malaysia, representing almost 50% of the population of administrative staff. A majority of the sample were females (58%); 52% aged 30 years or below. The respondents, who consisted of middle managers and administrative and technical support staff, were employed in various academic and management departments. The sample size was deemed adequate for the application of structural equation modeling (SEM) to address the research objectives.

To collect the data, we used a self-reported questionnaire containing items that measured three exogenous constructs of interest, namely computer self-efficacy, perceived usefulness (PU), and intention to use. Each construct consists of items to which respondents would indicate on a 5-point scale the extent of their agreement or disagreement with each assertion. In addition, the frequency of using three types of computer-mediated systems — communication systems, general purpose systems, and office systems — collectively served as the endogenous variable (USE).

To test the research hypotheses, the study applied a three-stage structural equation modeling, using the AMOS (version 16) model-fitting program. Using confirmatory factor analysis (CFA), the study first assessed the validity of the measurement model of use of computer-mediated technology. Next, we examined the good-fit of the full-fledged TAME (Figure 3). Finally, we cross-validated the model to assess the moderating effects of gender and age groups of TAME.

Results

This section presents the results of the structural equation modeling that addressed the objectives of the study.

Validity of the Measure of Use of Computer-Mediated Technology

Figure 2 contains the measurement model of the faculty's use of computer-mediated technology that comprised three first-order and one second-order factors. Each of these first-order factors was measured by three items; each item was assumed to load only on its respective dimension. The three factors, namely the communication systems, general-purpose systems, and office systems were expected to load on the second-order factor, the staff members' use of the technology (USE). Using the maximum likelihood estimation procedure of the confirmatory factor analysis, the validity of this measurement model was tested first.

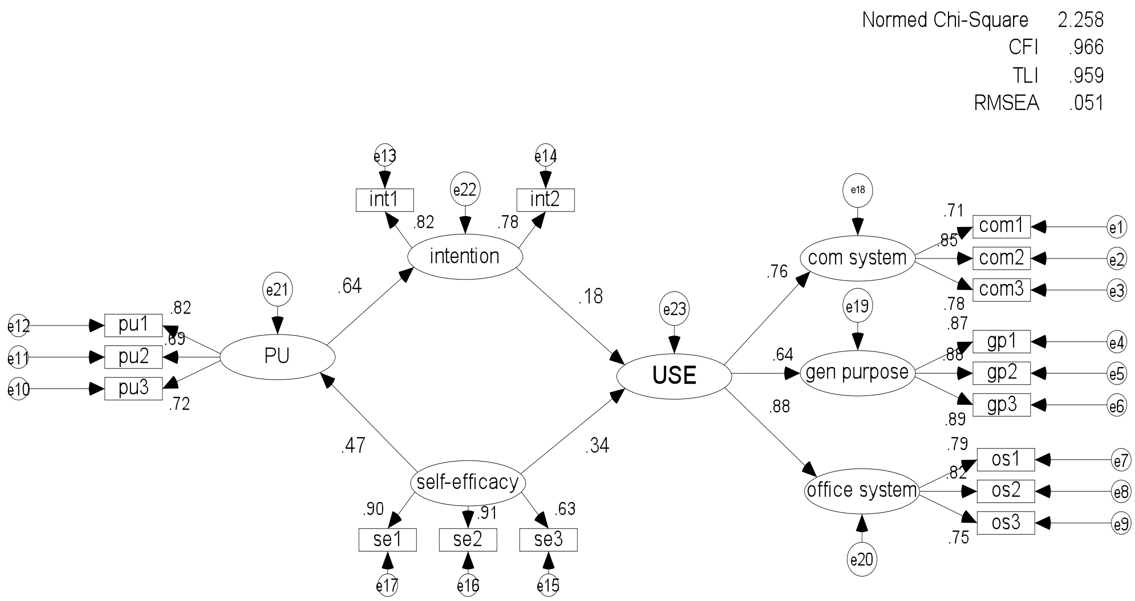
The results indicated that the hypothesized nine-item measurement model was consistent with the data. The overall fit of the model was adequate, the relative χ^2 = 2.23; RMSEA = .05; CFI = .99; TLI = .98. In other words, the measurement of technology use did generate the observed covariance matrix; there was no evidence that the measurement model is incorrect. In addition, the direction and magnitude of factor loadings were substantial and statistically significant, and the model was free from offending estimates. The Cronbach's alpha for the first-order factors were .82 (communication systems), .91 (general-purpose systems), and .83 (office systems). The data also supported the measurement adequacy in terms of their convergent and divergent validity; these are supports for construct validity of the model.

Adequacy of the Causal Structure of the Extended Model (TAME)

Figure 3 summarizes the results of structural equation modeling of TAME. The confirmatory modeling yielded consistency of the hypothesized causal relationships with the data (relative χ^2 = 2.26; RMSEA = .05; CFI = .97; TLI = .96). All these fit indices satisfied their critical cutscores; the results, therefore, indicated a fitting TAME.

The parameter estimates of the hypothesized model were free from offending values. All path coefficients of the casual structure were statistically significant at .005 levels, and were of practical importance. The data indicated that computer self-efficacy was relatively more influential than was behavioral intention in affecting the use of computer technology. The total standardized effect size of computer self-efficacy→use was .39, .06 indirectly via PU and intention to use. In sum, the results provided support for the four research hypotheses.

Figure 3: Standardized Coefficients of the Hypothesized TAME



Gender- and Age-Invariant of the Extended Model

Another objective of this study was to examine the structural invariance of TAME across two likely moderators, gender and age groups. To test gender-invariant, a simultaneous analysis on both the male (n1 = 189) and female (n2 = 265) samples was conducted, first without constraining the structural paths; the results derived a baseline chi-square value. Next, structural paths (self-efficacy→USE; self-efficacy→PU; PU→intention; intention→USE) were constrained to be equal for the male and female groups. The analysis of this constrained TAME produced another chi-square value, which was then tested against the baseline value for statistically significant differences. A similar procedure was used to examine the age-invariant of TAME. The results of the multiple-group SEMs are presented in Table 1.

The invariance test across the male and female groups resulted in a statistically insignificant change in the chi-square value, $\chi^2(4) = 13.44$, $p > .005$. Simply said, the difference in the chi-square values between the unrestricted model and the constrained model did not produce a poorer-fit model. The path coefficients did not vary significantly across gender. It is justifiable then to conclude that gender did not interact with the exogenous variables to influence the staff members' use of computer-mediated technology; hence, gender is not a moderating variable.

Table 1: Results of Multiple Group Modeling

		χ^2	df	Critical-Value	χ^2 Change
Gender					
	Unrestricted	479.16	224		
	Constrained	488.89	238	14.9	9.73
Age					
	Unrestricted	369.10	224		
	Constrained	395.97	228	14.9	26.87*

* Statistically significant at .005

On the contrary, the age-invariant test was statistically significant, $\chi^2(4) = 26.87$, $p < .005$. Specifically, the constrained TAME was much worse than the unrestricted model. This shows that the path coefficients varied across the two levels of age group (30 years old or less; more than 30 years old) because age group interacted significantly with the exogenous variables. Thus, group memberships moderated the causal relationships.

Conclusion

The findings of the present study have expanded the existing body of knowledge on TAM in several ways. First, the results substantiated the psychometric properties of the measure of use of computer-mediated technology. The measure seems to be adequate to represent the ongoing use of communication systems, office systems, and general computer-based applications among administrative staff. Second, the results validated the good-fit of the extended technology acceptance model (TAME). The results also support the efficacy of the original TAM (Davis et al., 1989), which posits that perceived usefulness and behavioral intention explain computer usage. In addition, the result is consistent with Compeau and Higgins's (1995) work that found the influential effect of computer self-efficacy on technology use. Finally, the present study provides indications that while the extended model is applicable for male and female computer users, age factor limits the generality of the TAME.

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RESEARCH ON IMPROVING PROCESS ASSESSMENT SYSTEM OF DISTANCE EDUCATION BASED ON DATA MINING

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Abstract

In order to promote students' interests in courses, and enhance teaching design for management, the process assessment system is applied to the student's whole learning process, such as attending lectures, assignments, discussions and examination. The parameters in assessments system are usually designated via experiences. According to the normal distribution of population, we utilize the k-means to cluster the parameters of assessment, and discuss the relationship between the parameters and the final score. It is concluded that the assessment system need to be perfected further, and more help should be offered for the distance learners.

Preface

In China, the exploration of Internet-based distance education lasts for eleven years. As a new mode of life-long education, it not only promotes the education level of the society, but also provides the comprehensive and convenient mode for the construction of a learning society. However, now there are many problems in the distance education in China. For example, in the teaching process, the subject construction does not completely match the distance education, and the learning mode does not match the learning evaluation mode. All of these make the teaching and learning quality unsatisfied for the learners and teachers. Some researchers propose that it is essential to strengthen the whole process monitoring, and it includes three aspects: monitoring input quality, running quality and output quality.

Process assessment is important for the whole process monitoring on teaching and learning quality. It is an evaluation of learning process of the students, and the instruction on the learning process and improvement on the teaching are emphasized. Black (1998) thinks that the information collected in the formative evaluation (similar with the process evaluation) is useful in adjusting the teaching and learning process. Boston (2002) points out that formative evaluation includes inspection of the teacher, discussion in the classroom, and analysis of the learning process (including homework and examination). The Assessment Reform Group, ARP UK, issued ten principles of formative evaluation.

In the practice of distance education, the educators found that it's important to construct the learning evaluation system, which is different from that in the traditional education mode. FAST (The Formative Assessment in Science Teaching) undertaken by OU (Open University of UK) has developed the online formative evaluation framework. In the Open University of Hong Kong, students must pass both formative assessment and terminative examination in some courses. The weight of the formative assessment in the final score is different in different countries and districts. In some Open Universities in India, South Korea, Pakistan, Sri Lanka, it's 30%, and in the Open University of Hong Kong, it's 50%, and in China Central Radio and TV University, it's 20%. However, it's inevitable to increase the weight of formative assessment in the distance education (Chen Nai Lin, 2006).

In China, there are 67 universities engaged in the modern distance education trial work. In a broad sense, the concept of formative assessment includes all the activities of teachers and students, and the activities can be used diagnostically to alter teaching and learning (Huang Rui-hong, 2006). However, in this passage, we mainly discuss the learning process of the students, and we call it process assessment system.

Now many methods are provided for the distant learner, such as courseware through the Internet, discussion in BBS, question and answer on Internet through audio and video, and homework in the Internet. The question is how to gain our ends by these methods, and how to reflect this to the final assessment (Zhang Jianhua, 2007; Zhu Yu-ping, 2006). We have established the evaluation system based on process assessment. In practice, the criteria system including six parameters was adopted to evaluate the learner, and the six parameters were set to different weight to calculate the final score.

This paper is organized as follows: the step of k-means algorithm is briefly introduced, the process assessment system is proposed, an illustrative example is provided from ECUST (East China University of Science and Technology), and some conclusions are drawn.

Cluster Analysis

According to the principle of "maximizing the similarity in the cluster, minimizing the similarity among the clusters," the data objects are grouped into different classes or clusters. The objects in the same cluster have higher similarity, while the objects in different clusters have lower similarity. Clustering analysis mainly includes partition-based algorithm, hierarchy-based algorithm, density-based algorithm, grid-based algorithm, and model-based algorithm. K-means belongs to the partition-based algorithm, and its merit is simple algorithm structure and fast convergence rate, and fitness for the large-scale data analysis (He Ling, 2007).

In the iteration of k-means algorithm, the center of every cluster C_i in previous iteration was calculated as the seed of current iteration. The procedure is as follows:

1. Select k different data objects as the center of k clusters;
2. Assign every data objects to the class which represent the nearest cluster, and k clusters are formed, then the cluster criteria function is calculated;
3. Calculate the center of every cluster in previous iteration, and regard it as the center of the current iteration;
4. If these centers are the same as the centers in the previous iteration or the value of cluster criteria function is lower than the threshold value for more than twice, then terminate or carry out the next iteration. (Jiawei Han, 2007)

The center of k-means means the averaged value of the object in the cluster. Since cluster algorithm is an unsupervised algorithm, the performance evaluation function is used for the validity judgment of the cluster output. In k-means, the Euclidean distance between the object and the center or its square deviation is used to evaluate the cluster, and the definition is:

$$E = \sum_{i-1}^{k} \sum_{p \in C_i} \left| p - m_i \right|^2$$

E represents the sum of all the square deviation of the objects, and p is a point which represents the object, and m_i is the averaged value of cluster C_i (p and m_i are both multidimensional)

Process Assessment System

The fair-and-square and all-around evaluation for the learning process of the students is very important. It’s not only the evidence of the scholarship and entitled certificate, but also the motivation of the student on study. Especially in the distance education, the target population is the amateurish learner. The evaluation mode in traditional university education mainly depends on the final exam score, and is obviously not fit for the students in distance education. For these students, the following factors should be taken into account: the learning process, the capability to learn and to implement in the work. So a new learning evaluation system (or as we call it “process assessment system”) must be established.

The approaches provided for the learners are also the reference criteria in the process assessment. The following factors could be the reference criteria: the log of the count and the time length of the courseware study (the granularity of navigation map in courseware for the learner is a week, and the granularity of content is a study guide in every chapter); the valid post in the study community (we have established the study community for every course, and the learner can put question here and there are tutors to answer the questions and confirm the valid post); the record of the online consultation through audio and video based on the Internet; the record provided by the learning centers of attending class and discussion and the evaluation of their activity; the score of the phase exercises and homework based on Internet.

In our teaching and learning system, we trace the learning process through the record of courseware study, online homework, examination, BBS and so on. According to the experience in practice, we adopt the criteria system with six parameters, including the count and time length of the courseware study, valid post number on BBS, regular evaluation from the teacher, scores on the final exam and scores in the online homework. The six parameters were set to different weight to calculate the final score. In need of data mining analysis, several fields in the database from different table were picked up. The meaning of the criteria is shown in Table 1.

Table 1: Parameters of Learning Process on One Course

Parameter	**Unit**	**Weight in final score**	**Remark**
the count of the courseware study	times	10%	Not less than 10 times in a semester
time length of the courseware study	Minutes		Not less than 15 minutes
Regular evaluation from the teacher	Score	10%	
valid post number on BBS	Number of the post	5%	Not less than 5 times
scores in the online homework (1)	Score	7.5%	
scores in the online homework (2)	Score	7.5%	
scores on the final exam	Score	60%	

Since the object is the cluster characteristic of learning process in one course with statistical meaning. The characteristic of learner and course should be hidden. The six parameters almost cover the learning process, including having classes, attending discussion, test and examination. The weight of the criterion parameters are set for the calculation of the final score.

However, the process assessment system is established by experience, and it is essential to analyze and prove the validity of the system, especially the parameter setting. We try to find the validity and the aspect to be improved by cluster analysis.

Experiment

If the quality of the data source to analyze is poor, it's difficult to guarantee the output of the data mining. Usually, there is noise, data loss, data inconsistency in database, so the data pretreatment is necessary.

Data Pretreatment

The steps of Data Pretreatment are follows:

1. Data clean-up. Firstly, the fragmentary data should be disposed. The absent record in six parameters, for example, the record which is zero in the count of the courseware study, should be deleted. That is to say, the object is the learners who have really taken part into the distance education. The next step is dealing with the data noise. The data noise is the data which deviate from the cluster badly or do not conform to the reality. There are two ways to get rid of the noise. The first is to set the critical value, for example, all the records of the time length in the courseware study which is higher is more than 100 hours should be deleted; the second is to delete the data which deviate from the cluster obviously by the pre-cluster method.

2. Data reduction. Data reduction is a measure of data pretreatment in data mining. The data set after reduction is much smaller than the original. However, the integrity of the data is maintained furthest, that is to say, the analysis result is similar with the one which uses original data set and has higher computation complexity. The strategy of data reduction includes the data cube collection, property subset choice, latitude reduction, value reduction, discretization, concept hierarchy and so on. In the experiment, the non-layback Simple random sampling is adopted, and finally 1127 records without characteristic of the course

and 100 records in *ethic* course are decided to taken into the final computation.

3. Standardization. This is a required step of data pretreatment for cluster analysis. Since the Euclidean distance has to be computed for the evaluation, the step to eliminate the dimensions brought by different parameters is essential. So we standardize the property data and make them fall into the region, and the standardization formula is

$$X_{ij} = \frac{x_{ij} - \overline{x}_j}{S_j}.$$

K-means Clustering Result

Firstly, it is an important technique to choose the appropriate cluster count. K-means would select initial centers from K clusters, and it is badly influential to change the count of the selected clusters. The disposal strategy of k-means is to experimentalize repeatedly to decide the most appropriate K value. In the process to select the K value, we could judge the estimation of the cluster result by analyzing the center square deviation parameter.

Based on the physical meaning of the clusters in reality, we could also set the initial K value purposefully. Here, we select three kinds of students: excellent, common, inferior, and this is based on the characteristic of normal distribution of population. So we set k = 3 as the base of initial cluster count. In the experiment, we have tried to set K = 3 and K = 5, and found that the two choices could classify the learning condition of the students commendably. Every cluster was classified further, and shown in Table 2, ordered by the estimation of whole behavior.

Table 2: Comparison of Different Clusters Based on 1127 Records without Characteristic of the Course

<table>
<tr><td rowspan="2">estimation of whole behavior</td><td colspan="2">K=3</td><td colspan="3">K=5</td></tr>
<tr><td>Record count</td><td>proportion</td><td>Record count</td><td>proportion</td><td>Proportion after Consolidation</td></tr>
<tr><td rowspan="2">Excellent</td><td rowspan="2">163</td><td rowspan="2">14.5%</td><td>52</td><td>4.7%</td><td rowspan="2">11.4%</td></tr>
<tr><td>75</td><td>6.7%</td></tr>
<tr><td rowspan="2">Common</td><td rowspan="2">658</td><td rowspan="2">58.4%</td><td>473</td><td>41.9%</td><td rowspan="2">72%</td></tr>
<tr><td>340</td><td>30.1%</td></tr>
<tr><td>Inferior</td><td>306</td><td>27.1%</td><td>187</td><td>16.6%</td><td>16.6%</td></tr>
</table>

So in general, the learner can be classified into three groups:

- Spend much time on study, excellent (about 10%–20%)
- Study according to the basic demand, common (about 60%–70%)
- Spend little time on study, inferior (about 10%–20%)

Meanwhile, if the count of the cluster is not enough, the result set would be too rough, whereas we could find more details for the behavior of the learner, and provide more suggestions for the teaching setting and construction of the assessment system. So the following analysis would set K = 5 in clustering.

To know the learning status of the students better, except the requisite fields for process assessment system, we also found that the logon count in the learning system and BBS also reflects the status of the learning process, so it was regarded as the property of the cluster. We have make k-means clustering for the 1127 records without characteristic of the course and the 100 records in *ethic* course (see Table 3 and Table 4 below).

Table 3: Clustering Result Based on 1127 Records without Characteristic of the Course

Serial number of Cluster	Averaged Count for courseware study	Time length	Count of post in BBS	Score in exam	Score in homework 1	Score in homework 2	Logon Count in the learning system	Logon Count in BBS	Count of records
0	14.2	281.17	10.57	77.92	89.79	79.75	418.27	20.32	75
1	10.77	231.65	5.09	74.68	93.07	86.33	244.32	4.51	473
2	10.92	215.88	5.18	63.25	59.37	44.44	180.11	3.36	187
3	12.16	285.35	5.48	82.99	78.57	63.64	252.79	4.35	340
4	31.71	1150.39	5.98	78.38	88.08	75.63	410.13	7.58	52

Table4: Clustering Result Based on 100 Records in *Ethic* Course

Serial number of Cluster	Averaged Count for courseware study	Time length	Count of post in BBS	Score in exam	Score in homework 1	Score in homework 2	Logon Count in the learning system	Logon Count in BBS	Count of records
0	10.58	284.63	5.24	77.08	72.37	58.03	229.21	3.5	38
1	15.45	253.75	5.55	76	90.5	79	370.25	4	20
2	11.67	321.33	12.33	73	90	81.67	590.33	27.33	3
3	9.08	183.58	4.92	65.25	48.75	40.42	158.25	1.92	12
4	9.33	132.56	5.59	73.11	93.7	87.41	233.56	3.29	27

Discussion

From the k-means clustering analysis result, some conclusion can be drawn.

The Count and Time Length of Courseware Study

From Table 3, we can get the average time length of all the clusters and their score in examination. It is shown in Table 5.

Table 5: Count and Averaged Time Length of Courseware Study Based on 1127 Records without Characteristic of the Course

Serial number of Cluster	Averaged count for courseware study	Time length	Time Length/count	Averaged score in examination	Records count
0	14.2	281.17	19.8	77.92	75
1	10.77	231.65	21.51	74.68	473
2	10.92	215.88	19.77	63.25	187
3	12.16	285.35	23.47	82.99	340
4	31.71	1150.39	36.28	78.38	52

In our learning process assessment system, the learners were required to study the courseware continuously for more than 15 minutes, otherwise, the study would be judged invalid, and they are also demanded that the count of courseware study must be more than 10 times for every course. From Table 2, we know that cluster 4 is an excellent in the whole behavior. The averaged time length on courseware study is more than 36 minutes, and is much higher than threshold value. The count of courseware study is also much higher than the threshold value. It's obvious that the goal of these students is knowledge acquisition. However, they are minority. In the other 4 cluster, the time length of courseware study is almost 20 minutes, and the count is about 10 times and just more than the threshold value. So the goal of most students is to pass the process assessment. In Table 4, a similar conclusion can be drawn.

In the relationship between the courseware study and examination, the more time on courseware study doesn't mean that better score in examination, but at least it means that their score are not bad, while less study time means worse achievement. Usually, this conclusion conforms to our general knowledge. However, it also reminds us that we should take into account the efficiency in the teaching design. In the design of assessment system, we would consider the time length/count as a new factor to improve the study time.

Count of Logging on BBS and Post

In a similar way, the count of logging on BBS, post and the score in examination were shown in Table 6.

Table 6: Count of Logging on BBS, Post and the Score in Examination Based on 1127 Records without Characteristic of Courses

Serial number of Cluster	Averaged Count for BBS post	Averaged Count for BBS logon	**post/logon**	Averaged Score in examination	Records Count
0	10.57	20.32	**0.52**	77.92	75
1	5.09	4.51	**1.13**	74.68	473
2	5.18	3.36	**1.54**	63.25	187
3	5.48	4.35	**1.26**	82.99	340
4	5.98	7.58	**0.79**	78.38	52

In the process assessment system, the learners are required to have 5 valid posts. From Table 6, we know that all the learners in the clusters have met the requirement. However, the learners in cluster 0 frequently log on BBS and have many posts. Normally, these learners are used to discuss in BBS, and good in study. From Table 3, we know that the averaged score are similar in cluster 4 and cluster 0, and the difference is that the count of the post of the learners in cluster 0 is more than that in cluster 4, while the time length of courseware study of the learners in cluster 4 is more than that in cluster 0. And the count of logging on the learning system in the two clusters are similar and the most among all the learners. So we could consider that these learners are hard working. So they could be consolidated to one cluster.

In cluster 1 and cluster 3, most learners just log on BBS and post once, and just meet the basic requirement. In cluster 2, some learners just log on once, but open several topics, however, their examination scores are the most inferior. In Table 4, there are examples that learners in cluster 3 only have averaged 1.92 times of logging on BBS, while the averaged count of post are 4.92. It is obvious that the learners try to open all the required topics once and just get the process score. We can conclude that most learners who spend little time in BBS are also inferior to examination.

So, the count of logging on BBS is an important criterion, and we should add this to the process assessment system and guide the learners to take an active part into the discussion in BBS.

Score of Examination and Homework

From Table 2, we know that the number of learners in clusters 1 and 3 are more than that in other clusters. Except score of examination and homework, the other behavior is similar and just averaged, so their behavior reflects the characteristic of most learners. And they met all the rigid requirements such as count and time length of courseware study, post in BBS, and win all the process score.

As for the score of examination and homework, we draw them form table 3 into Table 7.

Table 7: Score of Examination and Homework Based on 1127 Records without Characteristic of the Course

Serial number of Cluster	examination	Homework 1	Homework 2	Count of record
0	77.92	89.79	79.75	75
1	74.68	93.07	86.33	473
2	63.25	59.37	44.44	187
3	82.99	78.57	63.64	340
4	78.38	88.08	75.63	52

The score of cluster 0 and cluster 4 are similar and high, while the score in cluster 2 are low in all the three fields. So we could conclude that the score of homework is the reflection of examination. In the two clusters which possess most learners, their scores of homework and examination are similar. Though there is fluctuation, according to our experience, it is because some learners reviewed the courses more while they are not satisfied with their homework and vice versa.

We found that many learners would review the courses more when they are not satisfied with their score of homework. So in the teaching design, we should provide these learners more chances to review.

Conclusion

Nowadays, the distance education in China has entered a new phase, and we have attached much importance to quality assurance. However, the traditional assessment mode is still pervasive and doesn't match the evaluation to learners' knowledge management in distance education. Based on the teaching and learning system, the process assessment system acquires the data from courseware study to examination of the distance learners, and evaluates the study of learners through the comprehensive computation. However, the choice of the parameters and the setting of the weight are based on the experience.

This passage proposes that we could adopt the cluster analysis from data mining methodology. Through the result of clustering, we concluded that the parameters of process assessment system should be improved further. For example, the count of logging on BBS and learning system should be added into the factors. In the teaching design, the majority should be guided to more courseware study and discussion in BBS, and tutors should provide more services in BBS and the question and answer system through audio and video.

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TUTORING THE ELDERLY ON THE USE OF RECOMMENDING SYSTEMS

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Abstract

Recommending systems are used by many researches to suggest to users all kinds of products. However, not all users of all ages can use these systems. This is particularly the case for the elderly who are not familiar with the computer technology. Moreover, the terminology of recommending systems or user interfaces may prove many times to be a difficult challenge for elderly users. In view of the above, we have created an intelligent tutoring component for product recommending applications. This tutoring component has been created especially for the elderly and it was incorporated into an e-shop application for the interactive TV, called iTVMobi.

Introduction

Nowadays internet, mobile phones, interactive TV and other media have become popular means for various every day activities such as entertainment and shopping. Intelligent systems, created for suggesting entertainment and shopping solutions, have been constructed in order to help users choose appropriate products for them. These systems are called recommending systems. Many times these systems have proved to be quite successful and have helped users choose what they really liked. However, not all users of all ages can use these systems. This is particularly the case for the elderly who are not familiar with the computer technology. Moreover, the terminology of recommending systems or user interfaces may prove many times to be a difficult challenge for elderly users. In view of the above, we have created an intelligent tutoring component for product recommending applications. This tutoring component has been created especially for the elderly. It can be incorporated into any kind of recommending products system and its role is to tutor and help elderly users of recommender systems in an adaptive way. Its reasoning system does not depend on products characteristics so its product independent. It is also medium independent as it is a separate component that functions outside the main reasoning of the system that incorporates it. This component helps elderly users use product recommending systems and also predicts mistakes made by the elderly based on this group’s most popular disadvantages such impaired sight, hearing and lack of understanding.

There are many examples of intelligent tutoring systems in e-learning, like the work of Frasson et al., 1997. Their work uses pedagogical agents to in a multi strategic tutoring system. Their paper describes the use of actors for implementing pedagogical strategies and more generally for detecting which strategy is more suited to a given learner. Their approach leads to the definition of a multi-strategic ITS based on pedagogical actors, that is able to switch among various strategies. In this framework pedagogical actors are used to model the expertise of the various pedagogical strategies. Another important work on the same field has been done by Heffernan and Koedinger (2002). Their work presents Ms. Lindquist, an Intelligent Tutoring System (ITS) designed to carry on a tutorial dialog about symbolization. Ms. Lindquist has a separate tutorial model encoding pedagogical content knowledge in the form of different tutorial strategies, which were partially developed by observing an experienced human tutor. A very important work has also been done by Suraweera and Mitrovic (2004). Their paper presents KERMIT, a Knowledge-based Entity Relationship Modelling Intelligent Tutor. KERMIT is a problem-solving environment for the university-level students, in which they can practice conceptual database design using the Entity-Relationship data model. KERMIT uses Constraint-Based Modelling (CBM) to model the domain knowledge and generate student models. We have used CBM previously in tutors that teach SQL and English punctuation rules.

Significant work has also been done by Brusilovsky et al. (1996) with ELM-ART. Their research discusses the problems of developing WWW-available ITS and, in particular, the problem of porting existing ITS to a WWW platform. They present the system ELMART which is a WWW-based ITS to support learning programming in Lisp. ELM-ART demonstrates how several known ITS technologies can be implemented in WWW context. Another important work in web ITS has also been done by Tsiriga and Virvou (2004). In their work they describe a framework for the initialization of student models in Web-based educational applications. The framework is called ISM. The basic idea of ISMis to set initial values for all aspects of student models using an innovative combination of stereotypes and the distance weighted k-nearest neighbour algorithm. In particular, a student is first assigned to a stereotype category concerning her/his knowledge level of the domain being taught. Then, the model of the new student is initialized by applying the distance weighted k-nearest neighbour algorithm among the students that belong to the same stereotype category with the new student.

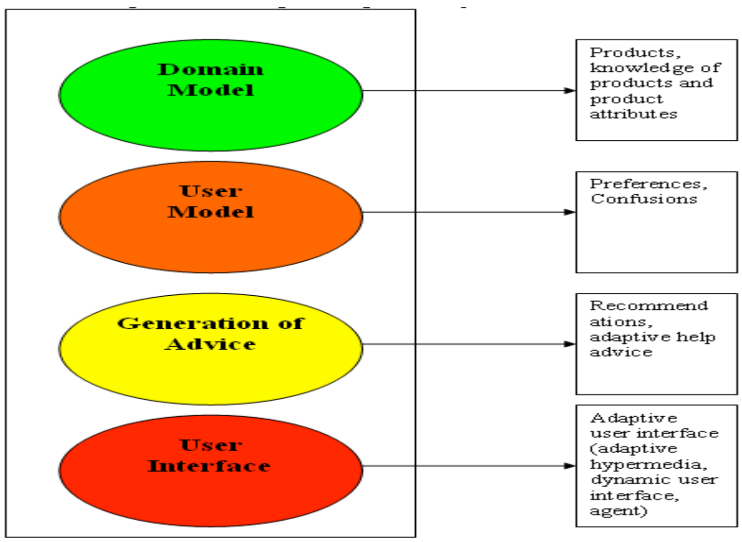
Last but not least we have two different approaches on the field of e-learning ITS. The first research has been done by Graesser et al. (2005). Their work presents AutoTutor that simulates a human tutor by holding a conversation with the learner in natural language. The dialogue is augmented by an animated conversational agent and three-dimensional (3-D) interactive simulations in order to enhance the learner's engagement and the depth of the learning. And the second work has been done by Baker et al. (2006) and introduces a system which gives a gaming student supplementary exercises focused on exactly the material the student bypassed by gaming, and which also expresses negative emotion to gaming students through an animated agent. Students using this system engage in less gaming, and students who receive many supplemental exercises have considerably better learning than is associated with gaming in the control condition or prior studies.

The novelty of our approach compared to the researches above lies in three reasons. The first is the entirely different field that we apply the ITS general architecture, which the field of e-shopping. The second reason is that the user group targeted by our application is a special group of users that due to their age they have impairment concerning the interaction with computer applications and knowledge of the product itself. The third reason is that the mechanism of generating advice in our system is a combination of technologies from the above system. More specifically, our system uses a 3-D animated agent, adaptive hypermedia and a dynamic user interface.

The Intelligent Tutoring Component Architecture

The main architecture of a tutoring system involves four major parts (Figure 1 left). The first is the Domain Model. This model includes all the information about the domain of the e-learning system, in other words what the intelligent tutoring system tries to teach to the student. The Domain Model includes the knowledge of the teaching field and also all the characteristics concerning this knowledge. Such characteristics can be area difficulty, knowledge level etc. In our approach the Domain Knowledge involves all the information about the product and their specific attributes. More specifically, the Domain Model includes information about how much the customers off all ages are familiar with the product, technical characteristics and also special attributes of the products that target specific age groups. Moreover, because our tutoring system targets the group of elderly people specific information about products attributes that concern this age group are stored in the Domain Model. The second part of the architecture of a tutoring system is the User Model. In this part all the information about students or users in general are stored in order for a user model to be created for every specific user. This information may include stereotypical data from user stereotypes, explicit information from answering questionnaires or implicit information from observing users' behavior. In our case we have two kinds of information. This first involves prefaces and interest degrees on the products that the application tries to sell. The second kind involves mistakes and confusion degrees concerning the usage of the system.

Figure 1: From the General Tutoring System Architecture to Our Approach



The third part of a tutoring system is the Generation of Advice. In this part the tutoring system based on information from the user model and the domain model makes assumptions and tries to resolve problematic situations. For example, if a student does many mistakes and concludes his/her tests in very little time then it can assume the particular student is careless. However, this part does not stop there but continues and tries to resolve the problem, maybe by suggesting to the student to take more time to conclude his/her test. In our tutoring system we have two kinds of suggestions extracted from the information observed by the customer's behavior. Our system observes customer's behavior and follows the buggy approach (Tsiriga & Virvou, 2004). The buggy approach means that the system assumes what the customer should buy or should do while interacting with the system. The Generation of Advice in our tutoring system is consisted of two kinds of advices. The first kind is recommendation of products that the system assumes a customer should buy based on his/her moves and the second kind is adaptive help actions that try to help the customer on what should do concerning a mistake with his/her interaction with the application. The last part of a tutoring system concerns the presentation of advices. There many technologies in intelligent systems that someone can customize the presentation of advices, but all of involve the user interface. In our approach we followed a combination of such technologies to achieve an adaptive user interface. The first technology is adaptive hypermedia, the second dynamic user interface adaptivity and the third is an animated agent. These three technologies are better explained in our case study. Combining these three technologies we managed to create an adaptive user interface that changes according customer preferences and confusions. Our tutoring system follows this general architecture of tutoring system but transfers the tutoring systems' techniques to a novel area, the area of e-commerce. Moreover, the age group that our system targets, which is the elderly people, creates an even more difficult environment for a system to be effective on tutoring.

The Case Study

In order to test our approach we incorporated it in an e-shop application that sells phones called iTVMobi. iTVMobi is an adaptive mobile shop created for the interactive television that learns from customer preferences (Figure 1, Figure 2). ITVMobi was built on Microsoft TV (MSTV) technology. The core components of MSTV are available in the Windows XP operating system and can be run on personal computers (PCs). MSTV technology can be utilized within a familiar and mature Integrated Development Environment (IDE). Microsoft Visual Studio offers a multitude of tools for designing, developing, testing and deploying an application. ITVMobi can be used by a telemarketing channel to sell mobile phones in a personalized way. Its aim is to provide help to customers with hearing and sight problems by suggesting the best mobile phone for them. The recommender system that makes suggestions concerning mobile phones and accessories is based on user modeling. The system can learn about the users' preferences and provide more helpful responses. User models are created using clustering algorithms. These techniques will be explained more thoroughly in the next section.

For every user, iTVMobi creates a different record at the user model database. In iTVMobi every customer can visit several mobile phones. For the purposes of our research we have implemented the system for five popular mobile brands. Every customer has her/his own personal shopping cart. If customers intend to buy a phone they must simply move the phone into their cart by pressing the specific button or they can press the buy button at their remote control at the time that the specific product is shown on their TV screen. They also have the ability to remove one or more phones from their cart by choosing to delete them. After deciding which phones to buy, a customer can easily purchase them by pressing the button "buy" at their shopping cart. All navigational moves of a customer are made through the TV remote control and are recorded by the system in the statistics database. In this way iTVMobi saves statistics considering the visits in the different brands and specific phones individually. The same type of statistics is saved for every customer and every phone that is moved to the buyer's cart. The same task is conducted for the mobile phones that are eventually bought by every customer. All of these statistical results are scaled to the unit interval [0, 1].

In particular, ITVMobi interprets users' actions in a way that results into two different functions. The first is the calculation of users' interests in individual phones and production companies and the second is the interpretation of users' actions concerning possible navigation mistakes. Each user's action contributes to the individual user profile by showing degrees of interest into one or another company or individual phone or by showing likelihood on a specific mistake. For example, the visit of a user into a phone-icon shows interest of this user to the particular phone and its brand. If the user puts this phone into the shopping cart this shows more interest in the particular phone and its brand. If a user buys this phone then this shows even more interest whereas if the user takes it out of the shopping cart before payment then there is not any increase in the interest counter. On the other hand if a user follows a different pattern of navigational moves, like repeated clicks on the same brand-name, the system interprets this action but as a confusion navigational mistake rather than as a high degree of interest in this brand. Thus, in this case, the system decides to intervene with an adaptive help action.

Apart from brands that are already presented, other features that are taken into consideration by iTVMobi, for customer interest degree, are the following: phone price range, phone technical features, phone size, phone connectivity, phone display features, phone memory capabilities and phone battery autonomy. All the above phone features are measured in three degrees. For example size can be small, medium or large. Every different feature is consisted of several feature values. Size is consisted of dimensions and grams. The technical features are consisted of phone functions, operating system, java abilities etc. The phone connectivity is consisted of bluetooth, infrared, gps and wlan abilities. The phone display is consisted of screen size, pixels and colors that can showed in the phone screen. The phone memory is consisted of internal memory, expandability or hard disk of phone. Lastly, phone battery is consisted of talk time and stand-by time. The price of every phone belongs to one of the five price ranges: 100 to 250 €, 251 to 400 €, 401 to 600 €, 601 to 800 € and over 801€. As for mistakes degrees we consider the following: difficulty of the user with sight and hearing problems to see brands' names, difficulty to see phones' names and pictures and the confusion degree. Suggested phones are presented in the suggestions window through the help of adaptive hypermedia. Moreover, iTVMobi uses an animated agent to inform and help the users throughout the system. This agent can give information about the usage of the system if a user cannot understand some sections.

The User Model

In order to achieve adaptivity in iTVMobi we used a user modelling technique based on features and problems of our customers. In this section we will present the user modelling process in general. We will emphasize on the general steps of this process and not on how this process is implemented in the two different systems. Further details on these two implementations will be given in the later sections.

The user modelling process is consisted of five major steps. At first, we conduct the Data Acquisition Step. In this step we define the data acquired, how this data will be acquired and in what form this data will be saved in order to be efficient for the next step of the user modelling process. For the data definitions we agreed that all data will be rates of either customer needs, interests, problems or mistakes. The data concerning needs and interests are based on the product features and concern visits on product pages, product acquisitions, actions with the shopping cart and request of product videos. The data concerning problems and mistakes are based on navigation problems, hearing and seeing disabilities and concern real time navigation problems and mistakes in product pages and shopping cart.

This data can be acquired by two different ways, explicitly or implicitly. Explicitly a customer can answer questions concerning tastes or problems, rate products, product categories or even other customers. Implicitly the system observers navigational behaviour (visits in product pages, buying products, making wrong navigation patters) and makes assumptions that alter this customer's user model. This data is saved in rate form in a database of user models in vector format in order to be easily available for the next of the user modelling process.

The next step of this process is Group Formulation. In this step the system uses a clustering algorithm in order to form groups of similar users (users with similar tastes for the recommender and user with similar mistakes for adaptive help). The input date is takes by the previous step and is inserted in the clustering algorithm. The clustering algorithm we chose to implement is k-means. The clustering algorithm is used to provide clusters groups of similar users that have a representative vector that does not necessarily is one the old users. This process is conducted in the same way for both functions, the recommender and adaptive help, but separately for every function. At the end of this step we have two results for every of the two functions. The first result is the groups of similar users and the second result are the representatives of these groups. The groups are used by the system for the dynamic stereotypes and the community system and representatives are used for the system's adaptive actions and responses (recommendations and help actions).

Next step is User Model Creation. In this step iTVMobi uses groups and representatives to create dynamic stereotypes. For the users that iTVMobi has few information creates a user model that combines stereotypical information and individual information. In this way iTVMobi fills rates about a user's interests or mistakes from the stereotypical in order to make assumptions about this specific user. On the other hand, if iTVMobi has enough information about a user then creates an individual user model based on previous user explicit and implicit data, group and representative. In this way every time the user model of this specific user is created dynamically but based on previous data and user model of this user. The next step is Adaptivity. This step incorporates all actions that iTVMobi takes in order to recommend products, change its interface dynamically or help users adaptively. In this step iTVMobi can use many techniques in order to provide product recommendations, help every user adaptively or correct users' mistakes. The techniques that iTVMobi uses are adaptive hypermedia, dynamic user interface alteration and an adaptive animated help and recommending agent. These techniques help iTVMobi to change the user interface adaptively in order to recommend products or catch user mistakes and provide the user with solutions or help the user navigate easily. In the next two sections we explain the major two functions that iTVMobi uses to help users adaptively choose easily a product that suits their interests.

Generation of Advice: Product Recommendations

The recommender system is based on user modeling that is constructed using the k-means algorithm. The recommender function is based on the principle that many customers tend to have similar interests. Every customer's interest in one of the phone features described above is recorded as a percentage of his/her visits in the respective phone pages. An interest of the customer at a particular phone is calculated by the equations 2 to 5.

$$InterestInFeature_1 = \frac{VisitsInPhonesWithThisFeature}{VisitsInAllPhones} \quad (2)$$

$$InterestInFeature_2 = \frac{PhonesPlacedInBasketWithThisFeature}{AllPhonesPlacedBasket} \quad (3)$$

$$InterestInFeature_3 = \frac{PhonesBoughtWithThisFeature}{AllBoughtPhones} \quad (4)$$

$$\begin{aligned} InterestInFeature = W_{C1} * InterestInFeature_1 + \\ W_{C2} * InterestInFeature_2 + W_{C3} * InterestInFeature_3 \end{aligned} \quad (5)$$

As the previous equations show the degree of interest in a phone feature is measured in three ways. Then in order for the full degree of interest to be acquired the system calculates a weighted sum of the three different degrees of interest, the degree of interest that corresponds to the visits of the user in the phone pages, the degree of interest that corresponds to the phones placed by the user to his/her basket and the interest that corresponds to the phones bought by the user. The weights used by the system are different for every phone feature and were extracted through the experience from the evaluation process of the system. For example a user chooses to visit a phone through the phone icon and does not have the ability to know the display abilities of this phone before opening the specific phone page. As such, the opening of a specific phone page through its icon may not mean that the user is necessarily interested in the phone but that s/he is just browsing several phones. On the other hand every company's name is displayed from the very beginning to every user and in this way the user is aware for the company that he/she selects to visit thus making his/her selection more accountable. As a result the W_{C1} weight used to measure the Interest in Company from the user visits is bigger than the weight W_{D1} used to measure the Interest in Phone Display from user visits in different phones. The recommender module uses the k-means clustering algorithm in order to create representatives of customer groups that the system uses to make buying suggestions. The recommender takes as input the statistical data, described above, of the navigational moves of every customer and feeds them to the clustering algorithm. The clustering algorithm provides the recommender with clusters-groups of customer that have similar tastes. The recommender module takes these results and calculates the representatives of every group.

Every time a customer uses the system the recommender module finds his/her representative and proposes phones based on the representative taste percentages through the use of adaptive hypermedia. After creating the proposing phones list, the recommender system considers the mistakes statistics database and chooses a corresponding list of accessories. These accessories are combined with proposed phones list in order to provide the customers with hearing and sight problems with a more complete solution for their needs. For example if the recommender finds a phone that is very close to the representative's tastes than this phone is noted as "recommended" product and is given a different type of indicator than a phone that is more far, considering the tastes of the representative. Then the system finds an accessory corresponding to this phone and to the mistakes made from this user. If a new user enters the system the recommender classifies him/her to the group that has the largest number of members. This is based on the idea that if many users have similar tastes then a new user is probably going to have similar tastes and mistakes with the majority of them. The degree of recommendation is presented through adaptive hypermedia. The product that has the highest degree of interest for this user is noted as a "recommended" product and the one with a lower degree is noted as "check this too" product. Similar degrees of annotation are used for the corresponding accessories. Sample screenshots of the recommendation page are illustrated in the figures below.

Figure 4 left: Sample screenshot of the two annotations, "hot product" (left) and "check this" (right). **Figure 4 right**: Screenshot from the phone and accessories recommendations.

Generation of Advice: Adaptive Help Actions

The adaptive help module concerns the adaptive help responses. This module tries to identify mistakes in the navigational moves of every user. This module is based on the principle that many users with sight and hearing problems tend to have similar navigational mistakes. Again, the k-means algorithm is used to group users but in this case a different set of input data is used. The input data consists of the mistake degrees that were introduced in the above section. Mistakes are considered as different "wrong" navigational patterns. For example, a user can make "confusion navigation" like the continuous visiting of two neighboring production company buttons. This action raises the possibility of vision problem. Another example is "navigation without a purpose" witch can be achieved by a pattern of pressed buttons and clicked areas that leads to no purpose. This action raises the confusion problem. Degrees are calculated as a percentage of specific mistakes committed in a specific phones' page. For example the disability to see companies' buttons degree is calculated by equation 9 and disability to recognize phone icons is calculated by equation 10.

$$HardtoSeeCompany = \frac{MistakesInCompaniesButtons}{TimesInCompaniesPage} \quad (9)$$

$$HardtoSeePhoneIcons = \frac{MistakesInPhoneIcons}{TimesInPhonePages} \quad (10)$$

If a user has many navigational mistakes then the system responds and tries to help this user with help actions customized to his/her mistakes. These actions can vary a lot. For example, the “confusion navigation” results in actions such as the automatic changing of the size of brand names buttons or phone links. This can result in a clearer presentation of the user interface. Another action taken by the system is changing the location of brand names’ buttons in order to avoid confusion. Other actions involve speech synthesizers and agents pointing on the screen in order to help customers understand the locations of the user’s interface components. The “navigation without a purpose” can result in actions like showing an options message and asking the user directly what he/she wants to do. An example of a wrong navigational pattern can be the following: a user chooses to click on company button, then click the adjacent company button, then click the previous company again and then click the same adjacent company again. These four moves are interpreted by the system as a possible mistake of confusion between company buttons. Every time a customer uses the system the adaptive help system finds his/her representative and responds with adaptive help actions.

User Interface: The Adaptive User Interface

The adaptive user interface of iTVMobi can change the user interface in real time according to the specific customer mistakes. An example can be seen in Figures 5 and 6. In this particular example the system observes the user’s navigation moves between two neighboring mobile phones and counts his/her mistakes. If a user has made a lot mistakes in this section, like browsing two neighboring phones repeatedly without putting any of phones in his cart at the meantime, then the system identifies that the user cannot view the phone pictures clearly and chooses to enlarge them. If the mistakes between the two neighboring phones continue then the system identifies that the user has confused only these two phones. The action taken by the system is to change the location of these two phones and move the one away from the other, while bringing a different phone close in order not to destroy the whole arrangement in the screen of the phones. If the user continues to make the same kind of mistakes then the system uses the animated agent in order point the phones by moving next to them, showing them with its “hand” and then telling with its “voice” the model of the phone. The system also increases the sound volume in order to help people with hearing problems understand more clearly the point out function of the animated agent. If the user finds annoying the changes of the user interface than he can disable them from his profile page.

Figure 5 Left: First stage of the phone user interface. Showing small pictures of mobile phones. **Figure 5 Right:** Second stage of the phone user interface. The user has made mistakes. Bigger phone pictures and a next button showing that phones are split in two pages.

Figure 6 left: Third stage of the phone user interface. The user has confused the first two phones on the bottom. The system has changed their locations and brought the silver phone near the first phone on the bottom. **Figure 6 right:** Fourth stage of the phone user interface. The user continues to confuse the phones. The system enables the animated agent in order to point the phones and increases the sound volume the agent.

Conclusions

In this paper we presented an intelligent tutoring component for product recommending applications. This tutoring component has been created especially for the elderly. It can be incorporated into any kind of recommending products system and its role is to tutor and help elderly users of recommender systems in an adaptive way. Its reasoning system does not depend on products characteristics so its product independent. It is also medium independent as it is a separate component that functions outside the main reasoning of the system that incorporates it. This component helps elderly users use product recommending systems and also predicts mistakes made by the elderly based on this group's most popular disadvantages such impaired sight, hearing and lack of understanding. We incorporated the component mentioned in a case study, an interactive TV shop that incorporates the intelligent tutoring component.

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ANYWHERE AND ANYTIME: EVALUATING STUDENTS' BEHAVIORS IN SCIENCE WEB BASED LEARNING ENVIRONMENT USING LOG FILE ANALYSIS

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Abstract

The main purpose of this research is to examine the learning processes of elementary school students in science web-based learning environment — at school and at home. To this end, the log files of the learning environment and data mining tools and techniques were used. Results suggest that the school-home gap is starting to fade away (learning wise) and a school-home learning continuum can be established. Part of the learning can be transferred to after school hours and can be evaluated similarly by means of data mining tools. Results also suggest that there are differences between learning at home versus learning at school across ages (such as duration of the learning and pace). Our future work will focus on gathering the learning variables and employing data mining techniques in order to find learning patterns at home and at school across ages.

Introduction

ICT have changed both the scope and the nature of learning, setting up new opportunities for learning, as well as offering different ways of learning. Web-based learning environments offer students the potential to be autonomous in their learning and study anywhere and anytime, especially outside of the school walls. When using these environments in the classroom, the teacher has significant control over the students' learning processes, whereas outside of the classroom the students have the responsibility for their own learning.

While engaging with web-based learning environments, students leave traces of their activity in the form of log files. These files document each action taken by three basic parameters: what was the action taken, who took it and when. Discovering and extracting educational information from these log files using data mining techniques is an emerging field called Educational Data Mining (EDM).

The basic assumption of our research is that learning processes can be reflected in the student's behavior while interacting with the environment; This behavior might be extracted from the log files and may shed light on learning processes for large populations in ways that were not previously possible (the assessment of learning processes is traditionally examined using qualitative tools and methods with small-scale populations).

The goal of this research is to explore the learning processes of elementary students in a science web-based learning environment, at school and at home, and to compare the both age wise.

Background

Information and communication technologies (ICT) have changed the way people learn in recent years. Web-based learning environments have expanded the concepts of time and space of learning. Learning is no longer confined to the four walls of a classroom. It can take place in a specific classroom, but also anywhere at school or at home, and it does not necessarily require the presence of a teacher and students physically together (Barker, 2000).

Web-based learning environments encourage students to exhibit autonomy and control over their learning process. They are encouraged to be more responsible for their learning, and in many cases they have to plan, carry out and evaluate their own learning processes (Besser & Bonn, 1997; Oliver, 2002). But whereas in the classroom the presence of the teacher can influence the learning process, after school hours the students are being confronted with the tasks alone. Research shows, that a primary characteristic that sets successful online learners apart from their classroom-based counterparts is their autonomy in learning (Keegan, 1996). It also indicates that autonomy and responsibility on the learning process are acquired skills, and by the time the students reach higher education, most adults have acquired a degree of autonomy in learning. Younger students need to have a scaffold during their learning (Cavanaugh et al., 2004). Research also found that older children have more internal locus of control than younger children (Gershaw, 1989).

Contemporary web-based science learning environments, such as WISE[1] and OFEK[2], offer a rich digital science curriculum, focusing on constructive approach to teaching and learning. These environments contain cognitive tools in which the students can learn, such as virtual models, experiments and simulations. These tools enable inquiry-based learning and visualization of scientific phenomena and processes which could not be demonstrated to students in any other way (Linn, Clark & Slotta, 2003; Osborne & Hennessy, 2003; Voogt, 2008). In addition, such environments may present the students a variety of instructional tools in which they can practice their knowledge, such as games, drill and practice exercises and self-tests. Being offered a variety of tools for learning and practice, students can freely navigate along their own chosen path and control their own learning process according to their preferences and needs. The aspects of control are expressed, for example, as control over content, control over time and pace, and control over the learning sequence (Sims & Hedberg, 1995).

The autonomy that the online learners need and implement in such environments, raises the need to enhance our understanding of their learning behaviors. However, this is not an easy task to achieve with traditional research methodologies, which can hardly cope with gathering of information about the online learners (Nachmias & Hershkovitz, 2007). Data Mining is an emerging methodology in the educational research field, which can advance us towards that goal. While learning with web-based environment students leave continuous hidden traces of their activity in the form of log file records, which document every action taken by three parameters: what was the action taken (e.g., the page URL, the file downloaded), who took it (if the system requires login, this field will usually include the student identification), and when (exact date, time). Researchers use data mining techniques to analyze this data and to locate different aspects of learning behaviors, such as patterns of navigation, time spans and sequences of learning (Romero, Ventura, & Garcia, 2007). Web-based learning environments might also hold information in the log files about the student's profile (e.g., age, gender, grades).

In this research we have analyzed the data derived from the students' log files, in order to enhance our understanding of the online learners' behavior in a web-based

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[1] http://wise-dev.berkeley.edu
[2] http://ofek.cet.ac.il

science learning environment, and also to learn about the differences in these behaviors — at school versus at home and across ages.

The Research Objectives

This study explores aspects of elementary students' learning processes in a science web-based learning environment at school and at home. Its specific aims were to:

- Explore and characterize the students' behaviors while engaging with the online environment at school versus at home.
- Explore and characterize the students' behaviors while engaging with the online environment at school versus at home in each specific age group.
- Demonstrate the potential of log file analysis and data mining to evaluate students' learning processes during online learning.

Methods

This framework concerns the characteristics and consequences of the actual usage of the web features within the learning processes in a specific science module. The investigation conducted is of a descriptive nature using quantitative methods (data mining), which have been used in order to explore the students' learning behaviors at school and at home and compare the both. We evaluated students' behaviors by analyzing their log files.

Participants

Participants were 1,671 3rd–6th grade students from different elementary schools in Israel, who learned in a science web-based learning module, as a part of their curriculum. 903 participants (54%) used the module at school, while 768 participants (46%) used it at home. As for the age groups of the students — 316 participants (19%) are in third grade, 325 participants (20%) are in fourth grade, 555 participants (33%) are in fifth grade, and 475 participants (28%) are in sixth grade.

The Learning Environment

We used an Earth Science web-based learning module dealing with the moon phases.[3] This module is a part of OFEK, a web-based learning environment[4] for

[3] http://www.cet.ac.il/ofek/eng/unit11.asp
[4] OFEK was developed by CET— the Center of Educational Technology.

elementary school, in Science, Math and Language. The module includes six different activities implementing four instructional tools: simulation (see Figure 1), three drill and practice exercises, a game and a self-test. The moon phases' simulation appears as the first activity. Following are the three drill and practice activities and a game. In the next page, the students may choose to do an on-line self-test. All of the activities (except for the simulation) offer the students an immediate feedback.

Figure 1: "The Rising of the Moon" Simulation in the Module

Procedure

Log files of a large population (N = 2,643) for six months (September 2008–February 2009) were collected and preprocessed. The study was carried out in four consecutive phases:

Phase I: Data exploration. This phase focuses on understanding the meaning of the metadata, collecting, describing, and exploring the data. In this phase we have examined the dataset and the format of the basic variables.

Phase II: Data preprocessing. This phase focuses on cleaning and formatting the data. The original dataset was much larger at first and was consisted out of N = 2,643 cases. The first stage was to filter all cases who were not students (e.g.

teachers, administrators). At the second stage a filter was applied for keeping students from third to sixth grade (we have decided to focus on students who are learning the subject as a part of their curriculum). At the third cleaning stage a filter was applied for screening students who only entered the environment but did not use the module (spent less than 5 minutes), students who did not log out from the environment (spent more than an hour) and those who spent time in the module at school and at home. The dataset was preprocessed and the final set of cases to be analyzed was defined (N = 1,671).

Phase III: Computing variables. The compatibility of the variable to previous empirical research in this field was taken into consideration, as well as their association to our framework. Algorithms for calculating the variables were formally written and implemented using EXCEL.

Phase IV: Descriptive statistics. Finally, independent *t tests* and ANOVA were performed using SPSS.

Variables

The variables that were extracted and computed from the log file (based on the students' behaviors) in Phase III are described in Table 1.

Table 1: Extracted and Computed Variable List

Variable name	Variable description	Remarks
Locus of Learning	Student's location	8:00-14:00 – School 14:00-8:00 - Home
Time on Task	Time on Task (entire module or activity)	Total learning time in the module or in activity (seconds)
Clicks	Actions taken in the module or in an activity	Number of mouse clicks in the module
Pace	Pace (entire module or activity)	Number of clicks divided by the time on task (clicks/sec)
Completed Activities	Completed Activities	Number of successfully completed activities
Incorrect answers	Errors in all activities	Number of negative feedbacks given to the student in all activities

Results

Students' Online Behaviors at School versus at Home

The analysis of the log file's extracted variables provided a summary of the students' behaviors (Time on task, Clicks and Pace) in the different activities at school and at home. As shown in Table 2, students tend to spend 699.9 seconds at home (SD = 530.6) on all the tasks in the module opposed to 553.3 seconds (SD = 369.4) at school, 27% more time at home. When we check their behavior in each activity we can observe the same tendency (except for the game). They also tend to learn in a slower pace, 0.134 (SD = 0.098) click per seconds, while the number of clicks (actions) stays the same (which means that the amount of activities learnt by the students remains the same at school and at home). As shown in Figure 2, the distribution of the students' Time on task in the module is very similar at school and at home.

Figure 2: Distribution of Time on Task at School versus at Home (N = 1671)

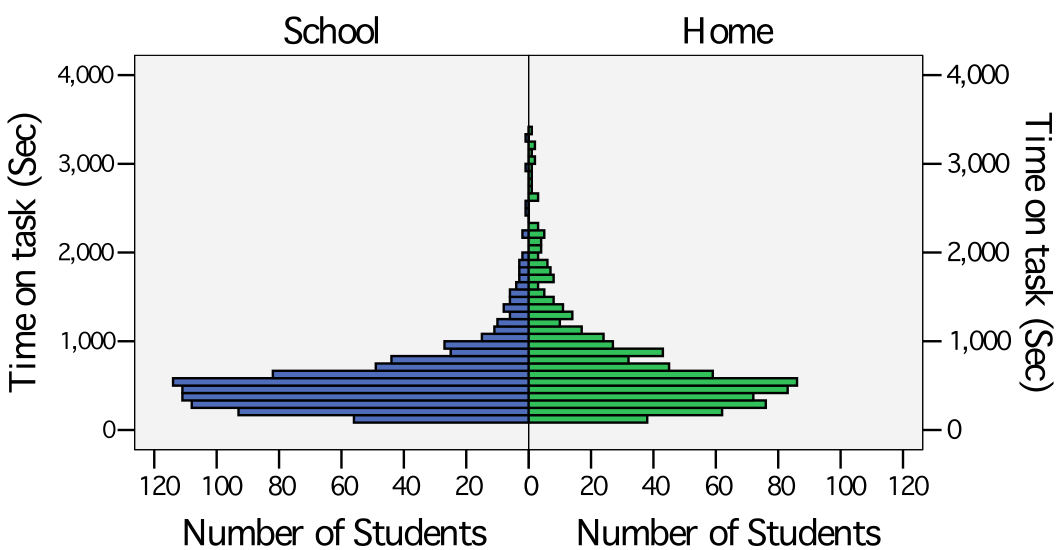


Table 2: Distribution of the students' activities at school and at home (N = 1671)

t	SD	M	Locus of Learning	Behavior	Activity
-3.80**	95.7	84.7	School	Time on Task	**Drag Quest**
	131.6	107.2	Home		
-2.32*	7.87	11.05	School	Clicks	
	11.47	12.23	Home		
2.90**	.142	.192	School	Pace	
	.127	.172	Home		
-2.99**	97.8	91.6	School	Time on Task	**Pull Down Menu**
	163.4	112.6	Home		
-.77	7.7	12.9	School	Clicks	
	10.6	13.2	Home		
2.85**	.117	.177	School	Pace	
	.122	.159	Home		
-2.33*	113.4	81.4	School	Time on Task	**Quiz**
	89.8	94.7	Home		
1.03	9.1	10.8	School	Clicks	
	10	10.3	Home		
4.12**	.148	.178	School	Pace	
	.130	.147	Home		
-3.28**	170.9	100.2	School	Time on Task	**Simulation**
	227.5	135.1	Home		
-1.70	24.5	14.7	School	Clicks	
	27.8	17.1	Home		
4.43**	.317	.238	School	Pace	
	.183	.176	Home		
-5.62**	116.7	200.1	School	Time on Task	**Test**
	201.8	251.9	Home		

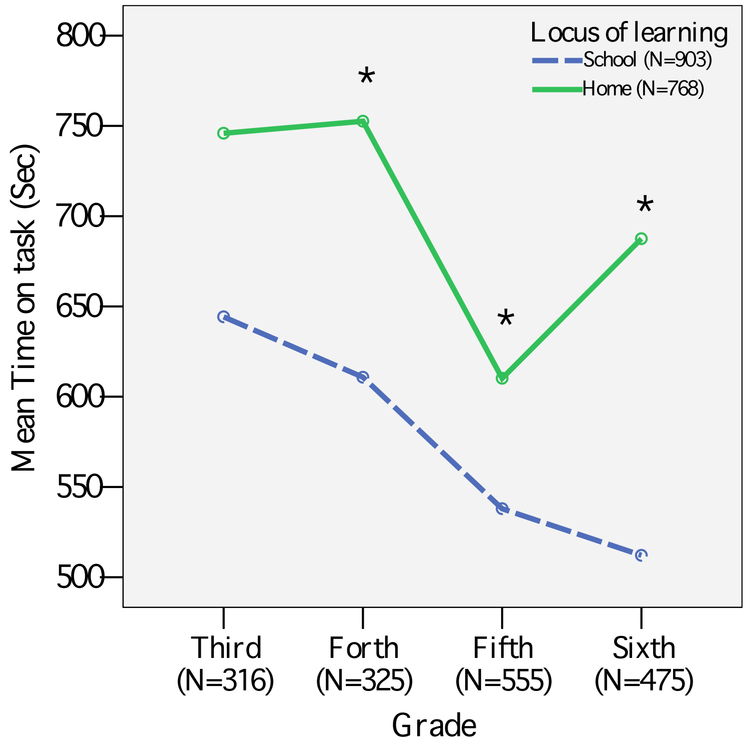
-.33	12.3	19.8	School	Clicks	
	17.2	20.1	Home		
4.16**	.092	.120	School	Pace	
	.076	.100	Home		
-1.51	148.2	138.5	School	Time on Task	**Game**
	181.5	152.4	Home		
1.30	21.9	23.8	School	Clicks	
	22.7	22.1	Home		
4.67**	.087	.189	School	Pace	
	.080	.167	Home		
-6.62**	369.4	553.3	School	Time on Task	**Total Activities**
	530.6	699.9	Home		
-1.41	45.5	74.4	School	Clicks	
	62.6	78.2	Home		
4.47**	.099	.156	School	Pace	
	.098	.134	Home		

*p<0.05, **p>0.01

Students' Online Behaviors at School versus at Home in Different Age Groups

The module's subject matter is a part of the 3rd – 6th grade science curriculum. We distinguished the students by their grade and their locus of learning and characterized their behaviors. The time on task at school and at home distinguished by grade is described in Figure 3. As also shown in previous results (Table 1), students tend to spend more time learning at home than at class (except for 3rd grade). Findings indicate that across grades, younger students spend more time than older students at school and at home ($F(1670) = 11.28$, $p < 0.01$). For example, 3rd grade students spend approximately 650 seconds at home while 6th grade students spend 525 seconds.

Figure 3: Mean Time on Task (Sec) at School and at Home in each Grade (Significant differences of *p* < 0.05 between locus groups are marked with an asterisk).



When examining the students' incorrect answers (Figure 4), 3rd, 5th and 6th grade students tend to make fewer errors when they use the module at home. The figures show that 3rd, 4th and 5th grade students have a similar amount of errors while 6th grade students have lass ($F(1578) = 8.13$, $p < 0.01$).

The students' completion of activities is shown in Figure 5. Only 5th grade students tend to complete more activities at home than at school. When examining the trends across ages, 3rd, 4th and 5th grade students behave differently while 6th grade students behave similarly to 5th grade students and tend to complete more activities. Older students tend to complete more activities than younger students ($F(1670) = 27.82$, $p < 0.01$).

Figure 4: Mean Incorrect Answers (%) at School and at Home in each Grade (Significant differences of $p < 0.05$ between locus groups are marked with an asterisk.)

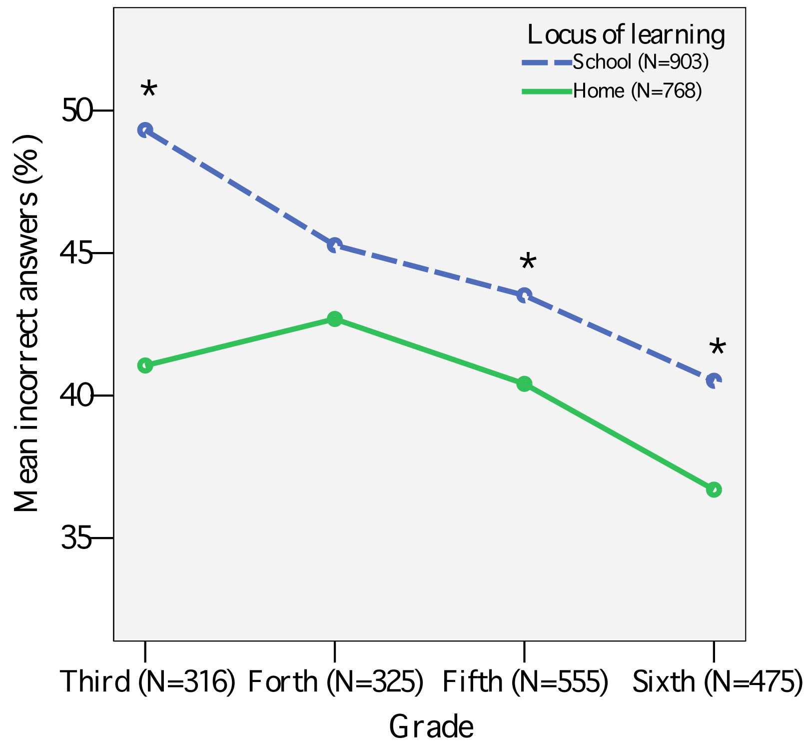
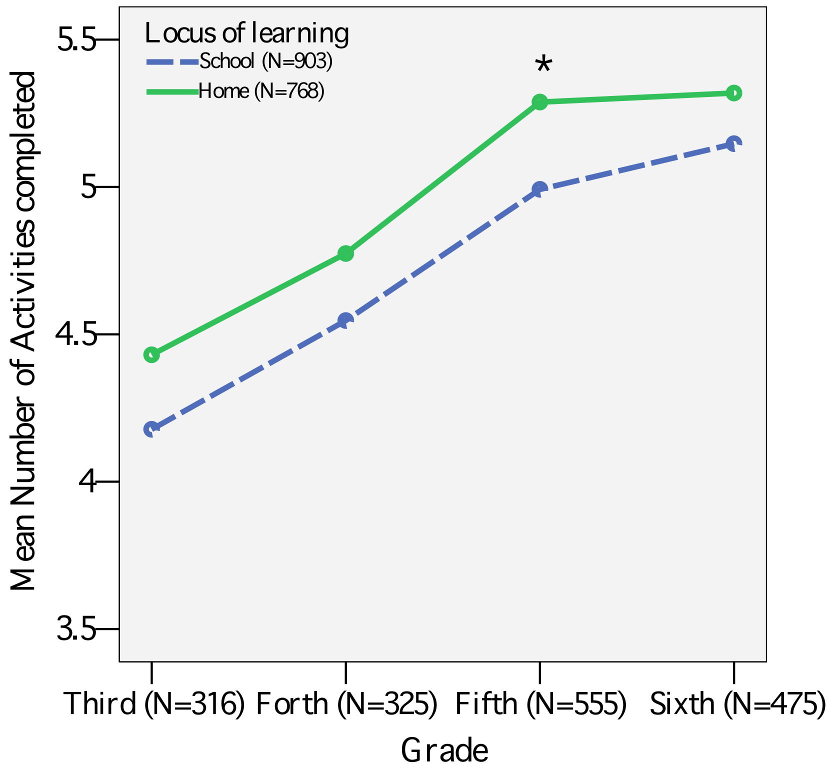


Figure 5: Number of Activities Completed at School and at Home in each Grade (Significant differences of $p < 0.05$ between locus groups are marked with an asterisk.)



Discussion and Future Work

Web-based learning environments require students to be autonomous in their learning, and even more so when they learn independently at home. Many cognitive, meta-cognitive and affective aspects of learning which are relevant to the way students learn online can be realized differantly depanding on the locus of learning and age among others. These aspects might be reflected by the hidden traces students leave in log files. A very challenging task is to reveal distintive behaviours and to infer from them on the learning processes. In this study, we have demonstrated the potential of using log file analysis for enhancing our understanding of the online learning process and also to learn about the differences in the learning behaviors — at school versus at home and across ages.

Our findings indicate that students learn autonomously at home without teacher supervision. More over, their learning behaviors are manifested differently according to the locus of learning (school vs. home) and grade (age). Students tend to spend more time (30% more) learning at home than at school, at a slower pace, get higher scores and have less incorrect answers. It may suggest that while learning at home students are less stressful, are not constraint by time and can be more focused on task. These findings are compatible with the evidence that students appear to benefit from smaller amounts of activities at home (less than 1 hour per night) and have a positive relationship with achievement (Cooper, Robinson, & Patall, 2006).

When comparing the age factor, older students tend to spend less time learning and complete more activities. Both older and younger students tend to spend more time learning at home while younger students tend to spend more time learning than older students. In contrary to other studies who have shown that younger students have less-effective study habits and are more easily distracted (Hoover-Dempsey et al., 2001; Muhlenbruck et al., 2000), our findings indicate the opposite.

School-home gap is starting to fade away (learning wise) and a school-home learning continuum can be established. Part of the learning can be transferred to after school hours and can be evaluated similarly by means of data mining tools. Our future work will focus on gathering all these variables and employing data mining techniques in order to find learning patterns at home and at school across ages.

Educational Data Mining is an emerging research field, serving a range of educational goals within web-based educational systems, such as: evaluation of learning and effectiveness of instructional designs, development of adaptive environments for students based on their actual behaviors, provision of feedback to both students and educators, or identification of irregular learning behaviors.

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NEW CONCEPT IN REMOTE LABORATORY: HIGH-SPEED MULTITASK SYSTEM DEVELOPED AS ONLINE RECONFIGURABLE PLATFORM

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Abstract

A new architecture for an educational high-speed remote laboratory is described in this paper. In order to remove the users' waiting list, we used a multitask type access on laboratory work platform, and a real-time reconfiguration of electric test circuits. Students are accessing from distance a system equipped with real instruments and perform online test workbenches. The errors detected in prescribing the commands towards the machine, are not automatically corrected. Instead, the student is warned, and the results of the tests are supplied to the user in the same way the real instrument does.

Introduction

The low-cost availability of new communication tools based on Internet is opening more and more horizons to remote teaching. Interactive on-line tutorials based on World Wide Web (WWW) sites can now be followed directly on the job site [1,2].

The recent wide diffusion of (i) easy-to-use software tools for the implementation of Graphical User Interfaces (GUIs); and (ii) communication-oriented instrumentation, often provided with Ethernet interface, in addition to the more traditional GPIB and RS-232 ones, can be particularly exploited in the field of measurement teaching. It is well known, in fact, that for a better understanding of the teaching issues in such a field, the students have to practice with real instrumentation. The computer-based simulations are often inadequate to assure a good experience in that direction. The tools mentioned above give the possibility of accessing real measurement instrumentation from a remote location, such as the students' home. [3-5]. Moreover, it could be possible to repeat the same experience many times in order to make all students able to operate the measuring instrumentation without devoting expert technicians to such activity for many days [6-10].

The feasibility of such a solution has already been proven [9-14]. This approach has been followed in a collaborative manner by two different research groups, with the aim of creating an international knowledge base, accessible from the students of both the Countries. This is the first step through the building of a common educational background by remotely sharing information and instrumentation among the students and the researchers of the involved Universities. At now, the project involves the Technical University Gh. Asachi, Iasi, Romania, and the University of Sannio, Benevento, Italy. This could lead to a common teaching method basing itself on the reciprocal validation of the student knowledge and on a continuous know-how exchange.

System Architecture

System's architecture (Figure 1) is structured on three main levels: reconfigurable workstation level, multitask server level and user server. The initiation of a laboratory work comes from the user level, by accessing the server's web interface through a commercial browser (S.M.).

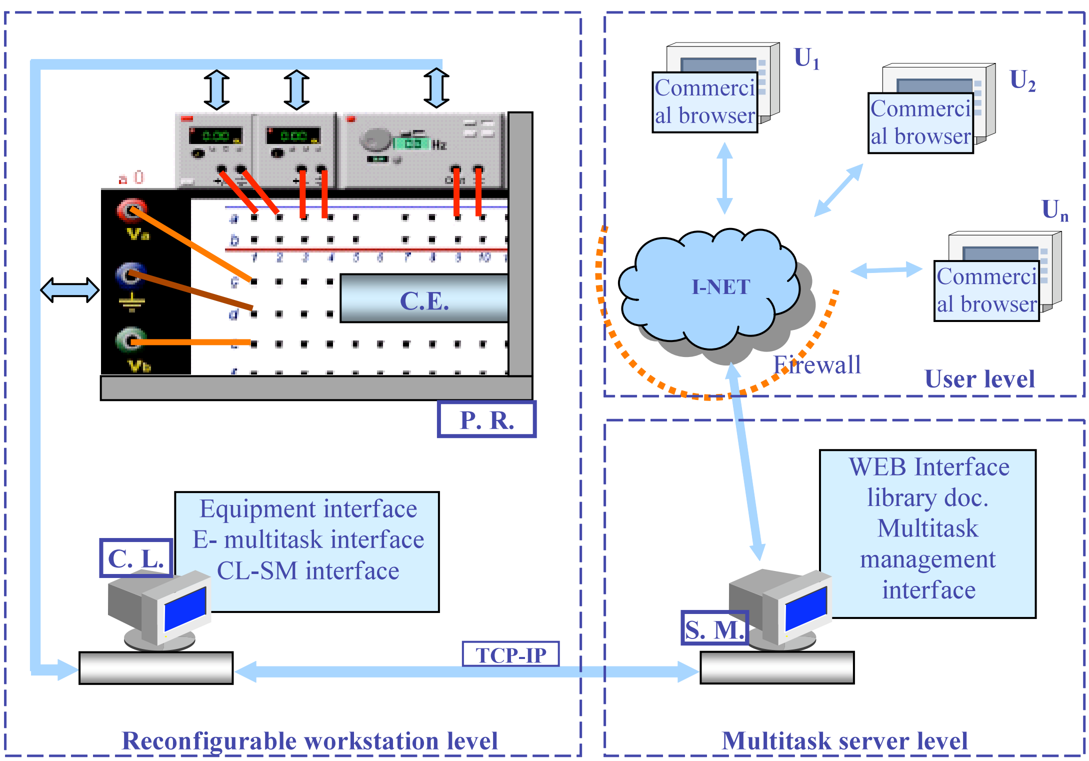

Fig 1. General system architecture

The Multitask management interface (Figure 2) allows access simultaneous to all solicitants towards the selective routine of laboratory work development parameters, in which the entrance/exit data and electric circuit configuration are settled. This routine has, as a front panel, a graphic interface of the laboratory work. In this stage the user define the configuration of the electric circuit, choose the measurement instruments, measurement points, electric components and signal sources and then configure the parameters of all the circuit equipments. The checking block of the multitask management interface verifies the configuration defined by the user and, if correct, transfer the execution parameters of the laboratory work to the E-Multitask routine resident on the computer of the reconfigurable workstation.

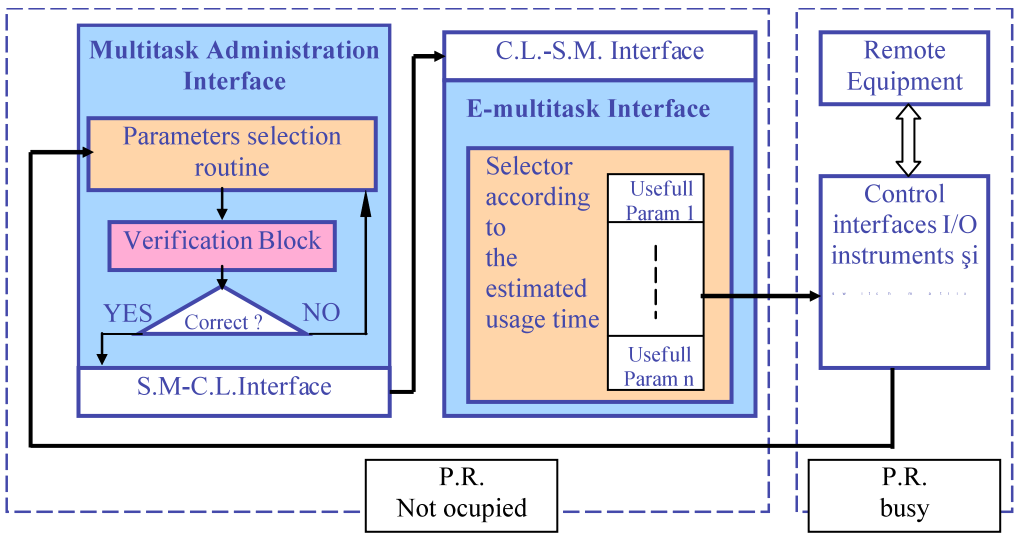

Fig 2. Diagram of the software procedures

The specific laboratory work is accomplished under the E-Multitask routine control, based on parameters received from the user. This routine determine the moment to execute the work request by estimating the effective time the reconfigurable platform will be occupied by this work. Physical area for development of laboratory work, named the reconfigurable platform (R.P.) will only be occupied during running of laboratory work by the E-Multitask routine. After obtaining the exit data, the reconfigurable platform is free, being able to put a new request into execution. The obtained output data are transferred to the graphic interface of the laboratory work. The structure thus conceived of software procedures allows removing inactivity time of users and slow execution speed, transferring control of the execution commands from users to the E-Multitask routine. As you can notice in Figure 2, the occupation time of the reconfigurable platform is reduced to the effective execution time in commanded software regime (occupied R.P), the platform being relieved during execution of the routines in the area (unoccupied R.P.). In case of launching in execution a laboratory work, the time for the zone (R.P. unoccupied) can reach up to 98% of the total accomplishment time, leading to an occupation time of the reconfigurable platform of 2 % of the total time.

Reconfigurable platform (R.P.), the physical area for laboratory work development, consists in a matrix of nodes with software controlled switches. The open/close state of switches (located by schematically placement coordinates) determines the realization of some specific electric circuits. Middle nodes are destined to the electronic component block (E.C.)

The primary role of the workstation (C.L.) is to control the realization of laboratory work through the E-Multitask routine, which settles the execution entrance order on the reconfigurable platform. The routine selection criterion is the effective time of occupation of the reconfigurable platform. Priority goes to work with minimal execution time. The switch matrix command interface, as well as the entrance/exit instrument command interface is resident on the workstation. Communication with entrance/exit instruments is accomplished through GPIB protocol. Management of information exchange with the multitask server is insured by the interface (CL-SM) through the protocol of peer to peer transmission TCP-IP.

Multitask server (M.S.) accomplish some basic functions as establishing the interactive communication with users through the intermediate web interface, as well as realizing bidirectional communication with (C.L.) through the interface (M.S.-C.L.), using the TCP-IP protocol. The web interface is structured in two levels, the first one containing the library of documents specific to users training, and the second one realizing the connection to the graphic interface of the laboratory work. On this server is resident the multitask management interface that allows all users to simultaneously access the routine of execution parameters.

Connection to the (M.S.) server can be done in two ways: as user or as operator. As user, one can do laboratory work, having total control on them, or can watch without any right to control, the realization of these by other users. Experimental data, obtained by the users after the accomplishment of the laboratory work can also be received by them by e-mail. Also, a copy of these data, together with the identification code of the user is stored in the data base. Connecting in *operator mode* is permitted only to instructors, giving them some control facilities at a superior level, so they can intervene during the laboratory work by taking over control or they can create demo sessions at certain dates known by users.

Laboratory Work Example: The Study of the Operational Amplifier as an Integrator

To study operational amplifier as an integrator at his input is applied a Vpulse=2V, and switch configuration is S2_12 (Vpulse), S2_16 (R1_AO), respective S3_21 (C3_AO) are ON. As long as Vout is not saturated, Cr1 ≠0 → V3 = V2, V3 = 0V, and if t= 1ms →Uout = -2V.Voltage on capacitor is rising linear after 1ms at -2 V. In Figure 3 is depicted the circuit diagram.

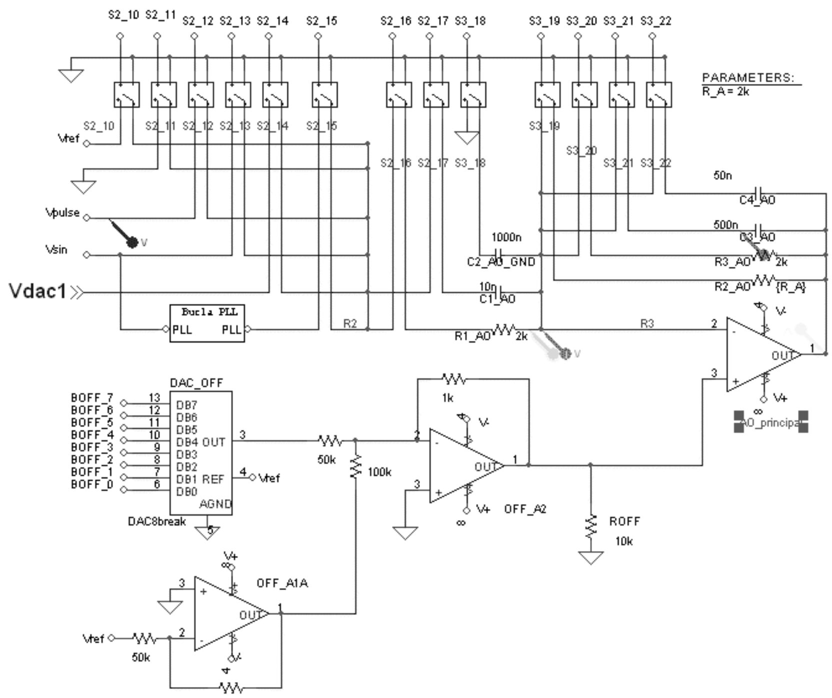

Fig.3. Operational amplifier as an integrator

Conclusions

The described high-speed laboratory architecture eliminates the waiting queues, a common problem of all remote laboratories. It introduce the multitask concept through multitask management interface and multitask execution interface.

As in any other electrical measurements laboratory, the user will study all the theoretical issues and then he will set the parameters for the laboratory work, the execution being developed automatically, under soft control. The optimization of the execution order is insured by the E-Multitask interface. When confirmed, the work request is passed to the reconfigurable platform and the switching matrix is configured as for requested electric circuit. The results of the experiments, either text or graphic files, are returned to the user for further processing.

Acknowledgements
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RESEARCH ON THE EXPERIMENT ENVIRONMENT IN DISTANCE ENGINEERING EDUCATION

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Abstract

The engineering course experiment is the key point of distance engineering education. This paper introduces the research and implementation of experiment environment in ECUST (East China University of Science and Technology). As a typical case of remote control laboratory, a two-water-tanks experimental system using programmable automation controller (PAC) was introduced. A virtual experiment based on interactive flash of physical chemistry was briefly introduced. The statistical data of the experiment courses and the feedback from the students were analyzed. It shows that there are some details that should be improved.

Preface

Experimental work is a vital part of engineering education at all levels, and also a big problem in distance education. Traditionally, home experiment kits or intensive residential schools as part of the course are adopted in the teaching process but the high cost prevents us from implementing this in large scale.

The Internet-based experiment environment is a good solution of experimental work in distance engineering education. It is the integration of information communication technologies and education technologies, and must be flexible, user friendly and fault tolerant. Now it mainly consists of virtual experiment and real-time remote experiment.

In virtual experiments, the device is mainly made by multimedia technology, such as Flash, Matlab or VRML. The technology for virtual experiments is getting more mature, and educational organizations and companies have developed many products.

In real-time remote experiments, the device is the real one in the remote laboratory. Through the Internet, the learners could finish the experiments by video, configuration interface and some simulators.

Real-Time Remote Experiments

Recently, some real-time remote experiments have been developed. Although remote laboratory platforms seem developing quickly, they are still not used in large scale. This is because most of them are simple, or not practical in the learning process. Of course, we strongly believed in that software must be developed in practice. Nonetheless, the current software developments try to search existing practical solution for the remote experiments, and it turns out to be in vain. On the contrary, every remote laboratory project implements its own software architecture, but each one obviously lack of a comparison among existing architectures. Therefore it is not easy to assess the future directions in our research (Scanlon, 2004).

Some appliances directly provide an Internet connection, and it seems different from others. However, this is only because they embed a modern operating system inside the device, which therefore does not require a local computer. So it does not make much difference, and there is no breakthrough (Baran, 2004).

Usually, remote laboratories architects build a middleware allowing remote clients to connect to the local computer. It's comparatively easy, and that is why the most remote laboratories are using this kind of software solutions, as it provided them the remote control over the local computer connected to the corresponding device. Nonetheless, many solutions lack security and require too much bandwidth. (Srinivasagupta, 2003)

A two-water-tanks experimental system will be introduced, and this experiment is for the course of Process Automation Instrumentation. It's a common experiment system in the traditional laboratory, and we added the remote elements and \rebuilt it to a real-time remote experiment system. We select it out because it's typical and comparatively successful. From the construction and practice of the system, we have summarized the guidelines of real-time remote experiments. In current condition, the early experiment projects in ECUST which did not comply with the guidelines turned out to be a failure.

A Case: Two-water-tanks Experiment System

In this experiment, the new programmable automation controller (PAC) was used to develop a two-water-tanks real-time remote control experiment based on Internet.

To assure the reliability and safety, a three-layer distributed architecture and B/S (Browser/Server) mode was adopted. PAC was adopted in the host controller to configure the host detection and control system, and a monitoring software was adopted as the middle ware. In the experiment system, we could finish several experiments ranged from simple object characteristic test to Cascade Control in the course of Process Automation Instrumentation.

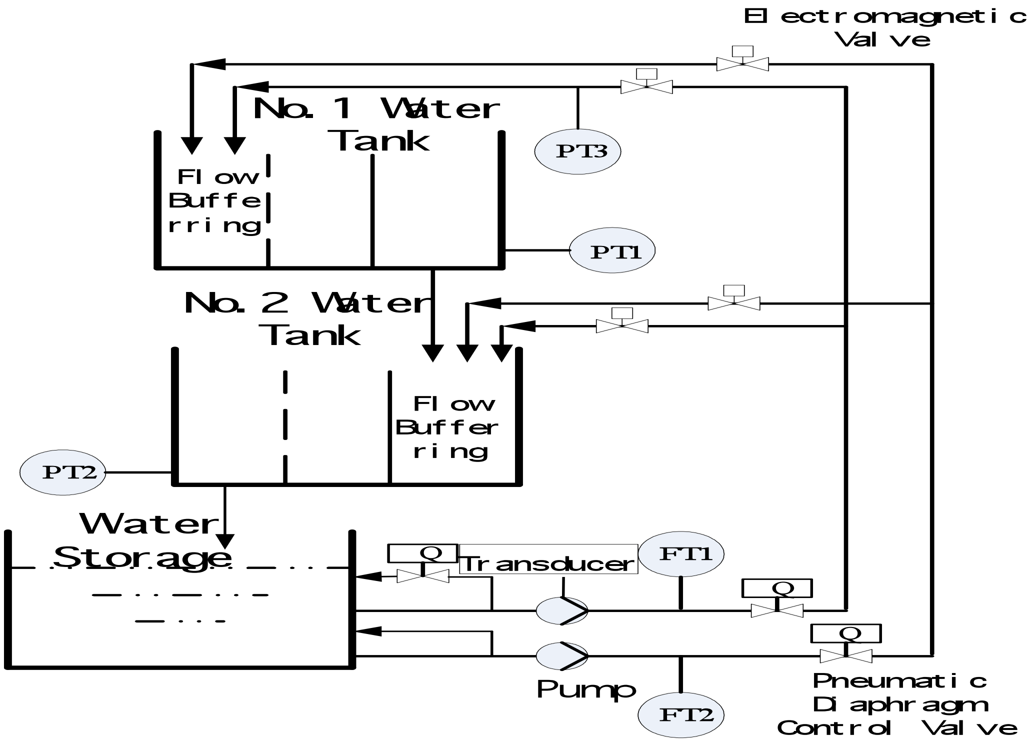
Two-water-tanks Experiment Object. According to the syllabus of the process automation, a two-water-tanks device was developed. The flowchart was shown in Figure 1. In the object, we could finish the following experiment:

1. first-order object and second-order object characteristic test;
2. simple control system experiment, such as first-order object or second-order object set value control or trace control;
3. complex control system experiment, such as proportional control, cascade control;
4. frequency control.

The hardware includes three liquid level detecting instrument, two flow measuring meter, three pneumatic diaphragm control valve, one transducer, four electromagnetic valves, and electrical safety protection appliance. The output of all the instruments is standard signal 4~20mA, and accuracy class is 0.5. In the experiment process, the detection and control system will switch the valve automatically to build up different loops for different experiment function.

The medium of the device is water, and the water was cycled in the closed-system, so overflow would not take place. There are no high-power devices such as the heater. All the action of the device could be implemented automatically, and this is fit for the distance education.

Figure 1: Flowchart of the Two Water Tanks Experimental System

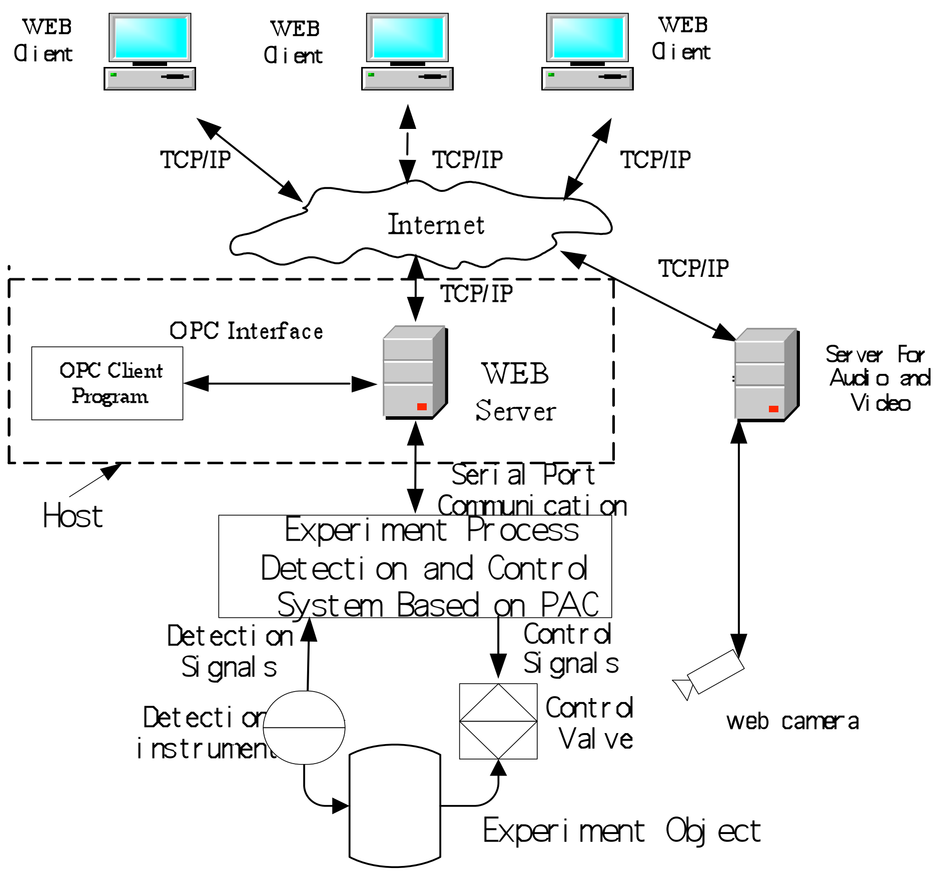


In the design of the water tanks, the multi-vessel structure with flow buffering was adopted. If the cubage was changed, the time constant of the object could be changed; and if the initial level of the flow buffering was set to different value, the pure lag time could be changed. This design makes the simple object possess some complex characteristics, such as time-variant, pure lag, uncertainty, and so on.

The structure design. The structures of most current remote experiment systems are similar. Computers in the system are connected to engineering instruments through the detection and control modules. When students log in to the system over the Internet, they are able to control the equipment through the Internet and server computer. A video camera can also be used to live broadcast what is happening in the physical world. It does not matter if the student is in a nearby dorm room or on the other side of the world (Salzmann, 2000)

The diagram of process automation remote experiment is shown in Figure 2. Its principle is the same as that mentioned above, and it is composed of two water tanks, the process detection and control system based on PAC, server for audio and video, Web server, the client for operator and administrators (the computer with Web browser). When Web server accepts the request from the client, it will control the device to accomplish the specific experiment, and transmit the result and live program of audio and video to the remote learner. The lamp will be turned on automatically in the night if the learner comes in, and the learner could control the angle and focus of the web camera for the better observation. (Zhang Fan, 2008)

Figure 2: Principal Diagram of the Remote Experimental System based on Internet



Development of detection and control system based on PAC. The model of PAC in the system as the host controller is ADAM-5510KW, which is developed by Yanhua Company in Taiwan. This PAC has CPU, ROM SRAM and Flash Memory, built-in watch-dog circuit, real-time timer and multiform communication interface

The configuration of PAC system is as following: the analog input chooses the ADAM-5017 module, and the locale transmitters transit the signal of water level and flow rate to 4-20mA electrical current, and this is the input of ADAM-5017; the analog output chooses ADAM-5024 module, and output of 4-20mA signal drives the locale pneumatic valve to implement the control to the water level and flow rate. Besides, the digital input and output are also configured to implement the control to electromagnetic valve

In the host computer, KW-Multiprog, the software in ADAM-5510KW would program for PAC. Several languages such as Trapeziform Diagram and Structural Text were used in the programming. The control program would be downloaded and run in PAC. The learners and administrators could modify the control parameters in the client computer through Web server to accomplish the experiment (Lin Xiaofeng, 2007).

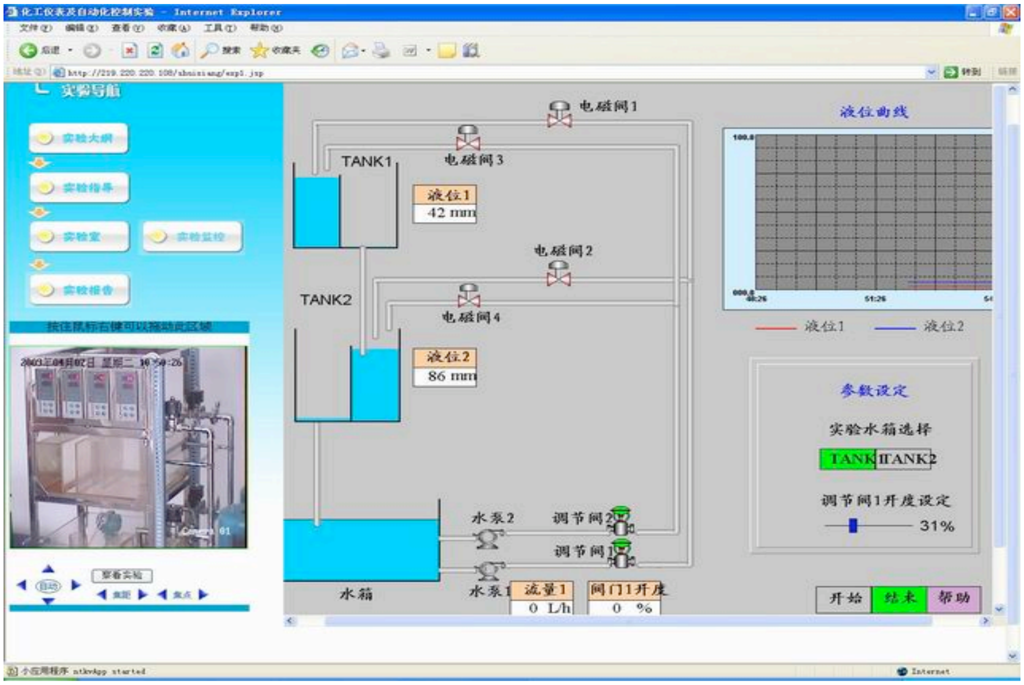
Though the learner could find out what happens in the locale through the configuration software and monitoring audio and video, there is no teacher in the locale. So when a malfunction takes place, the detection and control system must have the function of self-protection and reset. Besides, to avoid any danger, the system must refuse to execute some wrong operation command.

Development of WEB server software. The dynamic data of the experiment is transmitted by socket based on TCP/IP. Now there are two types of program to implement the dynamic data transmission between the client and remote laboratory, and that are remote experiment ActiveX control based on socket or Java Applet program. In this experiment, Java Applet program is adopted. (Tang Hong-ru, 2005)

“Configuration King”, industrial control software developed by a company in China is chosen as the middleware software, and it supports multitask and has the function of OPC server and client.

The system just allows one learner to operate one experiment device, and if the devices were occupied, the other learners only have the right to watch. An online appointment system was developed as a sub-system, and the learners could schedule as their wishes through the system.

Figure 3: Two-water-tanks Experiment System Interface



The experimental report. When the experiment is over, the learner should download the correlative data. This system developed application programs by Visual Basic.net, and this program exchanges the real-time data with Web server through OPC, and records all the data in the experiment and saves it. This is better than the DDE (Chen Shangjun, 2000).

In the process of experiment, the data shown in client is the same as that in locale. However, in the current Internet circumstance, there is lag in the data display sometimes in the trial. For the object which has small time constant, the lag might cause the wrong judgment from the learner. So we should avoid this kind of hidden trouble in the experiment design.

Virtual Experiment

The key point of the virtual experiment is to accept the request from the learner and simulate the experiment appliances and process. As it is mentioned before, the technology is getting mature now. So we just have a brief introduction of a virtual experiment developed by ECUST.

This virtual experiment is developed by Flash technology. Because the graphics system of Flash is based on vector, its file is small in size, and this is important in Internet. The system simulates the mechanism of the appliances, the operation and feedback of the panel. In the virtual experiment, fusion heat of inorganic salt is measured, and the interface of the experiment is shown in Figure 4. It's a common chemical experiment, but even when the learners execute the same input, the output is random in some degree, and different learners will get different experimental report. This makes the virtual experiment approaches the real one more than before.

For virtual experiments, the learning effect of virtual experiment is still in dispute. At least, we think that it can not take the place of traditional experiment circumstance totally.

Figure 4: Interface of Measuring Fusion Heat of Inorganic Salt Experiment

Practice and Discussion

In 2007, when the first version of web laboratory was established, these experiments were open for the distance learners as a trial. Two classes from different major were required to finish the two experiments respectively. This is compulsory, but the result would not be recorded into the final score. For the virtual experiment, there was no time limit, while for the real-time remote experiment, the time was appointed by the learners themselves through the appointment system mentioned above.

The comparison of these two experiments is shown in Table 1. As long as the experimental report was created and passed, we regard this experiment as a successful one. We have recorded all the consultation and complaints on the experiments from the students. The data comes from the students support department of Distance Education Institute of ECUST, and the data from question and answer system in definite time was also taken into account.

Table 1 Comparison of Practice of Virtual Experiment and Real-time Remote Experiments in 2007

	Virtual Experiment	Real-time Remote Experiments
Experimenters	43	35
Successful Number	42	18
Successful rate	98%	51%
Consultation	39	78
Complaints	2	20

For the virtual experiment, it is successful. Only one learner did not finish the experiment, and that was because he was sick at that period of time. Only 2 students complained that the experiment output was too simple, and they just got the same data if they did this experiment repeatedly. In the new version of the experiment this was improved as mentioned before.

For the real-time remote experiments, from Table 1, we could see that it was a failure. The statistics of the complaints were listed as following,

- 2 students complained that they could not enter the experiment system;
- 7 students complained that the system have ever crashed in the process of experiment;
- 11 students complained that the network was so congested that they often could not operate the device, and the quality of video was terrible.

We have investigated all the complaints. For complaint 1, we found the learners had not come here in appointed time. However, when the request from the learners to enter the system had been refused, the system had not given a hint. So the reason is that the interface is not friendly enough.

For complaint 2, we checked the log, and found that the system had never crashed, but some learners had lost the connection. The reason of most problems was that the fault-tolerance of system was not satisfying.

But for complaint 3, it was really complex. As we know that the Internet transmission speed is not stable, while the audio and video require lots of bandwidth. If we reduced the frame and quality of the video, the details of the experiment might not be known well for the learners, and it’s a dilemma. So we concluded that the device should not be too large in volume, or it's difficult for the learner to observe the experiment. Maybe the two-water-tanks device is the ceiling in volume in current Internet circumstance.

In 2008, in the new version of web laboratory, more experiments were open for the distance learner, but they were still trials. We selected two classes to do the same experiment as that in 2007. The comparison of these two experiments is shown in Table 2.

Table 2: Comparison of Practice of Virtual Experiment and Real-time Remote Experiments in 2008

	Virtual experiment	Real-time remote experiments
Experimenters	58	46
Successful Number	58	39
Successful rate	100%	85%
Consultation	42	67
Complaints	0	11

From Table 2, we could see that the both experiments were improved. However, the network congestion was still a problem, and most complaints still concentrated on this.

The trial shows that many experiments are not suitable to be rebuilt to a remote one. We summarized the guidelines of the development on real-time remote experiments. In the guidelines, the experiments with the following characteristics would not be developed to a real-time remote one in current condition:

- there are some heaters and other high-power devices;
- in need of charge and other manpower or manipulator intervention ;
- the medium (most are water) could not be recycled;
- the number of devices exceeds 2, or the number of detection points exceeds 10, or the number of control points exceeds 10, or the number of control points operated in one experiment exceeds 4.

Because we have not enough people, the learning effect of the experiments is not investigated in the research. And most time in the trial, we were obsessed by the complaints from the students about the remote real-time experiments system. And in the further research, more importance will be attached to the learning effect.

Conclusion

In the development of real-time remote experiment system, there are lots of limits, and flexibility, user-friendliness and fault-tolerance of the system are very important. Otherwise it's not a practical in the teaching process. In this paper, we have built up guidelines to evaluate the real-time remote experiment development.

For virtual experiments, it's easy to implement. However, it's just a simulation of reality, and can not take the place of traditional experiment circumstance totally.

In fact, in the Distance Education Institute of ECUST, The traditional experiment circumstance is also kept in some courses.

There are three solutions in the development of the experiment. The choice is based on many factors, such as cost of construction and maintenance, learning effects, fitness for distributed learning, and so on.

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TEACHING 'LINUX AS A FORENSIC TOOL' (ONLINE) TO EUROPEAN LAW ENFORCEMENT

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Abstract

The purpose of this work is to discuss the implications of creating, delivering and maintaining an online MSc level course in forensic computing. There are unique issues associated with this endeavour as the development group for this particular module is comprised of experts from law enforcement and academia from across the European Union and the students are serving police officers from the member states. This paper discusses the reasons for running the course online, the issues associated with this change, and the challenges faced by the development team.

Introduction

In 2002 under the European Commission (EC) funded Falcone Programme (European Commission, 2002), an expert group comprising law enforcement officials and academics from across the European Union held several meetings to identify areas for improvement in training for high tech crime investigators. Having examined the training programmes available in a number of member states, the group concluded that a European approach to cybercrime training and education was required. The panel of experts recommended that university accredited training in computer forensics be provided to law enforcement officers that is consistent throughout the member states. Furthermore, they agreed that provision should be made for sharing of training materials and the development of new resources in an attempt to minimise workload and promote best practice (Ó Ciárdhuain et al., 2003).

The following year several members of the Falcone Programme expert group began to carry out these recommendations. The funding was made available through the AGIS Programme (European Commission, 2006) under the title Cybercrime Investigation — Developing an International Training Programme for the Future. Microsoft and several of the organisations involved in the development provided additional funding. The projects ran between 2001 and 2008 and as of January 2008, there were seven courses that had been developed for use by law enforcement organisations internationally:

- Introductory IT Forensics and Network Investigations (2003–2004);
- Applied NTFS Forensics (2005–2006);
- Intermediate Internet Investigations (2005–2006);
- Intermediate Network Investigations (2005–2006);
- Linux as a Forensic Tool (2006–2008);
- Mobile Phone Forensics (2006–2008);
- Wireless LANs and VOIP (2006–2008).

Whilst the early stages of the projects concentrated on the Windows-based forensics, the latter stages show how the field is fast developing, requiring an understanding of different operating systems, a wider range of techniques, and a need for frequent updates to all courses.

Under ISEC (European Commission, 2008) the latest incarnation of this project group (which now includes representatives of Europol, Interpol, and the UN ODC) suggests that three new courses be developed:

- Advanced Scripting
- Malware Investigations
- Live Data Forensics

In addition to these new courses it is suggested that all courses developed so far be updated (sponsored by Microsoft) and that all courses be run as an MSc scheme to be accredited by University College Dublin, Ireland in the first instance.

This paper focuses on the development and upgrade of the Linux as a Forensic Tool module.

Development of the Linux as a Forensic Tool Course

The Linux as a Forensic Tool course was developed for a number of reasons. One that is particularly important is that Linux is free and open source making it extremely attractive to publicly funded services such as the police, who investigate the crimes, and educational establishments, who teach the theories and principles of digital investigation. Many of the organisations now involved with the ISEC project also have a wider remit than just the EU, e.g., Interpol and UN ODC, are making these courses available to poorer nations such as those found in Africa and the Indian sub-continent, many of which cannot afford expensive hardware and software.

Open source software can be easily modified and added to. Linux is also better suited to many forensic tasks as opposed to Windows. For example, you can mount disks read only and disallow executables from running. As well as these advantages, Carrier (2003) argues that as these tools can dramatically affect people's lives by demonstrating innocence or guilt, they should be subject to a more stringent process of review than is available if the code of such systems is not published. Instead, he promotes an open-source approach whereby the processes and procedures used are clearly defined and subjected to systematic review and debate.

Some users of Linux argue that making the tools easier to use is one way of improving the numbers involved in carrying out digital investigations. Others however, claim that an investigator should be equipped with a more advanced knowledge of computing and therefore advocate the introduction of programming skills. The proposed ISEC Advanced Scripting course aims to provide such training.

The Linux as a Forensic Tool course was piloted in April 2007 at The Garda College, Templemore, Co. Tipperary, Ireland as a one-week course. Following evaluations by the students, trainers, training designer, and quality assurance experts it was decided that the course be split into a two week course due to its complexity. The first week would cover the basics of Linux in a forensic computing context and in the future will be run as an online module. Week two will cover the more in depth forensic features of Linux and the associated tools. Issues that arise concerning the updating of this course include changes:

1. in the Linux operating system installation and setup procedures, i.e., updates of operating system and user interface;

2. involving the update of the forensic image's operating system and file system, i.e., the update from Windows XP to Windows Vista and the introduction of features such as BitLocker drive encryption;

3. the introduction of and updating of free and open source tools, i.e., installation and use instructions will differ as well as better tools becoming available and others becoming obsolete;

4. the updating of forensic tools associated with forensic image production, i.e., potentially the EWF format could change with a new version of Encase;

5. the updating of anti-forensics techniques, i.e., new methods of obfuscating will need to be introduced into course material to make students aware of such approaches;

6. better hardware than is currently specified will be required, i.e., one aspect of the course involves running a suspect Windows image in a virtual machine on a Linux machine — Vista requires better hardware than XP; and

7. concerned with updating a class-based course to an online module, i.e., course material will need to be in a format suitable for self-paced, distance learning and suitable support structures will need to be in place.

Problems 1–6 above pose no major challenges, as part of the original course development and training team are working on these issues at present. The current course focuses on several forensic tools that have been well tested in the field, particularly by the Belgian Federal Computer Crime Unit. Some evaluation of these tools has also taken place in the laboratory by NIST (2008) and by Childs and Stephens (2008). Many of these tools are command line based and require an in depth knowledge of the Linux operating system as well as a good understanding of file systems. This can cause investigators major problems and may be one of the reasons why there is not a larger uptake of such tools. Even when there is a GUI front-end, such as that provided by Autopsy it is in need of improvement. Some of the work currently underway is intended to make these Linux tools easier to use, especially for those investigators coming from a Windows point-and-click environment (see for example Bennett & Stephens, 2008). Almost all of these tools are free and open source and therefore those with a programming background can enhance these tools. Although some law enforcement agencies are doing this, such as the Dutch National Police Agency, many do not have the expertise or the resources. This may therefore fall to the open source community with help from academic institutions. Issue number 7 above: converting a class-based course to an online module, will now be examined in more detail.

Reasons for Online Development

One of the major reasons for week one of the Linux as a Forensic Tool course being run online is concerned with cost issues. Funding estimates and project managers had originally only planned for a one-week course, however following the evaluations the two-week course was deemed necessary. The evaluators also concluded that there needed to be a sufficient break between week one and week two for students to experiment and for knowledge to 'sink in', thus escalating costs further. Although at present only week one of the Linux as a Forensic Tool course is being converted to an online module, this development is being seen as a pilot for all courses that will form part of the MSc scheme. Part of the reason for this is the cost savings such a measure would bring. Another part of the reason is to make the training available to the widest possible audience with the fewest possible instructors. This is important, as even in the UK there are not enough trained professionals to deal with the enormous amount of digital evidence. A report by UK MPs stated, “We have around 140,000 police officers in the UK. Barely 1,000 of them have been trained to handle digital evidence at the basic level and fewer than 250 are currently with Computer Crime Units or have higher level forensic skills” (Eurim, 2004). Whilst this situation may have improved in the past five years, anecdotally there is still a lack of trained computer forensics investigators. Finding instructors for the course is also difficult. Indeed the current upgrade was meant to occur during February 2009 but has had to be postponed until October 2009 due to a number of trainers being unavailable.

Issues Unique to this Course Development

There are several issues unique to the development of the Linux as a Forensic Tool course. Firstly, the course development team is truly international. Currently there are five trainers (including the author) from five separate countries: The UK, The Netherlands, Norway, Finland and Germany. In addition, the managers and other course developers such as the quality assurance experts can and do come from any of the other EU member states. This should not cause a major problem for the update of the course however, as the course manager (the author) will divide content amongst the trainers and all trainers will attend the upgrade meeting with their updated materials. The meeting will then provide a forum for discussion. The Moodle Course Management System (CMS) (Moodle.org, 2009), managed by University College Dublin, will also be used to get feedback regarding content updates before the meeting in October 2009.

A second issue is that all students are also international. Although the prerequisites state that it is essential that students have a good working knowledge of the English language, as the course lessons will be taught in English, there will inevitably be students with differing language skills. Particularly important is to ensure that colloquial English is not used. An online course may be much better in this respect as the content can be well thought out and phrased properly beforehand rather than a trainer giving an explanation spontaneously in a class-based situation.

Another problem unique to this course development is the differences in hardware between the distributed students. In the class-based course it was fairly easy to ensure that all students had the same or similar computer systems. This was especially important as Linux and some of the associated tools require particular hardware in order to run correctly. This could be a major issue as although the minimum specification of computer equipment will be defined there is a huge scope for individual differences. Students will be encouraged to check hardware compatibility lists in particular UbuntuHCL.org (2009). Supporting hardware issues remotely will be challenging, however, it is intended that there will be a forum for discussion on the courseware site (again powered by Moodle). This discussion board will provide a way for students to attempt to solve each others problems as well as for tutor support. Students should also be able to contact tutors direct via email and perhaps Telephone or via Skype. Tutor availability may be an additional problem as all trainers are essentially volunteers with day jobs. In subsequent bids for funding it may be necessary to ask for financial support to cover the time the trainers spend online.

Hardware issues could cause other problems as some of the current class-based materials use floppy disk drives whilst others use USB devices. This can be solved by updating course materials to only cover USB devices (floppy drives are becoming less and less common since the introduction of higher capacity, smaller and safer USB thumb drives).

In addition to hardware issues, other software installation could cause problems. The easiest solution to this problem is to ensure a network connection and use the `apt-get` installation tool. Another solution would be to provide all the software libraries on the Moodle server.

By far the largest problem we foresee however is with the content itself. Linux is notoriously difficult to learn and to teach. Whilst the hardware support and user interface are much improved from the early days of the operating system, Linux simply does not quite work the way a Windows user expects. The Linux as a Forensic Tool course also makes extensive use of the command line interface with which most users will be unfamiliar. In an attempt to address this problem, similar online/distance learning courses will be looked at as well as some of the literature for converting a class-based course to an online/distance learning module.

The Analysis of Similar Online/Distance Learning Courses

The Open University, UK began teaching a distance-learning course called Computer Forensics and Investigations (CFI) containing some online elements in May 2008 (Open University, 2009). CFI is a postgraduate module with no face-to-face tuition, no laboratories, and no licensed software. The course is taught over a 24-week period (requiring around 6–8 hours per week of study). Due to the lack of a laboratory and licensed software, free and open source tools are used to teach the course. Both the tools and computer forensics techniques taught are therefore similar to those on the Linux as a Forensic Tool course. CFI is taught largely using printed materials with software and case study material supplied on CD. This is augmented with an online discussion forum and online assessment submission procedures. The lack of a laboratory and no face-to-face teaching means that technical problems are difficult to deal with and support is provided via the online forum and limited telephone/e-mail support from tutors. In the first year of running, the attrition rate was around 35% and grades were amongst the lowest at the Open University. Possible explanations for this include the course being both technical (large elements of computing including Linux) and non-technical (essay and discussion based). Students that were more technical may have been put off by the non-technical aspects and vice versa. There also exists the possibility of poor teaching and/or poor course design (Price, 2008). For the Linux as a Forensic Tool course only the second of these suggestions poses a problem as students on the course will be serving police officers accustomed to dealing with both the technical and non-technical parts of the job. In terms of the suggestion of poor teaching and/or poor course design, the Open University is one of the largest organisations in the UK delivering distance education programmes and they have both stringent development procedures and strict staff hiring policies in place. It is difficult to believe therefore that this is the case. However, Price's results do suggest a careful handling of this subject matter and perhaps learning aids other than just printed materials.

Another example of digital forensics courses being taught online are those of Champlain College, USA. The BS in Computer & Digital Forensics has been offered at the college since 2003 (Champlain College, 2009). Both online and class-based versions of courses are offered. The content and the computer forensics techniques used by the course team are similar to those explored by the Linux as a Forensic Tool course. The difference between the Champlain College courses and that of the Open University course is in a greater use of the online technology in particular the use of the voice-over PowerPoint delivery of lecture method. In 2006, Champlain College performed a study to find out if the learning objectives of the computer forensics courses were being met equally well in both online and class-based courses. The results showed that while there was no significant difference between course outcomes in the two delivery modes, average grades in the online courses were slightly higher (Kessler, 2007).

Conversion of Class-based Content to Online/Distance Learning Material

nof-digitise Technical Advisory Service (no date) make some recommendations concerning the planning of online learning such as:

- the use of standards on the use of language, e.g., -ise versus -ize;
- learning design issues, e.g., learning objectives, overviews, summaries;
- content selection and length of sessions;
- target learners, e.g., knowing your audience.

These issues to a large extent were covered by the original course design team and as such the information exists in both the training materials and the Trainer's Guide and so will not be covered here. It is also probably worth mentioning that the development team has no intention of producing a HTML-only-based resource. Rather a series of learning objects that simulate the class-based experience will be made available via the Moodle CMS. These objects could also be distributed via CD/DVD.

At the moment the Linux as a Forensic Tool course consists of PowerPoint slides, which in a class-based scenario would be talked over and interspersed with demonstrations. There are exercise sheets which would be covered by in class demonstrations once students had had sufficient opportunity to attempt the task. There is reading material in the form of PDF documents, as well as a number of evidence files, some of them extremely large, for example, a Windows XP image file is 2.86GB.

To turn these materials into online/distance learning based content the course team propose enhancements to current content in a number of areas.

Voice-over-PowerPoint Presentations

These will be used for stand-alone lectures that do not require demonstrations. This will be achieved using PowerPoint's built in ability to record audio. The session will be scripted to ensure colloquial English is not used and that a common standard of language is used. According to Schneiderman (1992) (cited in Oliver, n.d.) online lectures need to be shorter and more to the point than traditional face-to-face sessions. This will mean carefully considering the length and content of each session accordingly. A transcript of the audio can also be provided for users without sound equipment and to improve accessibility.

Voice-over-screen Capture Presentations

For sessions that require demonstrations and possibly some element of PowerPoint, software such as Wink (2008) or Screentoaster (2009) will be used. Wink enables the user to create flash movies containing audio and text explanations. Screentoaster is an online service which allows the creation of QuickTime Video Clips. Both systems work under Linux and both produce content suitable for online download. Transcripts of any command line work can be produced using the Linux `script` command. These can then be appropriately colour coded by the development team to indicate the prompt, input and output.

Documents, Evidence Files and Software

Tutorial documents will be available as before however these may be accompanied by either video clips and/or reader documents so that a full explanation of their purpose can be given. As evidence files and software are large it is proposed that all content is given to students both online and via removable media. This has the advantage of making the material immediately available to those without or with very slow network connections. However, if students are working away from their usual machines they can still access materials.

Other Online/Distance Learning Strategies

One aspect that will need to be taken into account is an introduction to the Moodle CMS will have to be given so that students understand how to use the system. This process could be used to engage the students early on in online discussion and collaboration. Although online/distance learning can be thought of as an asynchronous activity, Kessler (2007), Oliver (n.d.) and Mason (1998) all advocate synchronous activities to maintain student interest. One way of achieving this is by getting them involved in a discussion forum early. This can be maintained by getting students to post at regular intervals on particular topics. Student answers to exercises that are set can also be uploaded and answer sessions only posted when this happens, possibly with tailored class feedback. Contact details of tutors will obviously be available and the team is considering some notion of ‘office hours’ when staff will be available. Lastly, the online assessment activity can be set online and follow a similar pattern to some of the exercises set throughout the course.

Future Work

The first aspect of this work that will need to be completed is the actual upgrade of the Linux as a Forensic Tool course, including the inclusion of the online materials for the first week of the module. This process will allow the evaluation of some of the methods for converting to online content in terms of ease of use and time constraints for tutors. For example, evaluations of voice-over-PowerPoint versus Wink (2008) versus Screentoaster (2009) versus printed materials can then be made. The materials for the course will be finalised in October 2007 at the update meeting to be held at the Norwegian Police University College in Oslo.

The next step in the process will be the delivery of the content to students. The online element is pencilled in to occur between March and May 2010 followed by the class-based part between 7 and 11 June 2010. This will allow evaluations to be made and modifications to be suggested.

Lastly, the production of online materials for the Linux as a Forensic Tool course can be seen as a pilot for all ten courses developed by the expert group as a part of the MSc. If successful, then all other courses may at some point in the future be upgraded in a similar fashion and so any lessons learned will be invaluable.

Conclusions

This paper discusses the development of the Linux as a Forensic Tool course from its origins as part of the Falcone and AGIS projects through to its place in the ISEC funded MSc to be validated by University College Dublin. Of particular interest is the fact that half of this course is to be delivered using online/distance learning methods. There are several good reasons for developing computer forensics courses with this delivery method including cost savings and the lack of qualified staff and tutors. There are a number of unique issues raised by the development of the online/distance learning aspect of this course such as the international nature of the course (staff and students are distributed and have different levels of language skills), hardware and software issues, and most importantly the difficulty of the content itself. To try and make sure that the materials developed are of the desired quality similar online/distance courses developed by the Open University and Champlain College were studied. This study suggested that a range of online/distance learning strategies were preferable to a course booklet only approach. Instead, course materials will be provided online and on removable media which will consist of voice-over-PowerPoint, voice-over-screen capture, printed materials, evidence files, and software resources. In addition, a Moodle server will be used to promote group discussion and communication. Synchronous activities will also be organised to encourage student participation and enthusiasm. It is hoped that these methods will make for a successful module which could be used as a model for future online/distance learning computer forensics course developments.

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TEACHING CONCEPTS IN MICROCONTROLLER EDUCATION: CISC VS RICS ASSEMLBY-LEVEL PROGRAMMING

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Abstract

This paper explores the teaching concepts in Reduced Instruction Set Computers and Complex Instruction Set Computers with reference to an assembly-level programming for small microcontroller units (MCUs). The objective of the proposed communication is to instill the confidence in the instructor regarding the selection of an effective MCU, appropriate for other than electrical/electronic engineering students.

Introduction

Microcontrollers are regularly addressed to students of the electrical/electronic engineering curriculum, but often migrate in allied disciplines so as to serve particular monitoring/control applications. Previous literature related to the important role of microcontrollers in solving engineering problems and subsequently, to the need of addressing a microcontroller-based course in various disciplines of engineering education, such as chemical engineering (Lodge, 2006), biological and agricultural engineering (Hamrita et al., 2002), and mechanical engineering (Culbreth, 2001; Giurgiutiu et al., 2004). Our lines of research are focused on the migration of microcontrollers' technology to students with software engineering orientation. Following an extensive educational research (Bolanakis et al., 2007a; Bolanakis et al., 2007b; Bolanakis et al., 2007c; Bolanakis et al., 2008a; Bolanakis et al., 2008b), an integrated microcontroller-based tutoring system is presently experienced at the Department of Communications, Informatics and Management, Arta, Greece.

Due to the fact that Microcontroller Units (MCUs) have become a popular teaching tool in various levels of engineering education, our recent propositions relied on an interdisciplinary methodology for bridging the gap between low-level and higher-level programming using assembly language learning for small microcontrollers (Bolanakis et al., 2008b). The methodology exploits the fact that freshman engineering students are regularly exposed to an introductory course on high-level programming and draws their attention to the parallelism between the assembly-level and higher-level programming topics. While this strategy acquires the composition of the fundamental high-level programming possibilities at the assembly-level using a Complex Instruction Set Computers (CISC) MCU, it is designed with a systematic attention so as it could be easily revised to any machine-depended language, using either CISC or Reduced Instruction Set Computer (RISC) MCUs. Following this particular communication, the present paper clarifies the entailed risk in addressing RISC MCUs to non electrical/ electronic engineering students. The goal of the present communication is to promote the distinguishing characteristics in the teaching of CISC and RICS assembly-level programming so as to instill the confidence in the instructor regarding the selection of an effective MCU, appropriate for other than electrical/electronic engineering students.

Criterion and Justification

Microcontroller designers are challenged to choose between two giant architectures: i.e. RISC and CISC processor units. The significant characteristic of RICS architectures, i.e. the use of simple instructions that can be executed within one clock cycle, provides large benefits in speed and minimization of the complexity measurements of algorithmic devices (El-Aawar, 2006). Accordingly, RISC architectures have become very popular tools for engineers and technicians. Alternatively, the significant characteristic of CISC architectures is related to the benefit of completing a task in as few lines of assembly code as possible. The question posed is which architecture is appropriate for educating engineering students?

An anticipated answer is that since assembly-level programming is regularly addressed for achieving the optimal performance of a low-level system implementation, students should be exposed to a RISC-based assembly language course. However, introducing students to the low-level (unstructured) programming techniques along with a reduced Instruction Set Architecture (ISA) entails the risk of causing confusion on their perception, especially when microcontrollers' technology is addressed to engineering students with insufficient background on hardware design issues (Bolanakis et al., 2007a). It is worth noting that, it is more important to provide engineering students with long-lasting knowledge rather than one that is in line with current technological trends and might be obsolete in a few years (Hue, 2003). In consideration of an efficient microcontroller education, students should be provided with the opportunity of switching between different MCUs (Bolanakis et al., 2008b). In the remainder of the paper we reveal barriers to understanding microcontroller education, with reference to RISC-based versus CISC-based assembly-level programming that clearly defines the benefits of adopting a CISC processor unit in microcontroller education.

CISC vs RISC Assembly-level Programming

One of the main objectives of the assembly language course is to provide the learner a deeper insight into the inner mechanisms of a processor unit. However, assembly language is not considered to be a friendly teaching tool (Buckner, 2006) and therefore, the need to provide to students a clear linkage between high-level and low-level programming is often posed in the literature (Bolanakis et al., 2008b; Freudental et al., 2008; Larson & Kim, 2008). The example presented here compares the implementation of C language paradigm in RISC-like and CISC-like assembly language, and reveals students' reflections on their learning processes with reference to these kinds of architecture. The example focuses on program flow-of-control and refers to the microcontrollers M68HC908GP32 (CISC processor unit) and PIC16F84A (RISC processor unit).

Flow-of-control

One of the most important chapters in sequential programming (either high-level or low-level) is the alteration of the regular execution of a program. Students are primarily taught how to provide a choice of action within programs. Flow-of-control statements in high-level programming use a test expression that regularly admits relational operators. According to the results of the evaluated expression, the body of the statement is either executed or aborted. On the other hand, low-level actions in assembly language evaluate flags of a status register embedded in the central processing unit (CPU) so as to determine a conditional branch to an effective address. Due to the necessary actions related to the CPU manipulation (which are regularly missing in high-level programming) students are exposed to an onslaught of new information early in their assembly language education.

Table 1: Relational Operators and CISC Assembly Instructions

Relational operators		**Mnemonics**	
<	Less than	BLO	Branch if lower
<=	Less than or equal to	BLS	Branch if lower or same
>	Greater than	BHI	Branch if higher
>=	Greater than or equal to	BHS	Branch if higher or same
==	Equal to	BEQ	Branch if equal
!=	Not equal to	BNE	Branch if not equal

CISC microcontrollers employ a set of assembly language instructions (mnemonics) that could be easily associated with relational operators. Compared to the ISA of a RISC MCU, this option provides the benefit of minimizing information during the initial learning stages for students. While these mnemonics evaluate the CPU status (flag) register, their description permits omission of this particular information and thus, facilitates the passage from a higher to a lower level of programming. In addition, CISC microcontrollers encompass mnemonics that perform subtraction between two registers without changing their content. Those mnemonics provide significant advantages during the assembly code development process. Tables 1 and 2 present relational-like and compare mnemonics respectively, which are referred to the microcontroller MC68HC908GP32. In the following we give an *if* statement example that is addressed to reveal the benefits in CISC-like assembly-level programming with reference to students' reflections on their learning processes.

Table 2: Compare Instructions in CISC Assembly Language

Compare mnemonics	
CMPA	Compare A (accumulator) with memory
CMPX	Compare X (index low) with memory
CBEQA	Compare accumulator with immediate and branch if equal
CBEQX	Compare X (index low) with immediate and branch if equal

IF example: Figure 1 a) presents an *if* example in C, while Figure 1 b) and c) presents the equivalent code in MC68HC908GP32 and PIC16F84A assembly language respectively.

Figure 1: C and Assembly Code (*if* example)

```
1  if (x>y & x>3)
2     {
3      "statements"
4     }
```

a)

```
1  if        lda   x        ;a <= x
2            cmpa  y        ;a-y (i.e x-y)
3            bls   if_end   ;skip if_body if x<=y

4            cmpa  #3       ;a-3 (i.e x-3)
5            bls   if_end   ;skip if_body if x<=3

6  if_body   "statements"

7  if_end
```

b)

```
1  if        movf  x,0        ;w <= x
2            subwf y,0        ;w <= w-y (i.e. w <= x-y)
3            btfsc status,C   ;test carry flag and skip next
                              ;instruction if C=0 (i.e. x>y)
4            goto  if_end     ;skip if_body if x<y

5            btfsc status,Z   ;test zero flag and skip next
                              ;instruction if Z=0 (i.e. x!=y)
6            goto  if_end     ;skip if_body if x==y

7            movf  x,0        ;w <= x
8            subwf 3h,0       ;w <= w-3 (i.e w <= x-3)
9            btfsc status,C   ;test carry flag and skip next
                              ;instruction if C=0 (i.e. x>3)
10           goto  if_end     ;skip if_body if x<3

11           btfsc status,Z   ;test zero flag and skip next
                              ;instruction if Z=0 (i.e. X!=3)
12           goto  if_end     ;skip if_body if x==3

13 if_body   "statements"

14 if_end
```

c)

Regarding the CISC-based assembly code in Figure 1 b), students are primarily introduced to the relational-like mnemonics (Table 1) and thereafter, it is explained to them that test expressions in the assembly-level are formed using a combination of compare (Table 2) and relational-like mnemonics. Compare mnemonics are used to prepare a condition, while the subsequent relational-like mnemonics are used to verify the condition. If the evaluated condition is found to be true, relational-like mnemonics alter the program flow to the memory location defined by a descriptive label. Otherwise, program flow continues to the subsequent instruction in the assembly code. Due to the fact that compare instructions are performed through the general purpose registers of the CPU, i.e. accumulator (A) and index register low (X), the content of the tested variable should be previously assigned to either A or X register. Another point that should be taken into account is the selection of the relational-like mnemonic that is associated to the opposite high-level operator, so as to ease the assembly code development process. Specifically, it is more convenient to evaluate the false condition and abort the execution of the flow-of-control statement rather than evaluate the true condition and fetch the body of the clause, in case the evaluated condition is verified. Accordingly, lines 1–3 in Figure 1 b) evaluate the condition $x \leq y$ end abort the execution of the statement in case it is found to be true, while lines 4–5 perform the same action in case the condition $x \leq 3$ is confirmed. At this point it is worth noting that, while compare mnemonics affect the flag register and relational-like instructions check the status of the register bits, that type of information could be easily omitted during the early lessons of assembly language learning. Therefore, students can focus on the necessary actions for switching from high-level statements to assembly-level techniques.

Contrary to CISC-like assembly language programming, this kind of information is necessary in RISC-like programming. Considering the RISC-based assembly code in Figure 1b), students should be primarily introduced to the CPU flag register and thereafter, learn which particular mnemonics have an effect on flag register and in which register bits. In addition, during the code development process, the students deal with the situation of thinking how the result of an arithmetic operation affects the flag register and subsequently the program flow. The lack of compare mnemonics present students with the responsibility of reassigning general purpose registers to the content of the tested variable before every arithmetic operation. Accordingly, line 1 assigns variable x to the CPU general purpose register (w), line 2 subtracts y variable from w and line 3 tests carry flag (C) in status register. If C = 1 (i.e. x < y) the subsequent instruction (line 4) is executed and thus, the body of the *if* clause is aborted. Otherwise, line 5 evaluates the zero flag (Z) and proceeds to the same action in case Z = 1 (i.e. x = y). Thus, if Z = 1 line 6 is executed and the body of the *if* clause is aborted. The same action is repeated in lines 7–12 so as to determine the execution of the *if* body in case x>3.

Assessment

In an effort to assess the value of the proposed CISC-based pedagogy, an anonymous questionnaire was administered to 39 students at the Department of Communications, Informatics and Management, Epirus Educational Institute of Technology, Arta, Greece. Table 3 summarizes the results of the assessment survey. The first two questions explore the value of the proposed methodology in obtaining the educational benefits of the assembly language programming course, that is, the understanding of computer architecture and the improvement of high-level programming skills. The third question examines the value of the proposed pedagogy in facilitating learning.

Positive results of the first two questions find the students agree with the effectiveness of the proposed methodology to their education. The expected higher score in the first question confirms that the assembly language learning helps more in understanding how a computer machine works and less in improving high-level programming skills. The high score of the third question proves that the proposed CISC-based approach facilitates students’ learning. The fact that none of the students believes that the current method helped in the conception of the low-level programming issues, shortly or at all, highlights the educational benefits of a CISC-based approach on students’ perception.

Table 3: Assessment Survey

No	Questions	Very much (5)	Much (4)	Enough (3)	Shortly (2)	At all (1)	average
1	Do you believe that the code development in low-level languages supports the understanding of the internal structure and the way a computer machine works?	3	14	17	4	1	3,36
2	Do you believe that the understanding of the code construction at the machine level can prove your skills on high-level programming?	1	13	17	7	1	3,15
3	Do you believe that the assembly language tutoring using structured peudocode of a familiar high-level language as an interim step facilitates the conception of the low-level programming issues?	14	16	9	0	0	4,13

Discussion and Concluding Remarks

The lack of structures in the assembly language requires a significant effort for transcending the limits between high-level and low-level programming. Therefore, our recent propositions relied on an interdisciplinary methodology for bridging the gap between low-level and higher-level programming using assembly language learning for small microcontrollers (Bolanakis et al., 2008b), while the present paper clarifies the reason for adopting a CISC CPU in microcontroller education. Because CISC microcontrollers employ a set of mnemonics that could be easily associated with relational operators, as well as compare mnemonics that create results on the fly, their usage permits minimization of information during the initial learning stages. This provides students with the advantage of focusing on low-level programming techniques for converting high-level programming constructs at the machine level; rather than focusing on too much technical detail regarding the effect of particular mnemonics on the CPU flag register. It is our belief the latter information should be provided to the students after their familiarization with the low-level programming techniques; otherwise students might face confusion and disorientation from the main purpose of the course. Following the proposed educational sequence, students could easily exploit low-level programming techniques in the subsequent advanced lessons of interrupts, timers, serial communication interfaces, etc. Due to the fact that RISC architectures have become very popular tools for engineers and technicians, the issues discussed within this paper reveal the entailed risk in addressing these architectures to students with insufficient background on topics related to hardware domain. The purpose of this communication is to instill the confidence in the instructors regarding the selection of an effective MCU, appropriate for other than electrical/electronic engineering students.

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RECONCEPTUALISING SCHOOLING FOR A WEB 2.0 GENERATION

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Abstract

This paper frames and theorises the nature of adolescents' informal experiences in Web 2.0 environments to articulate their fit or misfit with current conceptions of school education. Adolescents are increasingly active Web 2.0 users. However, the traditional research and education communities have been slow to respond to the rapid emergence of the digital generational culture. Adolescents' new ways of interacting and producing are likely to render current configurations of schooling obsolete and hence demand new conceptualisations of schooling. This paper discusses how these new visions might influence, disrupt and interact with future schooling scenarios.

Introduction

This paper considers the possible implications for schooling of adolescent activity in Web 2.0 read/write spaces. It presents arguments for considering such activity when thinking about future scenarios for schooling, and discusses whether adolescent Web 2.0 activity is pertinent to current and future ideas about schooling, learning and teaching. The aim of the paper is to stimulate debate and provoke thinking about learning and future schooling.

There is an urgent need to find out where new boundaries have emerged and to identify strategies for exploiting the fluid nature of adolescent Web 2.0 usage. Boundaries between private and public entities and between offline and online identities are blurring (Gefter, 2006) and implications of these shifts need investigation to inform school change. From a broader educational perspective, the use of social networking technologies provides an alternative to the dominant culture of schools (Heppell, 2000) and by implication a critique of current policy and practice.

Adolescent Engagement with Web 2.0

Technology plays a significant role in the life of today's adolescents. Increasing numbers are comfortable using Web 2.0 technologies to connect with people and express themselves. The term "Web 2.0 describes the range of user-controlled publishing and networking websites that have emerged over the past 5 years, effectively giving people increased autonomy and a greater voice in their online activities. This stands in contrast to older, less interactive Web 1.0 sites that limited users to passive viewing and information retrieval and whose content only the sites' owners could modify (O'Reilly, 2005). Web 2.0 embodies a "blurring of the boundaries between Web users and producers, consumption and participation, authority and amateurism, play and work, data and the network, reality and virtuality" (Zimmer, 2008, p. 1). Examples of these increasingly participative environments that contribute to a Web 2.0 ecology include (but are not restricted to) social networking, media sharing and manipulation sites, data/web mashups, conversational arenas, virtual worlds, social bookmarking, blogs, wikis and other collaborative editing sites (Crook, 2008).

In Australia, digital access is on the increase and patterns of usage mirror those of the UK, US and European countries. As of June 30, 2008, 52% of all Australian households had Broadband connections, an increase of 22% from the previous year. At the same date, 67% of Australian households had home Internet access and this figure rises to over 80% for households with children under 15 years of age (Australian Bureau of Statistics, 2008). A study of 751 Australian families containing 1003 young people aged 8–17 years by the Australian Communications and Media Authority (ACMA, 2007) found that young people spend about one and a quarter hours online each day on average. Over 40% of participants in the study had some of their own user-created material on the Internet and from age 14 this figure rose sharply to 70%. Among 16–17 year olds, two-thirds had an online profile in a social networking site, 1 in 6 had their own blog and 1 in 8 had published their own videos online. Similarly, a UK survey conducted in 2006 of 1,003 13–17 year olds and 1,003 parents found that 33% of the young people regularly use the Internet for blogging and 79% said they use Instant Messaging (IM) regularly (NCH, 2006). A Pew Internet Project (Lenhart & Madden, 2007) reported that over half of US adolescents, aged 12–17 were found to be using online social networking sites in 2006. Of these, 55% have created a personal profile, and 48% visit social networking sites daily or more often. Given the popularity of digital interactions for young people, the question arises as to whether educators should be considering the importance of these new technologies and their affordances for contributing to formal schooling. If so, what might schooling that exploits these technologies look like?

Chaos or Participatory Democracy in Society and Education?

The increase in usage of new technologies by adolescents has led educational reformers to suggest that these technologies will impact strongly on ways of learning, content of learning and location of learning (Warshauer, 2007). Warshauer notes that we are in a transitional period, between a period in which print media were dominant and one that will be characterised in different, "post-print" ways. Weston (1997), writing a decade earlier at the brink of this period of change, hypothesised that it was likely "that the existing social order is about to be challenged" (p. 196). He based this suggestion on the contrast between the ways in which we used the mass media of the day and the ways in which the Internet might be used. He noted that the Internet was used mainly for individuals to express themselves. In contrast other mass media presented content in a "nontransactional" way. It is for this reason that Weston believed that social change was likely on an unprecedented scale. As Weston so eloquently argued, "While expressions like 'public involvement' and 'participative democracy' are embedded in our rhetorical traditions, their unquestionable acceptability has always been conditional upon their equally unquestionable nonattainability" (p.197).

Somekh (2007) agrees that students' interactions through the Internet are vastly different from the sort of interactions that occurred prior to its advent. She highlights its anarchic and highly individualistic nature. She argues that the characteristics of Internet usage by young people are the antitheses of the traditional activities, norms and customs operating in schools. However, while a robust adolescent online culture has emerged, at this point, little attention is given by formal education authorities to the opportunities that these technologies give students for sharing ideas, exchanging and debating views and making global connections (Lamb & Johnson, 2006). There is a growing incongruence between students' informal and formal learning environments (Griffin & Aubusson, 2007) and a subsequent need to examine this shifting landscape. Further, the increased access to public networks and the growing opportunities for adolescents to produce, share and re-use artefacts with a global audience suggests a re-examination of the very nature of schooling, as indicated in Weston's prescient paper (1997). Yet, this need to re-examine and perhaps reconceptualise the nature of schooling, learning and teaching has not impacted much on societal and systemic views which appear largely to be entrenched in industrial-age thinking (Nagy & Bigum, 2007). Like others, Nagy and Bigum suggest that the biggest impact that new technologies have and will continue to have, is on interactions rather than content. This impact thus raises the question of what role schools might have in the production and consumption of knowledge, given the change in the valuing of various concepts and skills.

Ovsiannikov and Monakhov (2007) note that it is possible to understand and judge a society by its educational system. They suggest that "a system of education . . . produces the ideas, socially significant ideals, worldview positions, and hopes that go together to make up the future society as a whole and the destiny of individuals" (p. 61). Conversely, Somekh (2007) suggests that the institution of schooling is "formed, maintained and sustained as much by the assumptions and routine behaviours of those who work within it as by the larger system which gives it legitimacy" (p. 169). Somekh goes further to claim that "teachers, parents and the community — students even — can be said to be complicit in the unreformed institution of the school" (p.169). Attwell (2007) suggests that we understand education both in terms of the way society is portrayed in it and in terms of its assumptions about how we learn. He suggests that while industrial revolutions lead to far-reaching societal change, there is a substantial lag in such change. Indeed, Attwell argues that our current form of schooling and development of curriculum and pedagogy has its roots in the Industrial Revolution and that this paradigm is being challenged by the advent of the Web 2.0 read/write revolution. One of the major critiques that Atwell provides is that education systems have failed to recognise as valuable, any form of learning that occurs outside of the institution or its narrowly defined systems. Thus, "Education systems have failed to extend opportunities for learning outside the institutions and into wider layers of society at a widespread level" (p. 5).

It seems clear, therefore, that while governments have been considering ways to equip all schools with fast broadband connections, they are yet to propose ways to use this increased access effectively to enhance learning. A US study (Ito et al., 2008) investigated youth and young adults' (ages 10–30) media use through large scale ethnographic studies. Their major findings are that the main usage of these new digital media is to extend friendships and interests, and that young people engage in peer-based, self-directed learning online. The researchers suggest that these activities have altered how adolescents learn and interact and suggest that there are major implications for educators and policy makers. Meanwhile, Somekh (2007) has drawn attention to the vast difference in impact on young people's lives of new technologies in and out of school. She notes that while usage out of school is high, and having a great impact on students' lives, the opposite is true in schools. While Somekh cites studies and data that pertain to the turn of this century, the contrast between home use and school use is likely to be similar today.

Valkenburg, Peter, and Schouten (2006) provide a perspective on the benefits for adolescents of friend networking sites, and argue that feedback on their profiles impacted on their social self-esteem and well-being, both positively and negatively. The implication of their argument can be interpreted to be that educational systems need to be informed about the activities, values and dangers of Web 2.0 read/write sites to ensure that such systems are able to lay the foundations for the future well-being of the society. Important issues arising in this debate concern social responsibilities, global citizenship and curriculum applications, as well as questions of audience and new ways of forging community links with schools. As well, questions arise about the ethical and moral boundaries for teachers and students in these spaces, including duty of care issues, copyright, privacy and cyberbullying.

The potential relationship between Web 2.0 informal engagement and formal schooling remains an open question. Griffin and Aubusson (2007) argue that in school there has been "a lost opportunity to embrace the different learning experiences (that occur) . . . in authentic settings beyond the classroom." In a similar vein, Hull and Schultz (2001) urge researchers to help bridge the vast gulfs that separate and continue to widen between children and youth who succeed in school and those who do not, by seeking a collaborative understanding of the relationship between formal classroom learning and the informal learning that flourishes in a range of settings outside school. Heppell (2000) in his development of the Notschool initiative (notschool.com) has developed a different model for learning for marginalised teenagers. In this model, students have access to computers at home, use mobile technologies for their learning and work in ways that are fundamentally different from the autocratic and hierarchical structures of schools. These students have succeeded in learning, which has also resulted in higher self-esteem (Somekh, 2007). Somekh suggests that this practical exemplar of learning with new technologies, underpinned by activity theory (Wertsch, 1998), McLuhan's "the medium is the message" (1964), and Turkle's (1995) work on identity and information and communication technologies (ICT), indicates that a radical revisioning of schooling is not only possible, it is necessary.

Future Schooling Scenarios

This paper debates the potential of such revisioning with reference to OECD schooling scenarios. An OECD Future Schooling Scenarios paper (OECD, 2006) proposes a set of six possible scenarios for schools. We discuss these below and consider how the read/write characteristics of Web 2.0 fit or disrupt these scenarios. The OECD emphasises that the scenarios are not proposed as realities but are thinking devices that aim to sharpen distinctions, imagine possible alternatives and inform policy that may shape the future. There are three main categories — Status Quo, Re-schooling and De-schooling —each with contrasting alternatives.

In a *Status quo* future, schools attempt to maintain existing structures, procedures and practices by resisting change, resulting in mild perturbations and gradual evolution. In this future two extreme possibilities are identified. One scenario describes Bureaucratic School Systems, characterised by a centralised curriculum, management and governance dominated by accountability measures, predictable learning indicators readily and regularly assessed to promote efficiency of delivery and distribution of modest resources. An alternative prediction of the attempt to maintain status quo is the Meltdown Scenario characterised by teacher shortages and crisis management with increased centralisation to solve problems, and imbalances in resourcing.

The status quo model seems inconsistent with our analysis of Web 2.0 participation, access to information and social networking. The attempt to maintain status quo in schooling is likely to make schools increasingly irrelevant as sites of learning. In short, the status quo scenarios are unattractive and unsustainable as learning futures for a modern society. The inflexible, centralised, hierarchical nature of the status quo seems sharply at odds with the anarchy and unpredictable nature of Web 2.0 environments and the nimble thinking required for a knowledge-based society.

A recent report on Web 2.0 technologies (Crook, 2008), suggests that take-up of Web 2.0 tools for learning in schools depends on educational dispositions located within "systems of educational delivery, management and assessment that have been fashioned in harmony with such attitudes" (p. 6). If the influence of a growing adolescent digital culture is limited to the adoption of those aspects of Web 2.0 that are consistent with the prevailing policies and practices of current schooling then its impact is likely to be marginal and provide nothing remotely like the experience many adolescents enjoy in their Web 2.0 spaces. Furthermore, merely transplanting features of virtual adolescent cultures into formal school settings remains vexed and a formidable challenge (Pennycook, 2007).

Consequently, such an emaciated Web 2.0 — subservient to existing school mores, laws and rituals — cannot exploit its apparent potential for learning. Thus we question whether we should consider the adaptation of these technologies to serve the purposes of a status quo scenario and argue that adolescent Web 2.0 practices demand different scenarios for future schooling as indicated by the OECD (2006).

A *De-schooling* future predicts a dismantling of current school systems with a rise in dissatisfaction among key stakeholders and the middle classes. This provides for a continuum of potential alternatives ranging from cooperative learning networks to a competitive, consumer driven market system. A Learning Networks scenario is characterised by a learning organisation driven by individual and community interests, unpredictable patterns of knowledge acquisition and reduced measures of accountability. Resourcing of public institutions would diminish and teachers would be replaced by relatively informal networks where ICT would play a central role and attract major investments; small groups, the home and individual arrangements dominate. Alternatively, market led entrepreneurial providers emerge providing diverse means of accreditation, for consumers to purchase with a degree of public oversight and regulation.

The dismantling of schools as sites of education to be replaced by informal networks with universal access might seem attractive to some but there remain fundamental flaws in such anarchical dispersed mechanisms for education and learning. The absence of schools as institutions and their replacement with informal networks and ad hoc patterns of learning arising at need seems broadly consistent with the preceding analysis of Web 2.0 patterns of engagement among adolescents. However a mere consistency does not of itself imply it is an ideal state or recommended scenario.

The existence of a “second digital divide” (Somekh, 2007) illustrates that members of society have unequal access to technology and varied forms of participation in Web 2.0 activity in particular, “according to the cultural capital available to them” (p.173). Warschauer’s (2007) argument that the contribution of at-home computer use to education is highly variable with high socio-economic status learners benefiting more than those from low socio-economic status background underlines this point. Such a gap is morally intolerable. We are all the worse off if some of us are denied the tools they need to succeed in life; it is also economically intolerable if the benefits extend only to individuals with privileged access (Ogilvy, 2006). A schooling scenario with no place for schools, per se, removes one (albeit flawed) mechanism with capacity to provide educational access across socio-economic, racial and gender barriers. Consequently, any future learning scenario that aims to be broadly inclusive requires schooling that provides significant opportunities for digital learning and Web 2.0 engagement. Similarly a market-driven schooling system is likely to favour those with consumer power, inevitably high socio-economic status groups and the middle classes.

The collaborative ideals and universal access embedded in de-schooling scenarios are well matched to Web 2.0 possibilities. The consequences of de-schooling for the disadvantaged, however, raise critical concerns about its attractiveness as a schooling future.

Re-schooling predicts schools as either core social centres or as highly focused learning organisations. In both, schools are high status, highly valued organisations with teachers as respected professionals. However the school as core social centre emphasises values and citizenship rather than cognitive outcomes which are more readily addressed through informal systems. ICT is used extensively particularly for communication and in enhancing a sense of community. Leadership is distributed with local decision making. As learning organisations, schools are driven by a knowledge management rather than social agenda. Here extensive use of new media and ICT supports knowledge access and exchange in an environment that values small, relatively independent teams engaged in educational innovation.

Re-schooling scenarios retain a place for schools but address key problems of relevance and shift the role either towards social community roles and/or towards that of a learning organisation with a focus on knowledge production and exchange. In the context of re-schooling it is useful to consider the “how” and “where” paradoxes outlined by Warschauer (2007, p. 44–43). The “how paradox” is that learning autonomously will be critical in a digital future but, paradoxically, strong teacher mentoring is required for students to achieve this autonomy. Similarly, the “where paradox” suggests that at a time when informal and out-of school learning has become more powerful and ubiquitous so too formal education is having a greater impact on people’s lives and on workforce preparation. Therefore it seems that schools as institutions with professional teachers capable of facilitating student learning and capacity building will have a critical role in future learning, digital learning and learning in Web 2.0 spaces.

A consistent theme emerging from studies of Web 2.0 participation indicates that the types of activities are variable ranging from expansive creative use to descriptions of proposed and past social interactions; from extensive access among high SES adolescents to negligible access by those on the other side of the digital divide; from genuinely powerful learning tools to influential tools of social interaction and friendship groups. If there is to be a scenario where Web 2.0 features in providing a richer learning experience for all then it is likely to be within the broad parameters of a re-schooling scenario. Here the school as institution sustains social networks; facilitates the capability of learners for autonomy and independence, with an open unpredictable curriculum that addresses issues about access and equity; and thinking that draws on transdisciplinary knowledge.

Ideally school in this scenario would contribute to an open knowledge-building community where control and choice about what and how learning occurs is vested in the adolescent learner rather than determined by distant bureaucracy. This future would enable Attwell’s plea for a “basic paradigm shift from learners engaging with institutional provision and procedures to the institution engaging with the learner” (2007, p. 5) In such a future, Somekh suggests, schools might welcome being “fundamentally challenged by the destabilising impact of ICT on concepts like knowledge, teaching, the disciplines and rationality” (2007, p. 170) because schools are revisioned — not as objects of yesterday’s industrial revolution reproducing society and a workforce for today, but as sites for strong framing, creation and critique of knowledge for tomorrow. Schooling exists not as a process for stagnation and reproduction but as a social tool for leading learning with innovation driving informed, sensitive social transformation and knowledge production.

Implications and Conclusions

> Policy discussion about schooling is rarely informed by a serious appreciation of the nature of childhood or youth in today's society, perhaps because this is regarded as a given for all practical purpose. But it is neither given nor unchanging; it would be well for educational policies were more fully informed by a rounded appreciation of the lives of today's young.
> (Istance, 2000, p. 39)

A serious appreciation of the cultures, contributions, needs and characters of young people requires a deep understanding of adolescents' current and emerging online practices, their benefits and pitfalls; their implications for formal education; and the development of guidelines for the management and uptake of associated social technologies in schools. The potential for digital technologies to contribute to a useful, productive and engaged citizenry is self-evident. Current growth and use of social technologies is driving innovation in many areas of human endeavour. The smart use of such technologies requires workplaces, industries and education that embrace, exploit and invigorate young people's productive engagement with, and knowledge of, cutting edge technologies. A fundamental way to achieve this is by capitalising on the massive engagement of adolescents with technologies that are intrinsically attractive to them.

The implications for learning, of a phenomenon in which users have unprecedented access to self-expression, global audiences and public spaces, are undeniable. Patterns of behaviour, interaction and access in Web 2.0 contrast with the hierarchical and authoritarian context of current formal schooling. Given the increase in usage of new digital read/write spaces by young people, if nations wish to have schooling systems that are relevant and responsive to new developments, it is essential to develop policy and debate about the value of such technologies for changing our notions of what schools should look like as institutions of learning. In this context then, it is noteworthy that in a study of education policy leaders' future visions of schooling (Cogan, 2004) the schooling scenario that was considered most desirable was that of a (re-schooling) Learning Organisation. However, the scenario that was predicted as most likely was a Bureaucratic System (status quo). If this prediction proves correct then school systems will have increasingly and dramatically failed to capitalise on new online technologies.

Meanwhile, adolescents are likely to show ever increased engagement in their use of these ubiquitous technologies to network and express themselves. From a schooling perspective, there is an urgent need to find out where new boundaries have emerged and to develop strategies for exploiting the fluid nature of this second generation of web-based services. From a broader educational perspective, the use of Web 2.0 technologies could provide an alternative to the dominant culture of schools and by implication a critique of current policy and practice. Educational systems need to generate innovative learning opportunities for adolescents who operate in an online world, which is informal and social and which potentially provides them with unlimited voice, access and power. We have a digital generation of adolescents with capability in this area but young people's creativity and expertise, as exhibited in their informal use of Web 2.0 spaces, remains largely untapped and isolated from formal education. Hence, their contributions to national innovative capabilities are dispersed and meandering. Like Somekh (2007), we suggest that it is fruitful for educators to "use their sociological imagination to play a leadership role in scenario building to assist policy makers in the transformation of the education system" (p. 177).

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COMPUTER-ASSISTED EXAMPLE-BASED LEARNING: THE EFFECTS OF SELF-EXPLANATION AND INSTRUCTIONAL-EXPLANATION ON TRANSFER PERFORMANCE

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Abstract

This research examined the effect of applying two different explanatory procedures (self-explanation and instructional explanation) on topic knowledge acquisition performance, near transfer performance, and far transfer performance. A total of 76 students were randomly assigned into three groups and pre- and post tests were used to assess the learning outcomes. The analysis showed that the effect of self-explanation was more pronounced than instructional explanation especially in topic knowledge acquisition performance and near transfer performance. On the other hand, the positive effect of self-explanation was not noticeable in far transfer performance.

Introduction

Incorporating computer technology into learning can offer major advantages with regards to its flexibility, presentation, communication facilities, and reuse of materials (Van Merriënboer, Bastiaens, & Hoogveld, 2004). Moreover, computer technology supports many of the instructional methods that are necessary for transfer of learning. For instance, computer technology can be integrated into example-based instruction which may promote transfer of learning (Schworm & Renkl, 2006).

Computer-assisted example-based instruction is often accompanied by certain types of explanatory activities such as receiving instructional explanation or generating explanation (e.g. Reisslein et al., 2006; Scheiter & Catrambone, 2006). A wealth of research pertaining to self-explanation prompts and instructional explanation has been done in various learning domains. However, most of the research only put emphases on well-structured domains such as mathematics, physics, mechanics, and programming (see Chi & Bassok, 1989; Conati & VanLehn, 2000; Pirolli & Anderson, 1985; Renkl, 2002). Hence, not much is known about the effect of applying different explanatory procedures on a less well-structured domain such as Manufacturing Technology.

Example-Based Learning and Cognitive Load Theory

Example-based learning is a learning strategy in which worked examples are used as a primary learning tool for supporting the construction of mental model and the acquisition of cognitive skills. Generally, worked example encompasses two major components, namely, background story of the problem and solution procedure.

According to previous research findings, learning with worked example is effective for skills acquisition as well as transfer performance (Renkl, 2005). The efficiency of worked example learning approach is underpinned by the cognitive load theory which is distinguished between intrinsic, extraneous, and germane cognitive load. Intrinsic load refers to the complexity of learning contents or instructional task in relation to a learner's prior knowledge and depends on the number of interacting elements that have to be processed simultaneously and kept active in working memory during the learning process (Sweller, 1988; Van Gog, Paas, & Van Merriënboer, 2006), whereas extraneous load is referred to as an ineffective cognitive load because this load is unnecessary and it interferes with schema acquisition and automation (Paas, Renkl, & Sweller, 2003). Extraneous load is usually imposed by the design of the instructional task or by the activity which is not directly related to learning or schema acquisition (Van Gog, Paas, & Van Merriënboer, 2006). Lastly, germane load refers to cognitive load which is beneficial to schema acquisition and enhances learning. Unlike intrinsic load and like extraneous load, germane load is induced and influenced by instructional design. (Paas, Renkl, Sweller, 2003; Sweller, 1988).

By offering a worked-out problem, the use of an ineffective problem solving strategy (e.g. means-end analysis) which may induce extraneous cognitive load is prevented because the learner does not have to look for solution for the practice problem and, instead, can invest all available cognitive capacity to studying the solution given and constructing problem schema (Gerjets, Scheiter & Catrambone, 2006; Große & Renkl, 2006; Sweller, 1988). The cognitive capacity that is freed-up by reducing the extraneous load can be used to increase the germane load by some activities that improve learning, such as asking the learner to generate reasoning for each solution step or receive explanation related to the solution procedures (Chi & Bassok, 1989; De Leeuw & Chi, 2003).

Example-Based Learning with Self-Explanation Prompts and Instructional Explanation

Worked-out problems or example solutions typically do not include explicit explanation of each solution procedure. This is problematic because without completeness of information the learner may not fully understand the solution procedures. In order to learn with understanding, students need to overcome the incompleteness of a worked-out solution by generating inferences from the presented information (Chi, Bassok et al., 1989). Most students, therefore, will try to generate explanations (self-explanations) about the rationales behind each solution procedure. Renkl (1999) has argued that self-explanation is an effective means because it is easier to adapt to the learner's prior knowledge, it is better timed which means that self-explanation only takes place when it can be integrated into ongoing cognitive activities, and it can be more memorable for students when they can explain the solutions in their own words.

The reason why students often prefer to rely on self-explanation in order to optimise learning is that, the rationales of poorly-constructed example solutions are seldom spelled out and some provided rationales confuse students' understanding. In other words, the explanations provided for the example solutions do not fit with the students' understanding (Chi & Bassok, 1989). Self-explanation, by contrast is consistent with the students' own levels of understanding. This may help students to construct new knowledge and integrate it into existing knowledge effectively. Of course, the usefulness of self-explanation depends greatly on the accuracy, completeness, and quality of the explanation. Students, especially novices, may sometimes not generate explanations that are helpful for learning (Renkl, 1999).

In contrast to self-explanation, instructional explanation is designed to communicate a particular aspect of subject matter knowledge. This type of explanation is contributed by the teacher and teaching materials (e.g. text books, computer courseware) during the learning process and is regarded as a powerful tool to help students understand concepts, ideas, events, and procedures. Instructional explanations are usually correct and may help students to deal with comprehension difficulties when they discover the existence of gaps in their domain-specific knowledge.

A good instructional explanation helps convey both content of knowledge as well as the paradigms and methods of establishing new knowledge in the discipline. Provision of instructional explanation may be able to lead to optimistic outcomes, especially when students are incapable to self-explain on their own, or when they generate inaccurate explanations (Renkl, 2002). In this case, instructional explanation can be more advantageous compared to self-explanation because instructional explanations are usually correct. According to Gerjets, Scheiter and Catrambone (2006) instructional explanation should be very helpful for students especially when dealing with high complexity worked-out examples (high intrinsic cognitive load). This is because instructional explanation supports students in overcoming the comprehension difficulties due to the complicated solutions procedures or steps. That is, the intrinsic cognitive load is decreased with the help of instructional explanation. Instructional explanation tends to explain the complicated situations in a simpler way and gives hints to students of how the solutions work, so that students' working memories do not have to 'work hard' to figure out what is the relationship between the variables and why the solution is done that way because everything is explained.

However, too much elaboration in instructional explanation may bring negative effect to learning. The study by Catrambone and Carroll (1987) has shown that students can become lost in the overloaded information of instruction and it jeopardises the transfer performance. In addition, previous researches have shown controversial conclusions about the role of instructional explanation. For example, Renkl (2002) asserts that instructional explanations do not foster learning because they may not be adapted to the prior knowledge of students. When instructional explanation does not match the level of a student's prior knowledge, the student will face difficulty in understanding what is being explained in the instructional explanation. Likewise, Chi (2000) argues that instructional explanation should not be used because it not only impedes the self-explanatory activities which help discover erroneous information in one's knowledge, but it also hinders learners in trying to generate rationales for solution procedures on their own (Schworm & Renkl, 2006).

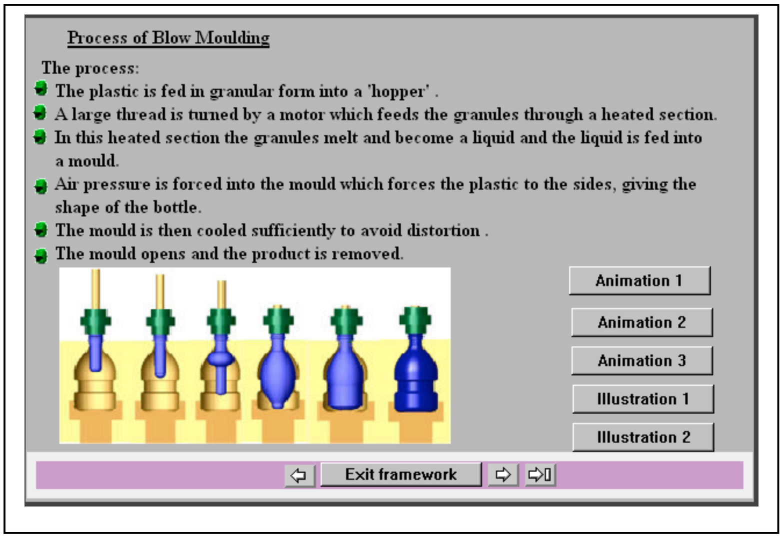
Purpose of Research

The purpose of this research was to investigate the impacts of applying self-explanation prompts and instructional explanation on (a) knowledge acquisition, (b) near transfer performance, and (c) far transfer performance. The research was implemented using worked-out problems in a computer-assisted instructional environment for an ill-structured domain (Manufacturing Technology).

Computer-Assisted Learning Environment

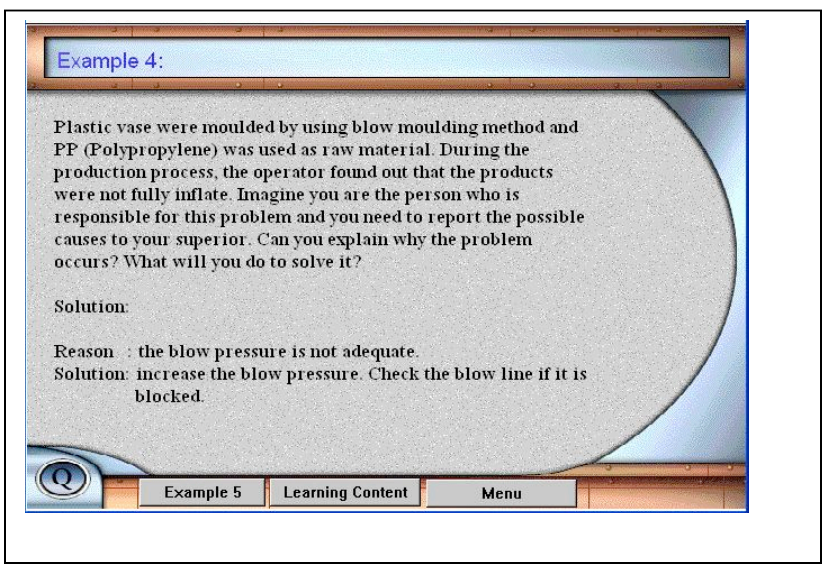
A self-developed courseware CD (using Macromedia Authorware 7.0) was used to create computer-assisted learning environment for Manufacturing Technology. The courseware CD consisted of fundamental knowledge of Manufacturing Technology and six examples of worked problems. The first part of the courseware delivers instruction on the basics of injection moulding, rotational moulding, blow moulding and extrusion process. The following is the example of a screen shot of the blow moulding process:

Figure 1: Screen shot of Blow Moulding Process



The worked examples were constructed in the manner of increasing complexity (low complex, medium complex, and high complex). A low-complex worked-out problem contains comparatively fewer variables, a single-goal, and the solution steps are relatively short compared to medium and high-complex worked-out problem. The following screen shot illustrates one of the worked examples:

Figure 2: Screen Shot of Worked Example



Participants

In the experiment, 76 students from University Tun Hussein Onn Malaysia (UTHM) attended the experiments (50 female and 26 male; mean age 20.99 years). All participants were randomly assigned into three groups, namely, Self-Explanation prompt (n = 25), Instructional-Explanation (n = 25), and control group (n = 26).

Pre-test

The assessment of entry knowledge was done before the treatment and it was divided into three parts which assessed factual knowledge acquisition, near-transfer, and far- transfer problem solving performance. The factual knowledge pre-test contains 10 multiple-choice items. The correct answer would be scored 1 point and no credit point was given or subtracted for the wrong answer. The second part measured near-transfer performance. This part consisted of five problems which required participants to write in short answers. The maximum score which could be obtained was five points. The actual score varied from 0 to 5 depending on the accuracy of the given answer. The final part of the pre-test was to assess far-transfer performance. The scores of between 0–5 points could be achieved by the participants. The pre-test was found reliable (Guttman coefficient lambda: 0.63).

Post-test

Basically, the post-test has an identical structure as the pre-test which consists of three sections (10 multiple-choice items for the first section, 5 short essay items for the second section, and 5 short essay items for the third section). The reliability was found to be acceptable for analysis (Guttman coefficient lambda: 0.65)

Experiment Procedures

The entire experiment comprised four phases, namely, introductory phase where participants learn the basics of Manufacturing Technology, pre-test phase, worked-example learning phase, and post-test phase. In the first introductory phase, the participants were required to fill out the demographic questionnaires and then were presented with learning material using the courseware CD. After the introduction phase, participants were required to work on the pre-test. After the pre-test, the treatment (worked-out problem learning phase) was administered. In order to minimise the effect of pre-testing, the second learning phase was carried out a week after the introductory phase and the pre-test.

For the self-explanation prompts (SE) group, the participants would have to try to understand the solution steps that were displayed on the computer screen. Then, the participants would be asked to justify and explain why or how the solution procedures were done in the way they were displayed on the computer screen.

Participants had to write down their explanation on the papers. For the instructional explanation (IE) group, the worked-out problem and solution procedure were presented to the participants. The instructor explained the problems and the complete solution to the students. After completion of the treatment phase, participants were required to sit for the post-test.

Results

Table 1 shows the means and standard deviation of the pre-test and post-test results in the experimental groups. Firstly, we examined whether all participants had the same level of entry knowledge. The ANOVA on the pre-test scores showed significant difference between the experimental groups beyond the level of 0.05 ($F(2,73) = 4.29$, $p = 0.02$, $\eta^2 = 0.08$: medium effect). The entry knowledge difference has to be eliminated in order to make the experimental groups comparable.

Table 1: Means (Standard Deviations) of Pre-test and Post-test Scores in the Experimental and Control Groups

	Control Group	Instructional-Explanation (IE)	Self-Explanation Prompt (SE)
Pre-test: topic knowledge acquisition	6.25 (1.11)	6.26 (1.01)	5.32 (1.60)
near-transfer	9.69 (2.58)	11.96 (3.71)	10.88 (4.10)
far-transfer score	8.19 (3.00)	8.54 (2.34)	7.98 (3.41)
overall score	24.12 (4.19)	26.76 (4.83)	24.18 (6.50)
Post-test: topic knowledge acquisition	6.29 (1.33)	6.83 (1.03)	6.92 (1.29)
near-transfer	9.73 (2.02)	12.22 (3.22)	13.96 (3.27)
far-transfer score	9.50 (2.87)	11.20 (3.39)	10.24 (3.01)
overall score	25.52 (3.79)	30.24 (5.12)	31.12 (6.05)
Difference between overall pre- and post test score	+1.40	+3.48	+6.94

This difference could be attributed to some participants in the respective groups who possibly did exceptionally well or poorly in the pre-test. A thorough examination of the pre-test scores distribution between experimental groups revealed that two participants of Instructional-Explanation group scored exceptionally high (39.5 and 40.0). Meanwhile, there were also two participants of the control group who scored exceptionally low (11.5 and 11.0). In order to eliminate this potential influence on treatment, those four participants (5.3% of the sample) were excluded and their data was left out from consideration. The re-analysed results revealed no significant differences between the experimental groups ($F(2,69) = 1,700$, $p > 0.05$). Thus, the experimental and control groups are now comparable with respect to the treatment prerequisite.

With regards to topic knowledge acquisition performance, both IE and SE groups did slightly better than the control group (IE: M = 6.83, SD = 1.03; SE: M = 6.92 (1.29); control group: M = 6.29, SD = 1.33). Therefore, it can be said that worked-out problem learning with explanatory activities enhanced learners' achievement with regard to topic knowledge acquisition. In addition, the IE group was also compared with the SE group using t test. The outcomes of the t test showed that the participants of both experimental groups were not statistically different ($t(46) = -0.28$, p = ns). However, from the aspect of test score increment, the SE group learners had significantly improved their performance from pre-test to post-test ($t(24) = -5.43$, $p < 0.01$ (two-tailed), cohen's $d = 1.09$ (large effect). In contrast to SE, the increases of knowledge acquisition performance for the other groups did not yield a significant difference.

With respect to near transfer performance, both IE and SE groups scored statistically significantly better than the control group, $F(2,69) = 13.19$, $p < 0.01$, $\eta^2 = 0.26$. However, this result did not tell exactly which explanatory activity is more superior. By taking a glance at the near-transfer test scores (Table 1), although the SE group obtained higher post-test scores compared to the IE group, the scores did not differ significantly ($t(46) =. -0.54$, $p > 0.05$). On the other hand, we discovered that the SE group had gained a significant increase of near transfer test score (increase from pretest to post test) ($t (24) = -3.75$, $p < 0.01$, two-tailed), whereas the gain scores of the IE group were not statistically significant ($t(22)=-0.33$, $p>0.05$). The significance of *t*-value for the SE group showed that the increase of near transfer test performance might be attributed to the self-explanation effect.

In terms of far transfer performance, participants of the both the IE and the SE groups outperformed the control group participants (IE: M = 11.20, SD = 3.39; SE: M = 10.24, SD = 3.01; Control: M = 9.50, SD = 2.87). Although the experimental group participants yielded higher far-transfer post-test scores, the ANOVA returned a non-significant value ($F(2,69) = 1.70$, $p > 0.05$), which indicates that the differences between the experimental and control groups were not statistically significant. Based on these findings, it is clear that neither instructional explanation nor self-explanation instructional procedures would help foster far-transfer learning outcome.

Discussion

It is astonishing to find out that self-explanation prompt group did not significantly outperform its counterpart in post test topic knowledge acquisition performance.

However, this partial result does not mean that the self-explanation prompt lacked a positive effect on topic knowledge acquisition performance. The reason behind this point is that we have discovered that learners who generated self-explanations had gained significant improvement from pretest to post test compared to learners who received explanations. This significant test improvement might be attributed to the self-explanation effect. Although the favourable effect of self-explanation was not very pronounced in topic knowledge acquisition, it did exist to a certain extent. Therefore, it is still plausible to conclude that application of self-explanation prompts may enhance topic knowledge acquisition.

Similarly, the learners of both the self- and instructional explanation achieved the same level of near-transfer performance (no significant difference was found in post test scores). However the distributions of near-transfer test scores illustrated that self-explanation learners had gained a significant increase of near-transfer test scores (pre-test to post-test). Again, this significant increase illustrates that the self-explanation effect was actually playing its role to push learners' performance to a higher end and promote deeper understanding than students who were not prompted to generate explanation. Therefore, applying self-explanation in the learning process is more advantageous over instructional explanation to a certain extent because learners who self-explain are likely to achieve higher gain scores.

Lastly, the positive effects of self-explanation prompts on far-transfer performance can be found in a wealth of previous researches (e.g. Renkl & Atkinson, 2003; Wong, Lawson, & Keeves, 2002). However, such a positive effect is not replicable in the present research. Based on the analysis outcomes of this research, it is very astonishing that no significant favourable effect was found either in self-explanation or instructional explanation in terms of far-transfer performance. Even worse, in terms of far-transfer gain scores, even worse, the self-explanation learners underperformed instructional explanation learners. This pattern of result clearly illustrates that the effects of self-explanation which are widely proved to be more effective (e.g. Aleven & Koedinger, 2002; Chi & Bassok, 1989) was not outstanding in the context of this research.

There are a few possible factors that might contribute to the detrimental effect of self-explanation prompts in the present learning context. First of all, the worked-out problems were presented from a low to high level of complexity which is expected to be able to facilitate learning (Collins, Brown, & Newman, 1989). For the low complexity or easy worked-out problems, it would be relatively easier for learners to comprehend the knowledge. When the learners move on to the more complicated worked-out problems, perhaps the existing mental model of the learners are not adapted to the complex information, and in turn, they fail to generate correct explanations. Thus, new knowledge cannot be accurately constructed on the existing knowledge. Therefore, the existence of knowledge gap between the worked-out problems might not bring out the favourable effect of self-explanation and thus impair transfer performance.

Apart from that, the participants of the SE were required to write down the explanations of each solution. It is important to note that the act of writing self-explanation does not directly contribute to knowledge representation or mental model construction. Any learner's physical activity (e.g. writing or typing) will inevitably impose an additional demand on cognitive resources which may not necessarily translate into cognitive processes (Kalyuga, 2007). Therefore in the context of this research, the process of writing can be viewed as an activity that introduces extraneous cognitive load which might disturb learning. This interpretation is in line with the cognitive load theory which claims that high intrinsic and extraneous cognitive loads are likely to deteriorate transfer performance (Schnotz & Kürschner, 2007; Sweller, 2005).

Although self-explanation imposes germane cognitive load that can enhance acquisition of knowledge and problem solving skills, it should be noted that germane cognitive load is only beneficial to learning if sufficient working memory capacity is available (Sweller, 2006). In the case of using both complex worked-out problems and written self-explanation, it tends to impose high intrinsic cognitive load as well as extraneous cognitive load which could have occupied a huge piece of working memory capacity leaving insufficient space for germane cognitive load. If self-explanation is implemented beyond the working memory capacity, even though germane cognitive load is increased, the learning performance is unlikely to be fruitful.

Future Direction

The present findings are focused on the domain of Manufacturing Technology. More studies are needed to determine if these results are replicable in other ill-structured non-engineering domains such as psychology, law, and education. Certainly, to know more about the relation between learner and instructional approach in different domains of knowledge, the tools of assessment must extend beyond commonplace multiple-choice item or the widely-used Likert scale. Qualitative method such as interviews and observations can be used cooperatively with quantitative strategies in order to supply a better understanding on the related issues.

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THE SNAP! PLATFORM: SOCIAL NETWORKING FOR ACADEMIC PURPOSES, PEER LEARNING, AND COMMUNITIES OF PRACTICE

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Abstract

E-learning platforms are being reconceptualized. There is a move away from the repository-style LMS towards one of increased communicative and collaborative potential that empowers the learner and leverages the learning experience. At Victoria University, the SNAP! Platform is being designed to support peer exchange and collaboration in developing learning skills. This platform includes social networking communication and profiling, shared bookmarking, student mentor blogs and commentary, RSS feeds, tagging, and the creation of peer-generated learning resources. The SNAP! Platform hopes to establish self-generating academic learning communities of practice in which students learn to take an active and dominant role in their own and each other's learning.

Introduction

The Web has undergone a transformation. It is no longer only or even primarily about disseminating and linking information; it is about linking and empowering people. Staley (2009) claims that Web 2.0 technologies "represent as important a historical phenomenon as the birth of bureaucracy" (p. 38) in that "they signal a participatory turn in our culture" (p. 39). Far from being a passing fad represented by MySpace, Facebook, YouTube, Twitter, or any other individual instantiation, Web 2.0 is an evolution in the social architecture and functionality of the Web (Limpens, Gandon, & Buffa, 2008) representing the potential of the individual, or individual node of the network, to contribute equally to the whole. This is what Staley calls "wikinomics" — after the collaborative writing platform of the wiki — a new form of social economy based on a truly participatory framework. About the future of the tertiary institution, he asks: "How will the logic of wikinomics affect [the] time-honored arrangement between teachers and students" (p. 38)?

E-learning platforms are also undergoing a transformation in response to the communicative and collaborative opportunities that Web 2.0 technologies afford. Learning Management Systems (LMSs) such as Sakai and Moodle have integrated many of the popular tools and functionality of Web 2.0: blogs, wikis, RSS feeds, bookmarking — and even Blackboard has learned that these can be important learning tools. Despite these added tools, LMSs remain at core institution-centric. The focus of these platforms, in design as well as functionality, is primarily administrative. But does it make sense, from a pedagogical perspective, to have the student learning platform married to the administrative needs of the institution — especially when these systems are locked into access regimes that stifle rather than support the platform's learning potential? Some educators are now asking what a truly learning-centered platform would look like — one that was fundamentally in the service of learners.

At Victoria University, the SNAP! Platform is being designed to support the development of students' academic skills. It is based on the principles of wikinomics and incorporates Web 2.0 tools, communicative and collaborative potential between staff and students, the opportunity to discuss and share resources, peer engagement and mentoring, the creation of learning communities of practice and — at its core and as its acronym indicates — *social networking for academic purposes*. This paper will discuss the pedagogical foundations of this platform in light of the personal and social affordances it seeks to support. It will then describe the components of the platform and how it may be extended into broader resource sharing and other enterprise-wide systems.

The Personal-Pedagogical Dimension

As a lecturer in learning support at Victoria University I have individual consultations with students about their academic work. In the morning I might see a philosophy major engaged in researching a paper about economic paradigms of the European Enlightenment. In the afternoon I might be helping a history student organise her thoughts about a project on the early Industrial Revolution and the rise of the concept of consumerism. It would be evident to me that their topics converge, and even more evident that these two students should be talking to each other, sharing their ideas and their research, and engaging in an intellectual conversation together that might spark further ideas and mutual interests. But I am these students' only node of possible connection and for reasons of privacy I can't help them find each other.

The above example highlights for me the need for a platform through which students could locate each other and share their ideas, research and experiences, through which informal learning communities might develop out of mutual interests and needs. Many students spend a lot of time on Facebook engaged in social networking, but where is the venue for them, as learners, to engage in social networking for academic purposes? And if one existed, would they use it?

In a knowledge economy the principles of active learning are paramount: students need to learn how to become arbiters of their own education, and how to negotiate and filter the increasingly complex and contradictory digital information and social environments to which they now have access (Hase & Kenyon, 2000;

Huijser, 2006). Critical thinking and discriminatory skills are an essential part of the learning toolkit. One could argue that this is not a new need; indeed, the passive, teacher-led model of mass education that has developed over the previous century supported an industrial-age labor economy, the unchecked and irresponsible actions of which has recently brought the world to its knees and led to mass global unemployment and unrest. As governments rebuild and rethink priorities around their citizen-base, so too should the education sector now develop strategies to establish and support the learning-centered pedagogies it has espoused in theory.

Constructivist pedagogy supports the notion that learning happens when students are engaged in producing knowledge and not simply absorbing knowledge created and divulged by the teacher. In this sense the constructivist classroom is like a Web 2.0 platform in which everyone is invited to participate in content-creation, and peer production is central to the intrinsic value of the platform. According to Staley (2009), the constructivist classroom is transformational, and teachers "must cede some of the control of the direction of the learning" to allow for the emergent learning that takes place when students are allowed to interact. Yet despite the social and cognitive benefits of constructivist learning, the teaching paradigm of universities is still overwhelmingly that of the lecture and the lecture hall.

There are other educational philosophies that are useful in developing a pedagogical framework for Web 2.0 learning platforms. Among these are Heutagogy (Hase & Kenyon, 2000), Connectivism (Siemens, 2004), Multiliteracies (Huijser, 2006), and Media Literacy (Wesch, 2009). As described by Hase and Kenyon (2000), heutagogy is a model of proactive and self-directed learning that does not necessarily progress linearly through a prescribed set of learning resources, is not always planned or conscious on the part of the learner, includes intuitive processes and is experiential and socially interactive. Central to this model is the development of a student's capability, both during formal education and after, as an effective, involved and empowered element of society. Connectivism (Siemens, 2004), a learning theory that has been gaining popularity and momentum over the last few years, also informs the learning design of the SNAP! Platform. Siemens maintains that learning is dependent upon a diversity of opinions, that the knowledge landscape is constantly shifting and that learners must be able to accommodate those shifts, that being able to make and maintain connections and link ideas is an essential skill, and that the health of a knowledge network is dependent upon the flow of information. According to him, "the starting point of connectivism is the individual. Personal knowledge is comprised of a network, which feeds into organizations and institutions, which in turn feed back into the network, and then continue to provide learning to individual [sic]. This cycle of knowledge development (personal to network to organization) allows learners to remain current in their field through the connections they have formed” (n.p.).

As does Siemens, Wesch (2009) maintains that knowledge is always and necessarily incomplete and subject to negotiation: “it becomes less important for students to know, memorize, or recall information, and more important for them to be able to find, sort, analyze, share, discuss, critique, and create information” (n.p.). Participation in the world is inevitable; how we participate defines us. And participation in media and content creation increases students’ social and literacy skills, as well as their ability to communicate information and co-create knowledge.

With the development of new media and the exponential increase of information on the Web, there is a need for new literacy skills. Like Wesch and Godwin-Jones (2006) and Huijser (2006) point out the need for students to engage critically with not only the textual but also the visual and video media of the Web. Huijser, like Hase and Kenyon, maintains that teacher-directed, text-based, linearly-sequenced learning paradigms are “inadequate to prepare students for a changing world” (p. 30). Clearly, new modes of teaching and new pedagogies are needed to address what Wesch (2009) perceives in his students as a “crisis of significance” about their education. These new modes need to address the disjunction students feel between their online environments — where they are engaged as social, creative and exploratory agents — and their academic environments, in which they are too often passive, controlled and bound by institutional regulations.

The Social Dimension

As Godwin-Jones (2006) points out:

> There is a clear social dimension to electronic literacy; reading and writing on-line are often collaborative activities. As educators we not only need to facilitate literacy skills in this new environment, we also need to be creating language learning media or applications which mirror the kind of online world students experience — student-centered with collaborative opportunities, allowing plenty of space for creative and reflective processes (p. 13).

The SNAP! Platform intends to be an environment in which peer learning, sharing, and collaboration are the key factors. At Victoria University, the School of Learning Support Services has a robust Student Mentoring Program, as well as Student Rovers in the University’s Learning Commons. These students will provide online mentoring in the form of blogposts, podcasts and vodcasts, and other forms of learning skills resource creation. Online peer-assisted learning approaches have received recent attention in Australian/New Zealand tertiary institutions (Huijser, Kimmins, & Evans, 2008; Ladyshewsky & Gardner, 2008; van der Meer & Scott, 2008), and face-to-face peer learning approaches have been well established there with the PASS (Peer-assisted Study Support) and PALS (Peer-assisted Learning Support) programs, as well as peer-assisted writing support programs at various universities.

Peer-assisted online learning has become much more possible with the advent of Web 2.0 technologies and services. As Benkler (2006) maintains, "[t]hese architectures and organizational models allow both independent creation that coexists and coheres into usable patterns, and interdependent cooperative enterprises in the form of peer-production processes" (p. 106). Van der Meer and Scott (2008) see peer-assisted learning approaches as particularly important for first-year tertiary education, and argue for "shifting the balance from an instruction focus of learning support staff to facilitating or supporting peer learning" (p. 73). They call for "peer learning primacy" in learning support services. Peer mentors play an important power-levelling role in a learning community of practice: they are authoritative without being an authority. And they are the intermediaries between the relative novices (the students) and the experts (the lecturers).

Chatti, Jarke and Frosch-Wilke (2007) stress the importance of the social aspect of learning and knowledge management, and the need for learning management systems to be people-driven rather than institution- or learning-object- driven. They suggest a shift towards the personal learning environment in which the instructor becomes "a knowledge broker, knowledge co-creator, mentor, coordinator and facilitator of the learning experience" (p. 412). There are several ways in which students, mentors and teaching staff can participate equally in the co-creation of resource-building on the SNAP! Platform. One is through sharing bookmarks to useful Web resources through a Delicious or Diigo feed. Another is by commenting on blogposts. Another is by asking and answering questions and sharing ideas on the threaded discussion forum.

The creation of shared metadata on e-learning objects through social tagging is another promising aspect of collaborative content creation in e-learning environments (Dahl & Vossen, 2008; Limpens et al., 2008; Lux & Dosinger, 2007; Maier & Thalmann, 2008). Rather than relying on established top-down ontologies and directories, bottom-up 'folksonomies' support the learner by providing a cognitive tool for knowledge building and negotiation: to tag a learning object, the learner needs to develop a sufficient-enough understanding of it to be able to summarize it by a set of keywords. Tagclouds, as a visual view of a set of tags, can help reveal relationships between learning objects that "do not have any usual metadata fields like author, title, format, or location in common" (Dahl & Vossen, 2008, p. 45). In addition, tagging — along with other user metadata such as comments and reviews, polls, etc. — establish a database of information to which students can refer to find useful information, and that can be instrumental in helping students find each other and co-locate into communities of shared interest (Godwin-Jones, 2006, p. 10; Limpens et al., 2008). My students at the University of Melbourne could have found each other through tagged resources and bookmarks.

Social folksonomies can be fraught, however, with the problem of 'noise': falsely-unique tags that are often created by misspellings, plurals, synonyms, homonyms and ambiguities, and the percentage of these 'errors' can rise as more tags are created (Limpens et al., 2008; Maier & Thalmann, 2008). One way to minimize this is by the initial seeding of a controlled vocabulary of tags (Limpens et al., 2008, pp. 74–75) — a combination of ontology and folksonomy that albeit may compromise the cognitive benefits of solely student-generated tags. Dahl and Vossen (2008) describe the difference between a broad folksonomy, in which each user contributes his/her own tags (e.g. Delicious), and a narrow folksonomy in which the object creator or administrator sets the tags (e.g. Flickr). The E-Learning Repository of the University of Muenster uses a version of both broad and narrow tagging: its *share.loc* repository creates initial tags and users can add additional ones, while in the *Learnr* platform users set their own tags to which they alone have access (pp. 38–39). In this way the benefits of a seeded ontology with user contributions and a personal folksonomy can complement each other.

Social tagging is a way for learning resources to be organised by students themselves, in ways that are personally useful and that provide the platform with organization and coherence. Broad tagging is a form of peer-to-peer (P2P) collaborative exchange. Bostrom, Gupta and Hill (2008) describe the potential for true P2P networks to support collaborative learning. The client/server computing relationship is a technological metaphor for traditional teacher/student paradigms: information flow is controlled by the server, not the client. Shouldn't learners be free to interact directly and informally with each other without having to go through an intermediary or authority? The problem with early P2P technology has been with issues of authentication, network control, metadata creation and security (p. 52) — all issues important to institutional enterprise systems; nevertheless, future iterations of P2P architecture may hold promise as collaborative learning platforms — especially in conjunction with traditional client/server systems.

The Platform

In an effort to remove the 'management' aspect of Learning Management Systems, some educators (Bogdanov, Salzmann, Helou, & Gillet, 2008; Chatti et al., 2007, p. 412) prefer the use of the term Personal Learning Environments (PLE) — a reflection of a more learning-centered approach to enterprise systems. As the

LMS evolves both conceptually and technically, a flurry of acronyms, habitats and atmospheres has been advanced: Virtual Learning Environment, Personal Learning Environment, Personal Learning Network, Learning Platform, Learning Ecosystem, Cloud. The progression is indicative of a move towards open systems; even Blackboard now calls itself a VLE rather than an LMS, has developed an 'open architecture' that provides developers the opportunity to develop third party integration; in the spirit of the times, it has even developed an i-phone application.

Farmer (2009) considers openness, flexibility and extensibility in LMS architecture to be critical components for creating a system that supports learning-centered pedagogies. He proposes an 'Open Learning Architecture' that contains four elements: 1) an IT Core combining backend and system integration with a content management system; 2) an LMS that provides course and ad hoc groupings; 3) a Presentation component that provides the user interface; and 4) an 'Open Adapter Framework' that allows developers to extend the functionality of the system with seamlessly integrated plug-ins from popular Web-based applications such as Google Docs, Twitter, Facebook, Delicious, and RSS feeds. Such architecture could maximize the means for students to engage in the collaborative and social opportunities that Web 2.0-based applications, or *cloud computing*, affords. Tertiary students are increasingly opting for cloud applications over enterprise systems (Brown, 2009, p. 66), and this trend is likely to continue. And yet most current institutional e-learning systems cannot or will not engage with cloud applications, social networking sites like Facebook, and even YouTube — despite the popular video sharing site having surpassed Yahoo! as the number two popular search engine (Hill, 2008) .

Victoria University currently supports a number of discrete, commercially-licensed enterprise e-learning systems: Blackboard as its LMS/VLE, ELGG as a social networking platform, and PebblePad as an e-portfolio platform. In contrast, the proposed SNAP! Platform is a non-commercial e-learning environment purpose-built for student learning support. As Farmer (Farmer, 2009) suggests, the presentation of the platform will be built with an open-source, content management system such as WordPress or Drupal. This is to make the platform as flexible and extensible as possible, as well as to allow automatic integration of core read/write (Web 2.0) technology. The central column will contain a group blog to which staff can post their latest thoughts and resources on academic learning. Students will have the opportunity to comment on these posts and to rate them for usefulness. The side columns will contain widgets with a calendar of learning support workshops and events, Diigo or Delicious bookmark contributions from staff, student mentors and students, a tagcloud for online learning resources, with a seeded vocabulary folksonomy to which students can contribute, links to student mentor blogs, links to a threaded discussion board where students can post questions and answers about academic skills issues, concerns and recommendations, and to which staff and mentors as well will contribute. The idea for this central component of the platform is to present students with the human side of the institution, with a community of teachers and learners who are engaged and active in student learning and open to sharing ideas and resources. By modelling this engagement and active interest it is hoped that students will learn how to become self-directed and self-reliant learners.

In addition to the main presentation, the SNAP! Platform could be extended by further student resource creation. One project could be a wiki-based platform in which students would collaborate in developing a resource for particular academic skills issues (for example, science report writing, or problem-based learning, or successful group work). This part of the platform could potentially result from integration with courses, in which the wiki project served as students' assessment.

The SNAP! Platform will also contain a widget library. Widgets, or Web-portable frames containing feeds and applications that get pushed to the user, are part of the growing ecosystem of the cloud-based Webscape (Mashery, 2009). The work of Scott Wilson (Sharples, Griffiths, & Wilson, 2008; Wilson, 2009; Wilson, Sharples, & Griffiths, 2008) to provide a W3C widget standard and the open standards widget engine Wookie is a promising addition to the functionality and extensibility of a personal learning environment. Widgets can be gathered and shared by students, and are not bound by a single platform or web page: a student can import a useful widget into his/her own iGoogle, Netvibes, or PageFlakes page, or into an LMS. A widget can be an RSS feed of the latest electronic articles on a particular topic, or shared bookmarks, a feed of course podcasts, or the latest contributions to a group project's online document. Mike Wesch uses widgets and Netvibes to great effect in the delivery of his courses at Kansas State University, and harnesses the involvement of his students in course content creation (http://www.netvibes.com/wesch).

There are additional ways to extend the notion of the SNAP! Platform. Jennings (2009) describes the JISC TILE (*Towards Implementation of Library 2.0 and the e-Framework*) Project, in which library IT architecture automatically harvests and aggregates library user behaviour to create tools such as Amazon-style automated recommendations, user bibliographies, shared reading lists, and so on. This may be a way to involve students in useful learning support metadata creation without their explicit participation. And libraries have the opportunity to provide users with metatagging opportunities through applications such as LibraryThing and Encore 2.0. Varas-Vera and Lytras (2008) describe a semantic web-enabled learning portal in which students have access to a number of generated technologies, such as a question/answer function and an annotation tool. Their idea is to develop a semantic social platform that employs metadata to create a highly personalized learning environment that matches learner profile to learning object, and ultimately supports a "humanistic vision for the knowledge society" (p. 15).

Conclusion

While many tertiary educators and educational designers are proposing more open-ended, learner-centric, flexible learning platforms, and some are employing the abundant and innovative learning tools of the Web to great success, institutional demands often require educators to work within commercial enterprise systems, licensed at great expense, that do not serve their pedagogical, or their students' learning, needs. And yet we aim to create students — and ultimately citizens — who are self-directed, self-reliant, responsible and efficacious. In order to nurture these qualities in our students, we need to first empower them by giving them voice and agency. The SNAP! Platform at Victoria University aims to provide this kind of empowerment.

Central to the success of the platform, however, is the engagement and participation of its users (Benkler, 2006; Hase & Kenyon, 2000; Sharples et al., 2008; Wilson, 2009; Wilson et al., 2008). The primary hurdle to *academic* social networking may not, in fact, be the constraints of the platform; it may rest, rather, in the academic culture itself — a culture that, from lectures and lecture halls to learning management systems, encourages student passivity. The current redesign of the hallowed halls and ivory towers into learning spaces and learning commons is a necessary start; the transformation of the lecture into a social learning event will be another. And assessment, in a heutagogical paradigm, must become "more of a learning experience rather than a means to measure attainment" (Hase & Kenyon, 2000, n.p.). If traditional universities will not evolve to provide the teaching and learning platforms necessary for a 21st century knowledge economy and a globalized world of great complexity and flux, then perhaps Staley's wikinomics will take over, and the university will become a fluid and self-organising platform of students and teachers. The SNAP! Platform will not be out of place in such a university.

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CONCEPTUALISING TEACHER PROFESSIONAL LEARNING WITH WEB 2.0 TECHNOLOGIES

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Abstract

This paper reflects on the affordances of Web 2.0 technologies to support teachers' professional learning. It argues that professional learning for teachers is a constructed process which combines elements of experience, reflection and knowledge-building. It occurs in specific contexts, through collaboration with others and the mediating effect of cultural artefacts. The emerging features of Web 2.0 technologies are seen as largely harmonious with these principles which are mapped together in a framework for understanding and exploring opportunities to support and enhance teachers' professional learning and knowledge construction.

Introduction

In a complex, uncertain and rapidly changing global landscape, career long professional learning is essential and it is important teachers better understand the processes and contexts that facilitate it (Ashton & Newman, 2006; Clarke & Hollingsworth, 2002; Grundy & Robinson, 2004):

> If we want to encourage different approaches to teaching and learning, and new relationships between pupils and teachers, we need to understand the ways in which teachers come to learn, adapt and make such new approaches a reality. (Fisher et al., 2008, p. 2)

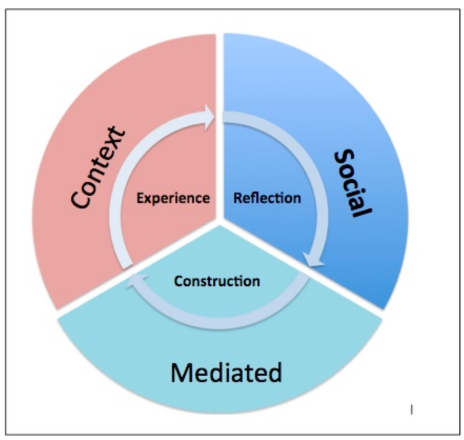
Teachers work in what has been described as a "paradigmatic" example of a "complex and ill-structured domain" (Yadav & Koehler, 2007) characterized as messy and cluttered (Mishra, Spiro, & Feltovich, 1996; Spiro & Jehng, 1990). As such, teachers are constantly asked to shift and modify their understanding and ways of knowing requiring considerable mental dexterity and flexibility (Ertmer, 2005; Greeno, 1994). They need to utilise a wide range of cognitive resources and knowledge domains in order to function effectively in this dynamic setting (Putnam & Borko, 2000; Shulman, 1986, 1987).

This paper theorises and conceptualizes the potential of Web 2.0 technologies to support the processes of teachers learning and knowledge construction. Web 2.0 is an emerging, experimental set of technologies and the research on enabling factors and constraints is scarce (Redecker, 2008, p. 5). Although there is a strong literature base that deals with teacher learning and an emerging literature base for thinking about learning with digital technologies, there is little that deals directly with teachers as learners with digital technologies (Fisher et al., 2006, p. 8). The impact and affordances of Web 2.0 technologies in teachers' professional learning is therefore largely unexplored or theorized.

Teacher Learning and Knowledge Construction

Rogoff defines "learning as the process of becoming someone who does something" (1993, p. 141) and teacher learning is a complex phenomenon resistant to simple formulas, descriptions or standardisation (Fisher et al., 2008; Banks et al., 1999). It is both a cognitive, individual process and also a socially constructed phenomenon occurring within a situative perspective (Putnam & Borko, 2000). This is a simplified description of a more complex phenomena variously referred to as professional or teacher learning. These processes are represented visually by the inner ring in Figure 1 below. This overview of teacher learning concentrates on the following processes (experience; reflection; construction) set within a situated perspective of teacher learning that includes context; mediation; and collaboration.

Figure 1: Processes and Contexts of Teacher Learning



The role of experience. It seems a truism that teachers will learn from experience (Eraut, 1994) but how such experiences are transacted as learning by teachers is still contentious and unclear (Luckmann, 1996). Many consider experience, or learning by doing, to be the precursor to learning through reflection (Kolb, 1984) but there is little consensus in the literature on this topic. Teachers' practical wisdom has been identified as the starting point for much of their professional learning: "It is a capacity, in the first place for synthesis rather than analysis" (Berlin, cited by Hargreaves, 2007, p. 49). In this sense learning from experience is seen to be learning to participate, a largely iterative and cyclical process. The key question here is how do teachers learn from their daily experiences and can technology be used to facilitate the development of structures that tap into these experiences (Schneider & Evans, 2008).

Critical reflection. Reflection on experience is widely recognized as a powerful form of professional learning for teachers consisting of "a state of doubt, hesitation, perplexity, or mental difficulty, in which thinking originates" (Dewey, 1933). This is a deeply thoughtful and purposeful activity that does not come naturally to all practitioners. Critical reflection is more than just technical description of teaching activities:

> Reflection is inquiry into pedagogy and curriculum, the underlying assumptions and consequences of these actions, and the moral implications of these actions in the structure of schooling (Liston & Zeichner, 1987).

In undertaking reflection teachers transform tacit knowledge often gained from experience about the world into explicit knowledge which other professionals can learn from (Schon, 1991). Critical reflection can lead to significant learning by teachers augmented by the observations of colleagues and mentors and supported through the appropriate use of technologies (Moon, 2008).

Construction. Teacher learning is recognized as an active process of construction rather than transmission of content (Burbank & Kauchak, 2003; Delgarno, 2001). In constructing learning teachers develop a variety of different knowledge domains in addition to content knowledge. They elaborate their pedagogical content knowledge which is a complex mixture of both procedural and declarative knowledge, enabling them to successfully translate content into understanding (Shulman, 1987). They achieve this both in their heads (cognitively) and socially with other colleagues and professionals as part of a community. Huberman describes this process as one that starts when individual teachers 'tinker' with a new technique or modify an existing approach within their own teaching context and then share the outcomes with colleagues where it "becomes more systematic, more collective and explicitly managed . . . and transformed into knowledge creation" (cited by Hargreaves, p. 231 in Moon et al., 2000).

More recently the concept of technological pedagogical content knowledge (TPCK) has been identified as a significant new knowledge base teachers need to learn and construct (Koeller & Mishra, 2009). Technological pedagogical content knowledge is a framework for understanding the complexities that the introduction of technology brings into teaching and learning.

The difficulty for teachers in developing their technological pedagogical content knowledge is compounded by the fluid nature of technology knowledge itself which changes rapidly as new technologies emerge. Teachers therefore need to learn the specific affordances which these new technologies will enable in terms of student learning.

The Situated Nature of Teacher Learning

The situated perspective on teacher learning, rooted in socio-cultural traditions (Putnam & Borko, 2000) emphasizes the importance of context or situation in relation to teacher learning. These are represented by the outer ring in Figure 1.

Teacher learning is context sensitive. The situative perspective holds that learning is rooted in particular contexts not to be confused with location alone. This perspective contrasts sharply with the traditional cognitive approach in which learning is fundamentally linked to the manipulation of symbols and other representational artefacts (e.g. language) largely in the mind of the individual. (Brown, Collins, & Duguid, 1989). Contexts for teacher learning will vary according to the nature of the learning taking place. In some instances the ideal contexts for teacher learning will be work-based. But it has also been noted that teachers need to be removed from their work-places in order to facilitate thinking and learning that is not constrained by the dominant "discourse communities" in which they practice:

> Teachers' knowledge is situated, but this truism creates a puzzle for reform. Through what activities and situations do teaches learn new practices that may not be routinely reinforced in the work setting?" (Sykes & Bird, 1992, p. 501)

It is likely different contexts will be more conducive to certain types of teacher learning than others. Correlating these two variables should result in more effective professional learning. For example, removing teachers from their working contexts might be effective if the purpose was to facilitate deep and critical reflective learning, unhindered by the presence of their existing discourse communities. But the working context might be ideal if the purpose was to simulate authentic task based learning in an experiential environment.

The social and collaborative nature of teacher learning. Membership of specific discourse communities (Putnam & Borko, 2000) and enculturation into communities of practice (Lave & Wenger, 1991) are both powerful forms of social learning for teachers. These entail more than just encouragement from other colleagues and recognizes the role other individuals and groups play, both in what is learned and how it is learned (Aubusson et al., 2007; Resnick, 1991). Rogoff describes the process as one of "participatory appropriation" in which both the member and the community are transformed by the individual's participation that dissolves the boundary that separates participants from their context (1993, p.153).

As Scheinder and Evans put it: “We are what we participate in” (2008). But teachers are traditionally nomadic, isolated individuals, often working alone rather than as part of a team and this mitigates against their membership of such groups (Aubusson, Schuck, & Burden, in print). And discourse communities and communities of practice are recognized as having both the influence to generate radical alternative perspectives for their members and to maintain the status quo by enculturating new members into “traditional school activities and ways of thinking” (Cohen, 1989, quoted by Putnam & Borko, 2000, p. 8). The ethos and culture of these communities are therefore vital barometers in determining whether teacher learning will be progressive and out-ward looking, or essentially conservative and resistant to change.

The distributed nature of teacher learning. Drawing heavily upon the socio-cultural traditions of learning, the situative perspective identifies learning as distributed between people, groups/systems and artefacts or objects (Wertsch, 1991). Whilst schools tend to focus heavily on the individual conception of cognition, Web 2.0 promises to offer support for a distributed view of cognition, particularly through the mediating impact of tools and artefacts. Artefacts are defined as tools and symbols which human beings have developed over time enabling them to undertake complex tasks in ways which would not otherwise be possible. They are tools which liberate humans from working entirely in their own mind and in doing so they enable us to off-load some of our cognitive load. Web 2.0 technologies are mediating tools which promise to support teacher learning and are the focus of the next section of the article.

Web 2.0 Technologies as Tools to Support Teacher Learning

Digital technologies are reported as having a significant role in affording new opportunities for learners ‘disrupting traditional learning and teaching patterns, giving rise to new and innovative ways of acquiring and managing knowledge (Redecker, 2008, p. 7). But much of the current research investigates how teachers can better prepare to use such technologies in their teaching rather than as part of their own learning (Downes, 2004; Fisher et al., 2006). Figure 2 illustrates a framework which has been developed to map the types of teacher learning identified above with the features and affordances of Web 2.0 technologies described below. In the final part of the article two scenarios are mapped against the framework to indicate how it might be used.

Figure 2: Affordances of Web 2.0 Technologies and Teacher Learning

		Types of teacher learning & knowledge building					
		Process of learning			Situated perspective on learning		
		Experiential	Reflecting	Constructing	Context	Collaborating	Distributed
Features and affordances of Web 2.0	Publishing						
	Sharing						
	Collaboration & participation						
	Re-purposing						
	Multi-literacies						
	Inquiry & research						

What is Web 2.0 and Does it Facilitate Teacher Learning?

Web 2.0 technologies, sometimes referred to as social software, are currently enjoying an impressive take up, particularly amongst younger people, but also across all age bands and demographics (Redecker, 2008, p. 9). Web 2.0 is used to describe a wide range of internet based tools and services characterized by participation and knowledge construction, rather than passive consumption. They include tools to support knowledge construction and dissemination (for example, blogs, wikis and podcasts); facilitation of social networking (for example FaceBook, MySpace, Twitter and Ning communities); media manipulation and sharing (for example, YouTube and FlickR) and virtuality in immersive environments supporting socializing and exploration (for example, Second Life and Teen Life). Crook describes Web 2.0 as a technology that "celebrates and *builds community*. It facilitates *participation* and it resources *debate*" (2008, p. 7). Technically Web 2.0 is not a radical departure from the original Internet (sometimes referred to as Web 1.0) but it does realize a number of aspirations and affordances which users have long desired. Where, for example, Web 1.0 is essentially a read-only medium, Web 2.0 is a 'read-write' medium (Thompson, 2007). The following five features are highlighted for their potential relevance to teachers' professional learning.

User-generated publishing. Web 2.0 technologies invite users to construct and publish content in ways that were previously costly, difficult or impossible. Blogs and wikis, for example, enable users to easily edit, re-purpose and publish text and media rich resources to the internet. They replicate many of the functions of the traditional publishing house in providing both a platform for the production and publication of ideas, generally at little or no cost to the author/s. Linked with social software networks such as FaceBook, MySpace and LinkedIn they offer new opportunities for teachers to develop and share their professional learning — to be creators rather than simply consumers of knowledge (Freeman, 1998). These services provide means for teachers to share and critique their representations with the world, accessing alternative perspectives which would not be as readily available in analogue formats. These affordances provide the opportunity for teachers to overcome the isolationist tendencies (and mindsets) forced upon them by their working contexts. Bruns and Humphreys (2007) use the term "produsage" to describe this process and it promises to be a powerful support for teacher agency as knowledge-constructors. These opportunities suggest teachers need to be flexible co-creators rather than 'self sufficient' producers; comfortable collaborators working in flat, rather than hierarchical structures and self critical good communicators (Redecker, 2008, p. 8).

Sharing. Sharing of resources and ideas is a core feature underpinning many Web 2.0 applications. This is more than the dissemination of content as it implies a moral and ethical position which is community orientated rather than individual. The use of freely available open source content and licensing arrangements, such as Creative Commons, encourages a communitarian ethos and services like photo sharing (e.g. FlickR and Picassa), video sharing (e.g. YouTube) and document sharing (e.g. Google Docs) are the means by which it is enacted by individuals and groups. Social book marking and personalized tagging applications are also examples of this feature. Tags, or 'folksonomies', can incorporate rich annotations and metadata enabling fellow users to identify and build upon socially valuable artefacts. For teacher learning these features could be very valuable but this will be dependent on whether the underlying culture within a community of practice is orientated towards the sharing or hoarding of resources and ideas.

Collaboration and participation. ". . . Web 2.0 offers educators a set of tools to support forms of learning that can be more strongly collaborative and more oriented to the building of classroom communities" (Crook, 2008, p. 28). These new forms of learning are emergent and yet to be standardized but they promise to exploit the social nature of learning itself which was recognized as a distinctive form of teacher learning above. Web 2.0 is predicated on an underlying "architecture of participation" (O'Reilly, 2004) which promises to get better the more people use it (Thompson, 2007, p. 1). Whether it be a collaborative wiki, a social forum or an immersive simulation such as Second life, collaboration is the defining characteristic. The key to success in these environments is the vitality and participation of the community which is encouraged into participating rather than passive ‘lurking’.

Re-purposing. Re-purposing or re-mixing of content takes advantage of the growing open education resource (OER) movement and the simultaneous development of open licensing agreement, typified by the Creative Commons movement. By providing access to the raw data itself, (e.g. the source code) users are actively encouraged to take resources, re-edit then and re-package them in new formats, sharing them with the wider community. It will be interesting to see how the teaching professional responds to these opportunities. Re-purposing of existing content (i.e. another professional) is something teachers have been traditionally resistant to undertake, preferring to make their own resources for specific contexts. How far the malleability of digital resources and the flexibility of Web 2.0 services will combine to free teachers from these underlying mindsets is to be seen and will be one of the primary focuses of this investigation.

Multi-literacies. In the post-modern world literacy is no longer associated exclusively with the printed word and the ability to read and write text. The term literacy is now seen to include other means of representation including images, sounds and moving image media (Kress, 2003). Schools and teachers across the world are beginning to explore the potential of these services which promote or enable multi-literacies to be developed in the classroom, such as YouTube and FlickR. How far these changes in definition have permeated the practices of learners, and teachers in particular, is not yet clear. They are potential vehicles for alternative approaches to teacher learning, for example by enabling teachers to use multimedia evidence and formats to report their learning as in the Video Papers project (Olivero & Sutherland, 2004). But equally, they pose a challenge for teachers who are unconvinced by the rhetoric put forward and still committed to a largely text-based understanding of literacy.

Inquiry and research. In the same way that Web 2.0 technologies have already modified the way students undertake research and the processes of inquiry, so they promise to radically alter the ways in which teachers undertake and think about research, inquiry and the resulting organization and classification of knowledge itself (Crook, 2008). These are not neutral or value free technologies. They imply significant shifts in thinking about the production and nature of knowledge and the processes by which knowledge is validated and authenticated (Grant et al., 2006). Shifts from bounded conceptions of knowledge (e.g. codified subject knowledge) to personalized versions and from static to animated mechanisms of engaging with knowledge challenge teacher learning where Web 2.0 technologies are employed. Freeman has described teachers as essentially “consumers, not producers of knowledge” (1998) but in facilitating the shifts outlined above teachers will also need to confront and overcome many challenges, not least their existing epistemological constructs and schemas.

Reflections: Two Scenarios

In the final part of the paper two possible scenarios are explored in which Web 2.0 technologies are used to support and enhance different types of teacher learning and knowledge construction in.

Teacher Knowledge Co-construction and Wikis

Wikis are websites which enable users to add, edit and modify existing content on a web-page collaboratively (Grant et al., 2006). This paper has highlighted the constructed and collaborative nature of teacher learning and knowledge building. Wikis are a very tangible example of how Web 2.0 technology that might be appropriated to support these various features of teacher learning. In our own professional development courses teachers and other teaching staff are encouraged to work in learning sets to construct their knowledge and share different perspectives around these representations. User-friendly wikis applications such as WetPaint support their learning in both face-to-face and entirely online contexts.

Knowledge construction, note Schneider and Evans, “requires that participants have serendipitous, spontaneous, and improvisational access to each other and to relevant expertise.” They go on to argue for the need for “ample opportunities for participants to observe each other in some way and be involved in hands-on activities” (2008, p. 2). Active wiki building appears to be well placed as a teacher learning device to promote these opportunities. The process enables teachers to personally construct the artefacts without having to wait for the intervention of a web specialist. In doing so they are modeling the processes that Schender and Evans talk about and are seen to be doing so by their colleagues. From the perspective of this particular study the production of a group wiki investigating the affordances and constraints of Web 2.0 technologies in the curriculum, will act as the central feature of the project and the most tangible and visible output of the intervention.

Reflection and Digital Conversations

Reflection has a central role to play in supporting teachers’ professional learning. Web 2.0 technologies such as blogs and wikis are likely to support reflection but mainly in text form. They have the potential to include multimedia but in practice they tend towards a text-based form of communication which fails to fully exploit the multi-literacies described earlier in the article. VoiceThread is one of the emerging “disruptive Web 2.0 technologies” (Redecker, 2008) which supports rich media forms of communication and reflection, within a collaborative knowledge-building paradigm. It is described by its creators as a ‘tool for having conversations around media’ and like many of the most recent conversational tools (e.g. Skype) it enables users to communicate in a multimodal fashion, in addition to traditional text conversations. Teachers are already appropriating this kind of tool to support and develop alternative perspectives and modes of communication for their students. In our own professional development programmes it is being used as a tool to underpin teachers’ own professional learning with a particular focus on collaborative knowledge-building and the sharing of alternative perspectives. This paper argues that teachers learn in particular contexts and these need to be aligned carefully with different types of professional learning activities. Critical reflection is a type of professional learning activity that Web 2.0 applications like VoiceThread support and enhance in ways that traditional analogue techniques (e.g. journals) fall short. For example, VoiceThread enables users to post their own reflections in traditional formats (text) but also augments this with video and audio communications. The opportunity for multimedia feedback from other members of the community appears to encourage a greater depth of participation than is evident in traditional blog entries. Reflection becomes a multi-dimensional conversation with other professionals rather than a solitary activity which typifies many blogs. Our initial feedback from teachers supports the general opinion expressed in the many VoiceThread communities that is broadly positive and encouraging. It represents an alternative perspective on the process of professional reflection in a virtual space supported by other colleagues.

Conclusions

This paper has attempted to outline the various processes which underpin teacher learning within a broadly situative perspective based on socio-cultural views and theories of learning. Five key ingredients or affordances of Web 2.0 technologies have been identified as being particularly valuable and harmonious with teacher learning even though most of these applications were not designed originally for schools or even education in the wider sense. The precise relationship between these variables (i.e. features of teacher learning and features of Web 2.0 technologies) are unclear and the attendant case study will seek to explore and map the precise configurations which maximize the benefits for teacher learning using the framework outline in Figure 2.

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TECHNOLOGICAL EVOLUTION AND PEDAGOGICAL RE-APPROACH TO EFFECTIVE LEARNING USING GAMES WITHIN THE HELLENIC AIR FORCE ACADEMY

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Abstract

The educational policy of the Hellenic Air Force Academy (HAFA) is designed to implement the standard of the Hellenic Air Force (HAF) officer. Our purpose is to specify and design a computer-based war game in order to use it as a tool for a) applying our educational policy; b) advancing the professional training of the students of the HAFA; c) assessing the behaviour of future officers in relation to the intended standard; d) understanding and resolving applied ethical questions. The game will also be used for professional informal continuing education in a distance learning environment, for promoting cooperative learning and the development of virtual communities of practice within HAF.

Advantages of Using Games in Learning

It would be advantageous to have a series of games and other educational activities other than classes (e.g., simulations), which, combined with formal education, would all contribute to a common educational goal. It is our intention to design an educational serious game which will help our graduates comprehend the mission of the HAF officer, as defined below. In this paper we are going to present the design issues of a strategy game, where the player assumes a particular role and has to make certain choices at any stage of the game. These choices could be either deterministic or non-deterministic, in which case the next stage would be expressed in a form of a utility function (Garris & Ahlers, 2001).

Our approach is: At first, a number of teaching methodologies, used to make ethical decisions concerning the conduct of war will be examined. For example, one can attempt to resolve military ethics dilemmas faced by contemporary armies with reference to war literature and poetry or by using philosophical texts relating to them. Another option is to refer extensively to the legal aspects of these dilemmas citing the provisions posed by International Humanitarian Law and each nation's military legislation. Also, we can discuss moral issues with reference to a particular theory (i.e. the just war theory (Brown, 2003)) and of course we can rely upon a number of case studies to make our students confront difficult questions like: "what should be done in this case?" or "which elements could help me decide which is the best choice?" or "how can I calculate the likely outcome of my actions?" Our aim is to show that we need a new pedagogical approach towards reflecting on military ethics, if we want an effective, ethical leadership and a conduct of hostilities according to moral and legal rules of war.

Secondly, the basic concepts of simulation and gaming, as well as their applications to strategic and tactical decision-making are examined. We attempt to show that employing games one can: a) determine the tactical options available to each side; b) assign a numerical value to each possible outcome; c) calculate all possible strategies and their outcomes; d) find each side's best options at strategic and tactical level; e) determine the expected result of the game, by examining whether the possible outcome favors the attacker or the defender and finally, f) evaluate each player according to their choices.

How to Teach Military Ethics?

As noted in the introductory section, literature and philosophy can be used to the officers' ethical training. War literature (Sherry, 2005; Thompson, 2004) and poetry (Stallworthy, 2003) related to warrior ethos, the conduct of hostilities or other, specific aspects of war (such as the treatment of prisoners of war or the protection of civilians) can be an excellent source for locating and commenting on ethical dilemmas concerning war. Many ideas expressed in religious and philosophical texts are now part of International Humanitarian Law (Nabulsi, 1999; Tuck, 1999). Undoubtedly, texts play an important role when discussing ethical dilemmas; they can provide us with a historical approach of the moral issues that are under consideration nowadays. Analysing texts may prove a positive element and precious supplement when thinking what action one should take in war, but alone can not help officers or soldiers to solve practical ethical problems. One needs a more systematic approach to deal with them efficiency.

Another step forward, moral theory can provide us with a useful framework, essential in our efforts to think about ethical dilemmas in a more organised context. For example, *just war theory* has a long history and flexibility to deal with a variety of situations; it covers a variety of topics, some related to the beginning of war (*jus ad bellum*) and some related to the conduct of hostilities (*jus in bello*). The problem with this approach is that there is no moral theory of any kind which can give as all the answers to every possible problem that could arise. Decision-making in a war is not an easy task. Moral theories can help military and political personnel in charge of planning this kind of operations to realise the ethical perspectives of their choices.

Another way of reflecting on ethical dilemmas and ambiguous cases is by resorting to the legal framework of war. In fact, a subset of moral rules with the lapse of time formed the moral baseline and actually became a part of the International Humanitarian Law (IHL). Let us think about tactical planning in a populated area. Is everything permissible in order to achieve the objectives set? Are there legal obligations towards civilians' protection? By using IHL, we can also analyse the use and limitations of specific types of weapons, as well as how their use can guarantee the best possible result, on both moral and practical grounds (Lekea, 2006). Is this sufficient though? The answer is negative as both ethical theories and international legislation tend to be rather generic by nature; hence, unable to deal with situations where a large number of interdependent factors are involved. The combination of ethical theories with international legislation can provide us with valuable directions on which the operation will be based, but can do very little with helping us to design and run it.

Games and simulations, on the other hand, will allow us to cater for these aspects as well in the form of a strategy, assuming rational players with incomplete information about one another abilities, which is true in almost all cases. The application of game theory and simulations to the study of war can be of great help (Haywood, 1951; Myerson, 1997; Shubic, 1983). They can provide us with the tools necessary for studying practical issues about the costs and benefits of a war, evaluating ethical questions on the use of force in the battlefield or in urban environments where the protection of civilians is crucial (e.g. fire exchange in the war against terrorism or humanitarian interventions). Game theory and war games (Jayakanthan, 2002) prove to be necessary in strategic and tactical decision-making (Colman, 1982; Hastie & Dawes, 2001; Isaacs, 1965; Osborne, 2003). At the strategic level, we can apply those theories and use games to decide when it is best to start (or end) a war, or even take an alternative political or diplomatic course of action according to the calculation of benefits from our actions. Military planners can also apply game-theoretic analysis to tactical operations since it enables them to estimate and confront effectively the capabilities and military choices of the enemy, evaluate how an intelligent (and rational) opponent is likely to behave in a given situation and which side is most likely to win.

Video Games and Learning

Many good video games incorporate a whole set of sound learning principles, strongly supported by contemporary research in cognitive science. Therefore, learning promoted by video games often exceeds the game playing period (Gee, 2003). Video games employ traditional educational concepts such as tutorials and assessment (mostly in the form of *scoring*). Tutorials present the player with the basics of how to control and interact with the game and then test the player on this information with a series of missions. Often, tutorial missions introduce gradually new features or play elements, to avoid overwhelming the player. By the time the player has completed these first few missions, he or she has "learned" the essentials of the game and can be provided with ever greater in-game challenges (Chen & Michael, 2005). Although tutorials sound like familiar terms to educators, we have a lot to learn about learning from good computer and video games (Gee, 2003). Some important educational features of video games are:

- Information "on demand" and "just in time". A common mistake in education is that too much information is offered out of the contexts of actual use or apart from students' purposes and goals. Good games invent ways to put information inside the worlds the players move through, and make clear the meaning of such information and how it applies to that world (Gee, 2003).

- Good games are pleasant and exploit in the best way the power of multimedia. Screens with moving content and sound immediately capture young peoples' attention. The current generation of students is so familiar to video games and that's why it is important to use them in education (Prensky, 2001).

- It is noteworthy that many video games achieve the players' commitment till the end, a characteristic so much desirable in education. Motivation leading to commitment is the most important factor driving learning. A simple definition of motivation is a learner's commitment to engage in a new area of learning (Gee, 2003). It is important to find out how good games manage to create and sustain players' motivation**.**

- A significant and promising feature of modern games is their *adaptability*. They are capable of monitoring the player's actions within the game, in order to adjust several features such as storylines, strategies and other variables. Games may adapt to players in various ways (Chen & Michael, 2005; Gee, 2003). This becomes even more important if we want to take into account the various *learning styles* (Honey & Mumford, 1992). Teachers always have the same teaching style which always favours the same group of students, having that particular learning style. In games we could adapt the learning style, in the same way we can do it in e-Learning settings (Grigoriadou, 2006); we can also add more and more missions to specific players which seem to learn a specific lesson difficulty, until they have reached the desired level (or, according to desired standards, as explained below).

- The underlying technology can promote many desired skills such as cooperation, sharing of knowledge, assumption of new roles (Gee, 2003). For instance, it is common to have players play in multiplayer mode, via networks or the Internet. It is also common to put them collaborate in teams, towards a common goal or mission, each using a different but overlapping set of skills. In such settings, players cooperate and share information, knowledge, skills and values with others (Wenger et al., 2002]) In this respect, games may be preferable to formal studies for preparing today's workers.

- Good computer and video games allow people to learn effectively while recreating themselves in virtual worlds (Gee, 2003).

- Game-Based Learning is extensively being used by the U.S. Armed Forces (Prensky, 2001).

HAF Officer Standard

The purpose of education at HAFA is to produce officers according to pre-specified standards by the Hellenic Air Force General Staff. In order to determine the parameters of the game, we have developed the "typical standard" of the Greek Air Force Officer. Its development is based on the officer's evaluation report (official document of the Air Force General Staff Office), as well as the legal framework that determines the appropriate behavior of an officer in times of war and peace. The legal documents refer to both official Greek Texts (Greek Military Law, orders relating to internal Air Force procedures), as well as to international humanitarian law. Finally, an important role in the development of the game was played by the doctrine of the country which is based on defense.

The major *assessment axes* are:

- mental abilities (judgment, analytical and critical thinking, intelligence, critical decision making);

- spiritual qualities (courage, team working, initiative);

- management qualities (interest for their subordinates/sound judgment for their involvement in the operations, leadership capabilities, ability to predict developments and co-ordination);

- professional qualities (professionalism of moves, efficiency of choice, interest in protecting his soldiers and any other available inventory);

- moral qualities (punctuality, dignity, sense of responsibility, serving with knowledge and respect of his mission, justice, making choices on the sole basis of qualities and evidence, discipline).

All these qualities are related to one another and evaluated with regards to the legal framework of war, as this is determined by the international treaties and conventions. As an example, the trainee has to restrict the use of weapons and war tactics (no nuclear, biochemical and weapons of mass destruction, no weapons that can cause disproportional damage to civilians and the environment, no tactics that can cause exorbitant pain to the opponent, observance of the principle of distinction and proportionality). Finally, in relation to the war doctrine, the emergence of hostilities should be related to reasons of defending and safeguarding national interests. The trainee, thus, has to try and act in accordance to the rules of the game when making his choices; cadets will be evaluated positively when they follow the standards (as this was described earlier) and negatively when they do not take them in consideration.

Assessment Issues

Assessment is probably what students hate most in education. Serious games represent an opportunity to change this fact, by providing alternative types of assessment, far away the simplistic, boring and narrowly focused testing provided by multiple-choice questions. In fact, they can do so by combining other forms of traditional assessment with methods modern video games now use on a regular basis. The goal should be to create pleasant, more complex and complete types of assessment than have ever been available before. Towards this goal, game designers and educational professionals need to work together in developing serious games as a new teaching tool (Chen & Michael, 2005).

Assessment Challenges

Despite their success using educational methods such as tutorials, game designers and developers must recognize their own limits when it comes to serious games. The use of serious games in education creates certain challenges that can make assessment difficult:

- With less emphasis on rote memorisation of facts, the assessment obtained from traditional methods may not accurately reflect the learning gained from serious games.

- Open-ended simulations can support a wide range of possible solutions. But which one is the best choice/catch?

- When teaching abstract skills such as teamwork and leadership, how do you measure learning and/or improvements? etc. (Chen & Michael, 2005).

Because serious games have such challenges, their developers have turned to more sophisticated assessment methods. The main types of assessment used in serious games (Chen & Michael, 2005) are the following:

- Completion Assessment; did the player complete the mission or pass the test?
- In-Process Assessment; how did the player choose his or her actions? Did he or she change their mind? If so, at what point? And so on.
- Teacher Evaluation; based on observations of the student, does the teacher think the student now knows/understands the material?

Scoring

The typical form of assessment in entertainment games is scoring. Games often offer comparisons between players with high score lists. The scoring system teaches the player what is important within the game; a positive score indicates a good choice, a negative score indicates a bad choice, and no score at all indicates that the performed action was probably unimportant. In this way, it is similar to the educational strategy of "teaching to the test", which explicitly identifies to the student what is important to learn and what can be ignored (Chen & Michael, 2005).

What's wrong with scoring? The problem of scoring is that it gives a "one-dimensional result." That is, it does not assess various virtues of the player individually, so that we cannot get detailed information about the player's skills.

Log Files

Video games often use log files to monitor player's action. Log files may track data like: i) Time required to complete the lesson; ii) Number of mistakes made; iii) Number of self-corrections made; and more (Chen & Michael, 2005). Such information is useful to teachers. Teacher evaluation may also be performed by observation of the students while playing the game.

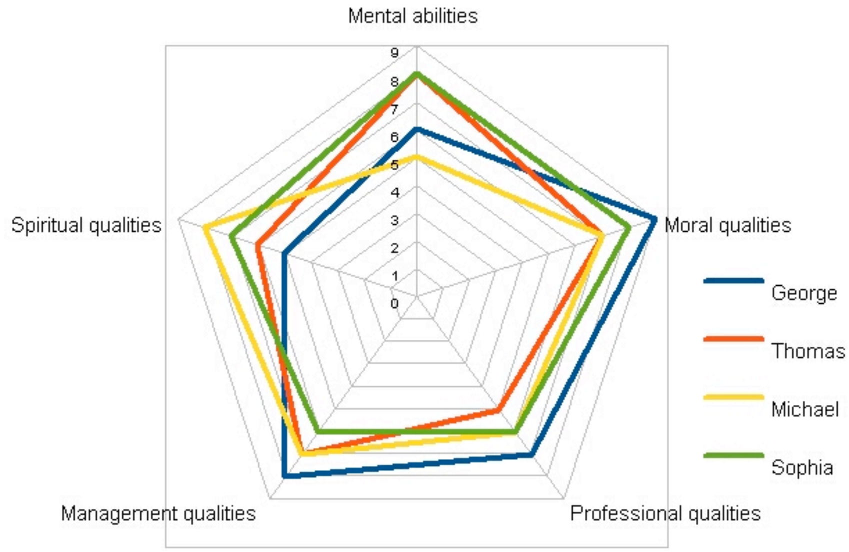
In our case, we plan to use the following framework:

- Did the player complete the mission?
- Did the player follow the rules (laws, ethics etc.)?
- Where there any losses and to what extent?
- Did the player make correct decisions and to what extent? Did he/she arrest the best action plan? Did he/she select the right weapons? Did he/she exploit all their forces, advantages, allies etc., and to what extend?

From the aforementioned discussion, it comes out that the ideal HAF officer should have some specific virtues, such as those discussed above. Assume that one player may perform well in some of the above issues and badly in some others; it is possible that this player may get the same score with another player who succeeds where the first player fails and vice versa. With a “flat” scoring scheme, we shall not be able to tell the difference between the two players. What is of utmost importance, we shall not be able to give detailed directions for improvement. Thus, what is needed is to assess each issue separately; then, given the possibility of game adjustment to players’ competence, we could design the game to present new challenges to each player, in order to help them improve particular skills. We have called this feature “multidimensional assessment”.

It would be desirable to produce officers that will be perfect in all the main guidelines ideally; but this is unrealistic. Instead, practically we should try to reach this goal as close as possible. Nobody is perfect everywhere, but he/she is good somewhere and less good somewhere else. Thus the purpose of education becomes how to strengthen one’s weaknesses, since he/she is a ring of the whole chain, and the strength of the chain is that of its weakest ring! Under this perspective, education should be personalized to each one’s needs. Thus, the same must hold for games, and this is a point where technology helps! Helps not only identifying one’s weaknesses, but also their learning style, and helps in adapting the game accordingly. The following picture presents possible scores of four different players as far as the aforementioned assessment issues are concerned.

Figure 1: Sketch of Multidimensional Assessment



Most video games would provide a flat assessment score, which would not give much useful information to teachers attempting to identify, improve and enforce players' weaknesses.

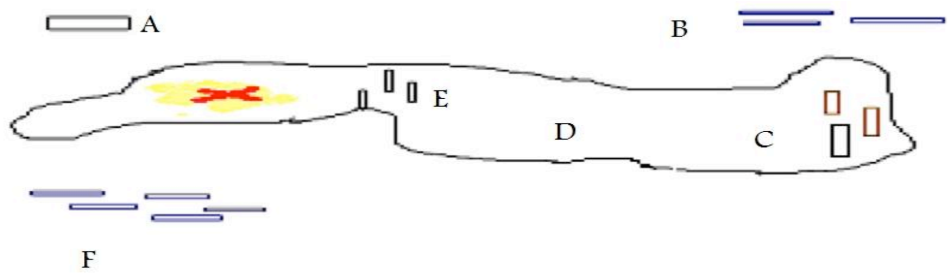
Case Study

Final year cadets at the Hellenic Air Force Academy have taken all courses of international legislation, inventory and staff management as well as the leadership module; therefore, we can safely assume that they possess the theoretical framework for judging, evaluating and selecting their moves. In the context of this research, they were given the following problem.

The Scenario of our Game

Let's assume that you are in charge of operations. In the drawing below you see the position of a suspect target in a "grey" area inside a civilian area. The time you have is very limited, the situation is extremely critical and the forces that you can use are those depicted in the drawing (Figure 2). How would you use your leadership skills, in order to effectively use the technological powers available? How would you mobilise your human resources? What factor would you pay more attention to: technical or human resources?

Figure 2: Map of the Various Forces Listed in the Scenario



Your target (marked with X) refers to an assumed terrorism operation centre. We do not know exactly what types of weapons they have there, but there are some reports suggesting the existence of biochemical weapons. You have twelve hours in order to collect additional information, to organise and run the mission. The resources you have are as follows:

- *In point A there is an aircraft carrier armed with photographic and other aircrafts with various abilities as well as helicopters.*
- *In point B there are vessels that carry armed soldiers, which after disembarking a company of artillery and a troop of infantry at point C, they are back to their bases.*
- *In point E, there are Special Forces, carried there by the helicopters.*
- *In point F, there are frigates and fast attack vessels in supporting roles.*

Please, take into account that, because of rough areas (in point D), there is a danger for the company not to make it in time and to be out of range for the operation as well as for the armoured vehicles not to be at point X (target) in time, i.e. within the twelve hours available.

After the class was split in two groups, one group looked at the choices of the army and the other one the choices of the terrorists. In relation to the above discussion, the evaluation of the results was made on the basis of:

a) observing the rules regarding to the principle of the distinction;

b) observing the rules relation to the principle of proportionality;

c) the appropriate use, management and protection of resources.

In the very interesting discussion that followed the presentation of the choices made by the two groups, the cadets admitted that their understanding of the complexity of the modern operations environment was improved with the use of the game, as well as of the difficulties of observing principles and rules of justice and morality. The options of the players were discussed in detail in a series of lectures that lasted for a long number of hours with heavy participation of the cadets, while comments on the current legal and moral framework were made (e.g. whether they need updating or not).

The key issue is that with the use of the game, the trainees played the role of commander and had to make choices (Bisson & Luckner, 1996). They did not have piecemeal solutions to choose from. They followed a procedure of thinking and resolving the problems and faced the consequences of their choices as if they were responsible for their choices in a real battlefield. In short, they got into the shoes of a commander, with any mistakes due to their short experience. The benefit, however, was much more important: they got into the process of thinking, selecting and taking responsibility for their actions.

The Design of a Serious Game for HAF

In relation to the above, our aim is to develop a game for use by the module of philosophy and ethics of war (Ravenscroft & Matheson, 2002). In this game, our aim will be to evaluate the choices of the trainee cadets in relation to the standard of the Greek Air Force Officer (Amory, Naicker, Vincent, & Adams, 1999).

The main idea is to foster the thinking and reaction of trainees, by giving them challenging scenarios, where their choices for army movements may have a high cost (Aldrich, 2004). They have to choose the best tactics for achieving their target with the least possible losses (logistics issue), as well as the least possible consequences to their subordinates, to civilians and the environment (legal concerns, as well as moral and war doctrine issues). Because there are no easy or right and wrong choices, the participants in the game have to negotiate and maybe change their initial thoughts and choices, which is a way of realising the responsibility they will be having when the time does come that they will have to take part and act in similar missions. As already mentioned, their evaluation will be based on legal documents, orders and official documents issued by the Air Force General Staff Headquarters, as well as the moral values of the force (and are described in documents such as the Air Force cadet’s manual and the oaths they take when entering into and graduating from the academy).

The schedule is to incorporate the game into the module (after some introductory lectures) and to use it as the main tool for evaluating the trainees. In order for this to happen, we shall need to define exhaustively the moral and legal framework of the game (implementation period of about 6 months). Following that, working closely with senior officers we shall develop the scenarios (implementation period of about 6 months). Finally, the coding of the game will take about 12 months. We expect to use the game for the final year cadets in the spring term of 2011.

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THE TELLING: TEACHING INFORMATION MANAGERS ABOUT MANAGEING INDIGENOUS (ECOLOGICAL) KNOWLEDGE

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For I come from the salt water people, we always live by the sea
— Neil Murray and Christine Anu

Abstract

Indigenous knowledge (IK) and Indigenous ecological knowledge (IEK) are subject areas that contribute to anthropology and multidisciplinary fields such as environmentalism. Here we identify key issues and barriers to teaching about IK/IEK in the context of developing a course for postgraduate information managers and pilots in two courses on *Knowledge Management in Organizations*.

Introduction

Study of Indigenous ecological knowledge (IK) and Indigenous ecological knowledge (IEK) of customs, flora, fauna and practice is increasingly recognized in anthropology as a sub-discipline (Brokensha et al., 1980) and also contributes to other subject areas, such as environmentalism and ethnopharmacology (Colorado & Collins, 1987; Ford, 2001). Unethical and illegal biopiracy, which has included harvesting and exploiting Indigenous peoples' genetic material without permission (Brush, 1996; Deloria, 1995; Haraway, 1996), has led to heightened Indigenous sensitivities and revised legal remedies for misconduct. So educators who are interested in studying and teaching IK/IEK must comply with ethical and legal frameworks governing how to acquire, store and disseminate such knowledges. Moreover these activities need to be compliant with nested Indigenous, National and International jurisprudences. Another complicating factor is brought by use of information and communication technologies (ICT) for technology enhanced learning (TEL). This paper investigates how IK can be ethically gathered and then shared with students, using technology to provide a virtual indigenous voice. Our work is in the context of developing a course on Preserving Indigenous Knowledge for the Business and Information Management (BIM) and the Library and Information Management (L&IM) postgraduate programs at the University of South Australia (UniSA). It reports upon lessons learned from two pilot experiences of including IK/IEK in courses in Knowledge Management in Organizations.

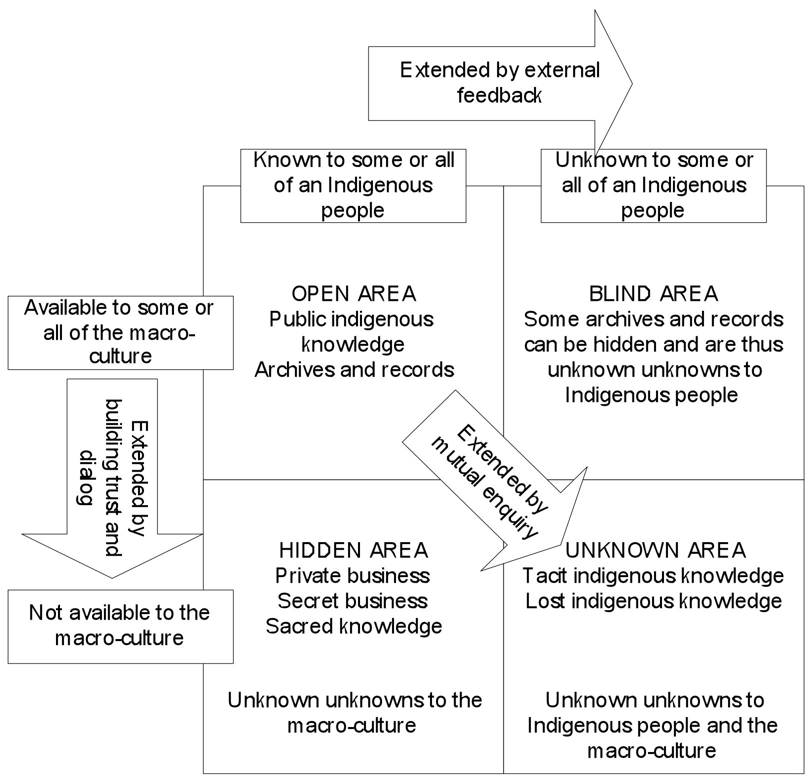
Indigenous Knowledge

Indigenous knowledge belongs to communities, such as the Australasian Aboriginals, the European Basques, and the North American Inuit, who are linked to geographical places — known in Australia as *Ngurrumbang or Country*, in Canada as *Nunavut and* in France as *Terroir*— and it is passed to succeeding generations via *predominantly* oral processes (Cox, 1987; Knudtson & Suzuki, 1992; Oguamanam, 2008; Stevenson, 1996; Warren et al., 1993). It is important to understand that Indigenous communities and IK exist in both *independent* and *interdependent* micro- and sub-cultures within and/or in opposition to the global macro-culture (Francis, 1992). As Stevenson comments "Indigenous knowledge can be viewed as having two sources: traditional knowledge and nontraditional knowledge . . . (1) aboriginal people also possess knowledge and experiences not grounded in traditional lifestyles, spirituality, philosophy, social relations, and cultural values; and (2) Indigenous knowledge is the articulation, and frequently the dialectic, of traditional and nontraditional knowledge" (Stevenson, 1996, p. 280). One example of *independent* IK is Australian Aboriginal music, which plays many authentic roles in Aboriginal society (Ellis, 1985). However, the same music as recorded commercially or by ethnomusicologists is regularly sold to tourists as a keepsake. A closely related example of *interdependent* IK is Australian Aboriginal country music, in which "aboriginal people adopted country music to tell their stories in a way that could be understood by non-Aboriginal Australians" (Breen,1989; Kirkbright, 2000, p. 65; Walker 2000).

Indigenous Ecological Knowledge

One form of IK which Indigenous sub-cultures own that is perceived as being valuable to members of macro-cultures is IEK (Berkes, 1993; Berkes, 1999; Gadgil & Berkes, 1991; Hardesty, 1977; Johannes, 1989; Johnson, 1990; Martinez, 1994; Stevenson, 1996). Indigenous ecological knowledge "is a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. Further, traditional ecological knowledge is an attribute of societies with historical continuity in resource use practices; by and large, these are non-industrial or less technologically advanced societies, many of them Indigenous or tribal" (Berkes, 1993, p. 3). For example, Australian Indigenous people own what environmentalists term *the desert knowledge*. This knowledge distils field-tested approaches to long-term survival in Australia's arid inland environment. In theory, IEK can facilitate sustainable environmental management and survival (Kendrick & Manseau, 2008). However, enthusiasm for such knowledge from members of the macro-culture and an assumption that Indigenous people own IEK that can solve pressing environmental problems (Berkes et al., 2000), such as Australia's water shortage, needs to be tempered with the observation that the macro-culture tend to see Indigenous peoples in ways that meet its current needs (Francis, 1992). So stakeholders in the macro-culture require education in differences between the popular conceptions and realties of IK/IEK. Even so, given the current Australian political and scientific awareness of climate change (Flannery, 2008; Senge et. al., 2008) IEK is a burning issue within Australian academia.

Figure 1: An Extended Johari Window



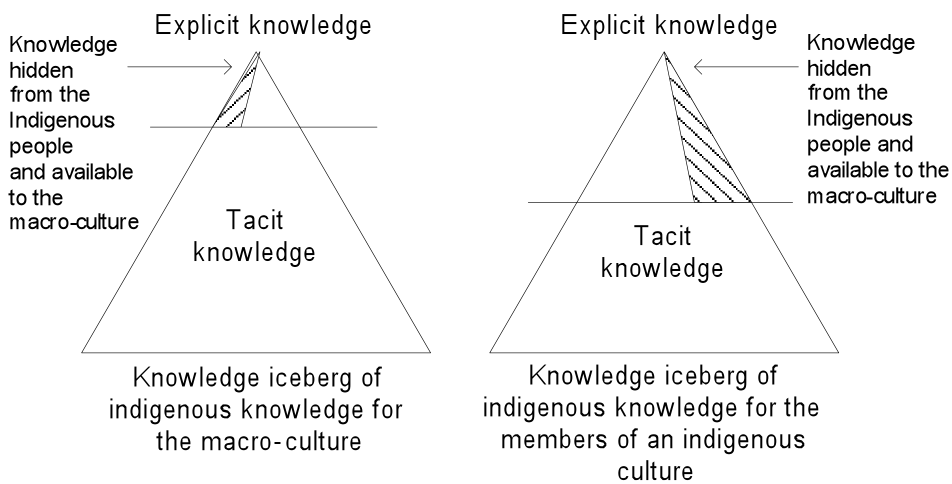
(after Luft and Ingham, 1955)

Indigenous Knowledge and Knowledge Acquisition

By extending the framework of the Johari window, which is usually applied in work on individual self-concept and leadership (Luft & Ingham, 1955), we can see that IK/IEK can be either 'known' or 'unknown' to an Indigenous individual or community or to members of the macro-culture (see Figure 1). Some IK/IEK that is a 'known known' to an Indigenous community will overlap with the 'unknown unknowns' of the macro-culture. Knowledge that is known to Indigenous individuals and communities and to members of the macro-culture equates to the visible tip of Seely Brown's knowledge iceberg while the remaining knowledge equates to the sub-aquatic or tacit portion of the knowledge iceberg (2002). The level on the iceberg where explicit knowledge is visible is likely to vary for members of the macro-culture and the Indigenous people (see Figure 2). In some cases members of Indigenous communities may deliberately hide IK/IEK from members of the macro-culture (for a fictionalized account, see LeGuin, 2000). One reason for such subterfuge is that as IK/IEK has increasingly been commoditized by western techno-science (Haraway, 1996; Posey, 2002; Roht-Arriaza, 1996).

Conversely some knowledge about the history of an indigenous people may be unavailable to them yet available to embers of the macro-culture (see Figure 2). Although Indigenous people's rights to share profits from IK/IEK are now protected by the United Nations' Convention on Biological Diversity (Oguamanam, 2006) in many cases bioprospecting has been performed surreptitiously, unethically or even illegally (Craig & Davis, 2005; Mgbeoji 2005). These issues make it hard to extend the open area of this Johari window into the private area via knowledge acquisition and to extend into the unknown area through mutual enquiry.

Figure 2: Knowledge icebergs representing the amount of explicit knowledge about an Indigenous people's knowledge that is available to the macro culture and the indigenous people. Note that some explicit knowledge about the history of the Indigenous may be unavailable to or hidden from members of the Indigenous people (after Seely Brown, 2002)



Unfortunately, there are many reasons why collecting, sharing and storing IK and IEK are not straightforward. Collecting IK is complicated by issues such as whether an Indigenous person has the right within their community to share their knowledge. Information technologies can exacerbate issues and sensitivities associated with preserving IK and IEK (see Christie, 2004). For example, storing knowledge in the form of visual audio-media of an Indigenous Australian can be insensitive if that media is stored or streamed subsequent to his or her death. Storing linguistic data or metadata is also difficult: a homonym in two neighboring Indigenous languages can refer to different flora or fauna; conversely, a type of flora or fauna can be referred to by different words in neighboring languages. So contextual knowledge of country and Indigenous linguistic history can be very important in eliciting accurate IEK. Given the loss of Indigenous knowledge holders to migration and premature death, this requirement means that it may be hard to train sufficient well educated and sensitive knowledge engineers while IEK still exists within Indigenous peoples.

Teaching Indigenous Knowledge

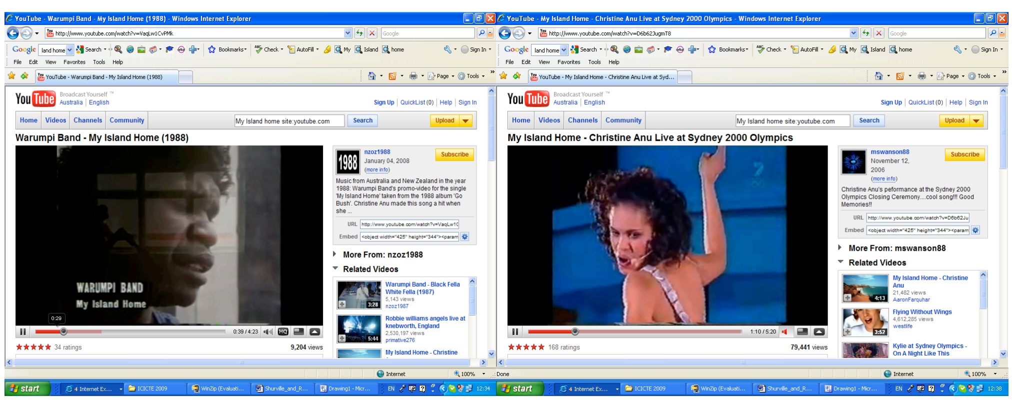
The University of South Australia (UniSA) is situated in country whose traditional owners are the *Kaurna* People of the Adelaide Plains. It has acknowledged "a special responsibility to provide leadership in Indigenous research and education by virtue of its founding Act." and "the Indigenous Content in Undergraduate Programs Policy (ICUP), an Australian University first . . . requires all UniSA undergraduate programs to include an assessable and compulsory component of Indigenous content by the year 2010"(UniSA, n.d.). So UniSA is a supportive environment at which to develop learning experiences about IK/IEK and Indigenous peoples. Here we describe some first steps towards establishing a significant presence for IK/IEK-oriented curriculum at the postgraduate level in courses in information management (IM).

The BIM and L&IM programs integrate four streams of IM viz. archival management, enterprise content and knowledge management, library management, and records management. In the Australian and UniSA contexts, IK/IEK is relevant to each of these streams. So the program now aspires to develop a course in eliciting, managing and preserving IK/IEK that can be taught across them and in external and internal modes. The tenets of developing the course include the following. A multi-cultural course development team must include indigenous people and involve stakeholders from relevant institutions such as libraries, museums and state records. Those involved need to learn about teaching IK/IEK in a way that is compliant with ethical standards and Indigenous, Australian, and international laws. During the learning design, Indigenous practices, such as story circles (Nabhan, 1997), need to be regarded as being equivalent in status with Western approaches and technologies. As Korma argues, "we are reminded of the global and historical tendency of complex technologies associated with economic powers to squash smaller, local technologies . . . We are urged to identify the valuable elements of smaller technologies and to create a place for them in the new century" (Kroma, 1996). So we are currently taking small steps towards developing the internal competence to establish working relationships with Indigenous people and especially teachers. As part of this process we feel that we need to demonstrate that Indigenous knowledge can be taught at the postgraduate level in UniSA in an ethical way.

In 2008, Shurville piloted a lecture on IK/IEK Management in the undergraduate course *Knowledge Management in Organizations*. The lecture contained information on the nature of IK/IEK and the problems associated with bioprospecting and biopiracy. It also discussed ethical approaches to elicitation, storing and disseminating IK/IEK. The lecture was well-received by the students. Indeed the learning conversations on the discussion boards were both deeper and more abundant than for other topics. One unexpected outcome of teaching about IK/IEK within a course on knowledge management was that discussion of the cognitive relationship between Indigenous peoples and their country helped students to understand the concepts of distributed cognition (Hutchins, 1995), the extended mind (Clark & Chalmers, 2003) and situated cognition (Hendriks-Jansen, 1996). These are fundamental to understanding how knowledge management systems composed of people and artifacts can help people to make smarter decisions. Following the lecture on IK/IEK, students started to spontaneously comment that Indigenous peoples are in cognitive relationships with their country, which provides explicit and tacit knowledge that helps them to make decisions and to survive. This experience demonstrated that IK/IEK could capture the imaginations of computing and management students. However, it was clear from face-to-face and virtual discussions that additional contextual background was required in order for the students to grasp the differences and similarities between IK/IEK and knowledge within the macro-culture. Moreover, reflection-on-action revealed that the student experience lacked an authentic Indigenous voice and an experiential learning component. So the undergraduate course indicated that, while that there were opportunities to teach appreciation of IK/IEK and to do so in ways that are in keeping with the learning and teaching philosophies of the University, further development of the learning design was necessary.

In 2009 Shurville redesigned the postgraduate course in *Knowledge Management in Organizations*. The curriculum was updated to include new topics such as *globalization and knowledge* and *Indigenous knowledge*. The assessment was redesigned to include experiential learning about the processes of knowledge management using authentic techniques for transforming tacit knowledge into explicit knowledge, such as action learning and anecdote circles.

Figure 3: Two versions of My Island Home by the Warumpi Band (left) (http://www.youtube.com/watch?v=VaqLw1CvPMk) and Christine Anu at the 2000 Olympics (right) (http://www.youtube.com/watch?v=D6b62JugmT8) (screenshots from You Tube)



The learning design for the lecture on IK/IEK now applies ICT to bring Indigenous voices to the lecture in three ways. The lecture opens with three audio visual samples of performances of the song *My Island Home* written by Neil Murray (Murray, n.d.). The first shows the song as originally performed by the Warumpi Band, which was a politically active rock band with Ingenious and

White Australian members (Warumpi Band, 1987) (see Figure 3). The song celebrates Elcho Island in the Arnhem country and laments the life of Indigenous people in the city. The second shows Torres Straight Islander Christine Anu, who is a former member of Neil Murray's later band The Rainmakers, singing her version (Anu, 1995) in the Australian country-rock genre. This version is altered to celebrate her own people's country. The third shows Christine Anu singing My Island Home at the 2000 Olympics in a fully Westernized production, featuring a Euro-disco beat and professional dancers representing Indigenous Australians (see Figure 3). The song is the same, yet the amount of Westernization varies considerably. Inclusion of the song is designed to facilitate later discussion of the creation of hybrid IK/IEK. A scene from the popular Australian comedy film *The Castle* (Stitch, 1997) is later used to establish the link between the constitutional right of Immigrant Australians to a house/home and the constitutional right of Aboriginal Australians to country/home. This scene is included to facilitate discussion of local and international law and IK/IEK. The lecture concludes with an audio-graphic presentation by an Aboriginal academic on an Indigenous experience of the deployment of ICT for Aboriginals in country.

An assessment for the course focuses on anecdote circles (Callahan et al., 2006). Anecdote circles are a popular knowledge management technique in Australia which are inspired by Indigenous story circles. An anecdote circle is designed to elicit snippets of narrative which illustrate the underlying values at play in an organization. They can be used for change management purposes by identifying how things are felt to be and how people might like them to be. In the learning design the students conduct an anecdote circle with up to four stakeholders in an organization to tease out anecdotes and narratives about how knowledge is managed or mismanaged within the organization. The students then construct a report to the management of that organization as a collaborative exercise using a variety of modes of communication and technology.

Reflection-on-action suggests that presenting such multimedia materials brought a selection of Indigenous voices to the lecture theater which constituted a small step forward. However, Shurville looks forward to an opportunity to redevelop the learning design alongside Indigenous academics and stakeholders.

Walking in Two Sunsets

We have touched upon some of the issues that should guide development of the proposed course on IM and IK/IEK. Rospigliosi is now enrolled at UniSA as an external student in a professional doctorate in ethical knowledge acquisition of IK/IEK. His thesis project aims to improve practice in the development and delivery of courses in IK/IEK and ethical and technical acquisition of IK/IEK.

Shurville is currently collaborating with Heather Brown of the State Library of South Australia and Simon Froude of State Records South Australia to develop a bid for external funding to design a course whose production and delivery will involve a range of Indigenous people and relevant agencies. So among our next steps is to develop a proposal and learning design that will involve Indigenous teachers and students and blend educational theory and technology with approaches derived from oral cultures. There is also the intention to discern ways that ICT might support the elicitation and sharing of IK/IEK. There is another underlying motivation, which we should make explicit. We believe that a course on IK/IEK in the context of a program on IM might help to tempt Indigenous Australians into training for a variety of IM professions where they are currently under represented (Dyson & Robertson, 2006). This is a slow process; walking in two worlds must be undertaken with care and respect (see Levy, 1992).

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AN APPETITE FOR CREATIVE DESTRUCTION: SHOULD THE SENIOR ACADEMIC TECHNOLOGY OFFICER BE MODELLED ON THE CIO OR THE CTO?

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Abstract

We examine the emerging role of Senior Academic Technology Officer and the shift from having acknowledged expertise to acquiring legitimate organizational power. We are particularly interested in the match or mismatch between their own appetite for radical technological change, i.e. for creative destruction (Schumpeter, 1942) and that of the institution. We also consider two existing templates for such a role from mainstream information management and information technology: the Chief Information Officer and the Chief Technology Officer.

Introduction

Technology enhanced learning (TEL) has newfound strategic importance within tertiary institutions whose mission is to deliver flexible distance- and/or mass-education (Shurville et al., 2008; in press). A senior educational technologist (SET) who is embedded within an institutional service is in an excellent position to fulfil the role of local TEL champion, which has been shown to be extremely influential in many institutions (Browne et al., 2008). Consequently, senior SETs are increasingly exercising expert power as change and innovation agents, although in the majority of cases they have not transitioned into leaders of institutional services (Shurville et al., 2008; in press).

Nevertheless, their growing influence has been recognized by the Association for Educational Communications and Technology (AECT). The AECT recently re-defined educational technology from a profession "concerned with the design, development, utilization, management, and evaluation of processes and resources for learning" (Seels & Richey, 1994, p. 1) to one concerned with "the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources" (Januszewski & Molenda, 2008, p. 1). As Richey comments: "a critical addition to

[this] definition is the term 'improving performance'. This echoes the demands now placed on our field. Effective products are no longer the primary goal. Even learning is no longer the only goal. Our efforts are expected to impact transfer as shown in individual and organizational performance improvement" (2008, p. 24). Richey's position is supported by a recent U.S. survey which highlighted the increased organizational legitimacy, influence, and in some cases power of this role (Albright & Nworie, 2008). Accordingly, Albright and Nworie recommend that institutions add a Senior Academic Technology Officer (SATO) to their organizational structure thus transforming influence and expert power into legitimate power. They argue that "campus leadership [for TEL] should never sit lower than one echelon below the chief information officer (CIO)" (Albright & Nworie, 2008, p. 21). So the SATO is a new and relatively senior role whose widespread adoption could mark a coming of age for SETs. Filling the role requires a combination of soft skills in areas such as change management and pedagogy as well as harder skills in techné (Shurville et al., 2008; in press). Here we examine the emerging role of the SATO and consider templates that could be borrowed from industry. An appropriate definition and choice of template is important because they will give the SATO room to provide authentic leadership. Studies have shown that authentic leadership can be an especially important success factor within higher education, because other motivators, such as financial reward, are less available within the sector (Shattock, 2003).

We shall discuss the match between a SATO's own appetite for incremental or radical technological change, i.e. for creative destruction (Schumpeter, 1942) and the corresponding appetite of the institution. We will also consider two existing templates for this role that higher education could borrow from industry viz. the Chief Information Officer (CIO) and the Chief Technology Officer (CTO) (see Lane & Koronios, 2007). Our discussion is informed by a reflective case study and by the excerpts from a virtual anecdote circle of stakeholders based in Asia, Australia, North America, and the United Kingdom.

Individual and Organizational Appetites for Creative Destruction

Institutional TEL services are good examples of socio-technical systems. The socio-elements of a TEL service can include academic development and learning design while its technical-elements can include a combination of managed, personal, and virtual learning environments (MLE, PLE, VLE). One of the key tasks of developing and maintaining a socio-technical system is that of ethical role design (Søndergaard et al., 2007). A premise of socio-technical theory is the importance of "the provision of learning experience for all employees that will provide challenge and enable them to increase their skills, to work cooperatively with others, and to become efficient decision takers and problem solvers"

(Mumford & Axtell, 2003, p. 335). So we believe that those designing roles for managers of socio-technical systems should acknowledge the requirement for both soft and hard skill sets. In the case of SATOs the role also needs to include knowledge and experience of learning and teaching &, increasingly, research and scholarship. To engage and retain SATOs they should therefore include responsibilities that are engaging and meaningful to individuals with inclinations to develop and apply all of these skill sets (see Herzberg et al., 1958). Moreover, to reduce dissatisfaction amongst SATOs, that could lead to flight risk, they should ensure that relevant policies, supervision structures, and working conditions are in place (see Herzberg et al., 1958; Shurville et al., 2008, in press). The validity of this premise at the coalface of socio-technical systems is evidenced by multiple studies of software developers, which show that empowerment leads to increased productivity and retention (Hall et al., 2008).

A well-designed role for a SATO should be sustainable for the individual and the organization (Saxe-Braithwaite et al., 2008). However, for the task of managing an institutional TEL service to be challenging and meaningful to an individual, some account needs to be taken of their own values (Blunt, 1983) and motivations towards leadership (Sosik, 2005). For example in ICT, some managers find satisfaction in maximising organizational efficiency while others are driven by transforming organizational effectiveness via innovation (Hunter, 2007). We can describe the former managers as having lower appetites for creative destruction and the later managers as having higher appetites for creative destruction (Schumpeter, 1942). Here we argue that those with a lower appetite for creative destruction are more suited to the role of CTO, while those with a higher appetite for creative destruction are more suited to the role of a CIO. The key question is 'which is needed by the institution?'

The CTO and the CIO

In a recent empirical study of the relationships between CTOs, CIOs, and a variety of organizations, Hunter (2007) characterized the difference between prototypical CTOs and CIOs. In Hunter's terminological shorthand: a CTO "will focus on the management of current operations with an emphasis on efficiency. That is, given the existing information technology services, how can these resources best be employed to support the company in the short term" (p. 264); and a CIO "will focus on effectiveness. The CIO will look beyond the present information technology resource base with a view to employing information technology in an innovative way to facilitate future initiatives" (p. 264). Hunter's research demonstrates that there is often some confusion between these idealised roles and the work that individuals who are recruited to fill them are expected to do. To appreciate the difference you might like to equate the CTO with business process improvement and the CIO with business process redesign or transformation. In other words, an efficient CTO should exhibit a controlled appetite for creative destruction and an eye for managerial detail within an existing business model. An effective CIO should exhibit a higher appetite for creative destruction.

Dealtry (2002) describes the dichotomy between a CIO and a CTO in the context of defining the attributes of a corporate university, and acknowledged the danger that an ill-conceived choice will mean "perpetuating existing structures and thinking that do not allow management to do what is necessary for a more effective intellectual orientation of the company" (Dealtry, 2002, p. 17). This point is exemplified by the new tension between running a conventional VLE 'efficiently', which is closer to the purview of a CTO, and the challenge of implementing a PLE 'effectively', which is closer to that of a CIO.

Hunter's research also shows that this difference is often ill-understood by both individuals within these roles and by organisations (Hunter, 2007). So, candidates for the role of CTO whose natural avocation is innovation can mistakenly apply for a position requiring a CIO and vice versa. Moreover, organisations often advertise for an innovator when one is not required. This can be because they practice unrealistic recruitment, i.e. they oversell the importance of a role to attract applicants and enhance their own reputation (see Wanous, 1978, cited in Raub & Streit, 2006).

We argue that institutions can be characterised in similar ways to individuals. With reference to the Moore's Technology Adoption Life Cycle (Moore, 1991), enthusiastic institutions exhibit higher appetites for creative destruction while mainstream institutions exhibit lower appetites (see Luckin et al., 2006). The higher its appetite, the more that the institution is prepared to challenge the scope of its business and culture using ICT (see Venkatraman, 1994). We should clarify that ICT is rarely the driver, per se, but rather it follows in the wake of new institutional visions, such as the teaching-research nexus. How ICT is used to respond to such visions depends on whether this joint appetite for creative destruction is shared.

So, designers of the role of university's SATO should examine whether accountability, control, influence and support that they design into the envisaged role will confer legitimate power to the SATO that matches the organization's own appetite for creative destruction. Moreover, those who are selecting candidates for the role should assess whether each candidate's appetite for creative destruction matches that of the organization. Finally, candidates should consider whether the organization is cognizant of this issue and has assessed both appetites correctly.

A Lived Experience

The following case study exemplifies some of the issues brought by a mismatch between individual and institutional appetites for creative destruction. In 2002, Shurville was recruited as a project director at a UK university with a portfolio to develop and roll out a managed learning environment (MLE) and a virtual learning environment (VLE). Making the organization more efficient, by delivering and embedding the MLE, required the attitude and skill set of a CTO (see Shurville & Williams, 2005). Transforming the organization to be more effective, by delivering and embedding a VLE and instigating online learning, required the attitude and skill set of a CIO (see Luckin et al., 2006). Hence he assessed the role as a satisfactory hybrid of CIO and CTO.

While Shurville's natural proclivity was towards being a CIO, he was happy to take on the combined role as it appeared to provide opportunities to develop skills in both efficient and effective management. Subsequent to accepting the role, it became apparent that senior management was only motivated by delivery of an MLE that leveraged existing information technology services to support the company in the short term. Despite public support for introducing a VLE, as expressed in Shurville's role description, senior management was privately resistant to developing a VLE that would look beyond the present information technology resource base with a view to employing information technology in an innovative way to facilitate future initiatives. In other words there was a mismatch between the senior management's espoused appetite for creative destruction and their underlying resistance to it. There was also a mismatch between Shurville's aspirations towards being a CIO when the organization was consciously or unconsciously seeking a candidate with the aspirations of a CTO.

The situation revealed itself to be more complicated in a number of ways. Some internal conflict in appetites for creative destruction between members of senior management and the project steering group became apparent, which undermined the confidence and institutional profile of the staff engaged in the VLE initiative. Subsequently, the senior management team changed sufficiently, such that the need to implement flexible learning via a VLE, which had been demonstrated at the grass roots level, became recognized (Luckin et al., 2006).

Community Views

So, how does this narrative generalize across the experiences of the community? We asked a panel of 20 senior administrators, SETs and academics with an interest in managing TEL three questions designed to elicit opinions and experiences. Here we present a selection of the most interesting answers from academic stakeholders.

Q1: Does the role of a CIO or a CTO come closer to the requirements for a SATO?

". . . the role of SATO varies in seniority from institution to institution but the more senior the position within the institution's hierarchy, the closer [it] is to a 'CTO'. I equate 'CTO' more closely with a role of a manager and the 'CIO' role exhibiting more leadership qualities. This also appears true for centralized roles versus more localized ones (i.e. located out with the disciplines), i.e., more 'CTO's in centralized units and more 'CIO's out at the coalface."

"CIO comes closer given your definition above; however, I don't know any universities that follow the corporate distinction. . . most universities I know have a single CIO role, which is actually all of IT. More importantly, most university CIOs I have known have a focus on enterprise IT management. . . and less on innovation or creative destruction, this tends to come more from innovative academic staff, and this often leads to conflict with CIOs."

"Much closer to a CIO. Those I have had close contact with are quite focused on institutional change and pedagogy as much as technology. . . they tend to be more experimental and strategic in their approaches, seeking funds and support to extend and improve learning opportunities. . . in both my current institutions there is a layering and distribution of the role so an individual's power is somewhat limited: others at different levels in the organisational hierarchy play a strong balancing part. . . the eternal war between networking departments and learning technology departments often acts as a counter-balance to radical change."

"The SATO should bend more towards the definition of CIO rather than CTO. However, I am concerned that both definitions have limited relevance to learning contexts."

"Is the SATO for research and/or learning or both? In the UK old universities the role may be combined (and this makes sense). However, in new universities, the latter role is paramount but the role itself (SATO) if it actually exists is usually distributed. In any case, in universities the CIO is typically a librarian, the CTO is in IT systems, and these two areas often have the problem of interoperating. If the SATO is as you say a 'SET' they are far and few between in universities. . . and are slowly being recognized as important by top level management but have workflow with other layers of senior management that can best be described as innovation in 'slowmo'."

"I would expect someone with the title of SATO to have both an eye on the efficiency of an organisation at the current moment in time and an eye towards the potential of future initiatives to improve the current offering, both in terms of user experience and efficiency. I can't really see that these two can be separated, although I can see that an emphasis could be placed on one focus or another, but a close working relationship between two different posts would then be essential."

Q2: Does a SATO's appetite for creative destruction need to match the institution's?

"I think this is a personal choice of the SATO. Different individuals have different tolerance for frustration and challenge, as do the management of institutions."

"It is always better if a leader of innovation and creative disruption is understood and valued by an organisation, and their activities recognized as part of the strategic plan of the organization — of course this is rare, but not impossible. What is more common is that innovators come into conflict with existing power structures with unhappy results. In a university, the innovator can sometimes survive outside the mainstream IT management through gaining independent funding (often from outside the university), or through some designation of a 'space' for innovation/disruption which is accepted as a non-core activity (various innovative research centers would fit this category). However, the real test is whether the innovations from an innovation group can make the transition into the mainstream IT (and academic) core of the university. This is an issue in both e-learning and more recently in e-research. In general, innovations are picked up at other institutions more easily than in a home institution, which seems an unfortunate outcome."

"It depends what is meant by 'institution'. The bottom-up and innately conservative groundswell of custom and practice within an institution may often be at odds with SATOs who see their role as instruments of change. However, I will take 'institution' to mean the entity that is defined by its management, policies, embedded practices and strategies. I have been lucky to have been associated with creative SATOs with strong communication skills and I suspect that this is the norm. They tend to come from inter-disciplinary backgrounds (usually education, computing and/or AN.Other). They talk well and listen well, so (whatever their personal inclinations) they tend to reach fairly close alignment with the institution, partly by promoting their causes in the right places and thus bringing about change, and partly by listening to higher management's goals and interests and aligning themselves with them. It's about negotiation. They are part of the institution, not separate from it. Wild mavericks tend not to get hired, nor do they last long in that role when they are. Having said that, I am not aware of any instances where SATOs are the conservative force in this equation and those that

are successful succeed in part because they push the envelope and want to bring about revolutions. The SATOs (or equivalents) I have known see their roles as transformative, meaning that they are often extending the boundaries and fighting conservatism. I suspect that there are two primary forces that drive this tendency. On the one hand, they are drawn to the field because of its innate affordances to change the status quo and, on the other, their roles naturally act as magnets for those who are keen to push the boundaries: they tend to talk more with those who want to change things and try new approaches, thus reinforcing their beliefs."

"Since the institution does not have a single voice it would be hard to match it. The dichotomy does not ring true. Why must there be either efficiency or effectiveness? Why is effectiveness associated with radical transformation? I would presume that the SATO role would be to lead peers as well as to advocate for peers to university organisational structure. As such there would be a constant shifting between incremental change and radical transformation depending on the technology, purpose, culture, etc."

"Surely, the SATO should be leading the institution's appetite with respect to technology? This may not indicate a lack of match, of course, more a lack of emphasis or direction at a particular point in time."

"The situation can be dynamic but depends on the institution's strategic plan. To convince factions and tribes you have to talk efficiency and evidence. Once you are on the road to change I think you need to gather evidence along the way for continued investment and eventually transformation.

Q3: What are the beneficial or detrimental impacts of a mismatch between the SATO's appetite for creative destruction and that of the institution?

"Benefits can be gained from a CIO being mismatched to the extent that they are required to implement change within an organization. Even if this person needs to be reigned in from time to time, progress will still be seen to be made by both sides. I think the disparity of mismatch that can be tolerated with a CTO is less. This would often be regarded as poor management and is less palatable. However, in all cases, if the mismatch is too great, the resultant conflict will not be productive and the SATO will feel impotent in their role."

"The benefits usually arise from the fact that technology is changing so fast, and with such broad impact, that some people need to be a the leading edge, so that their understanding and lessons can be transferred back into the mainstream in due course. Even with a mismatch, a time will usually come when the need to understand technology innovation outside the university is important even to the mainstream IT (e.g., the rise of Web 2 technologies), and so the innovator may be

helpful in this context. However, there are many detrimental aspects of the mismatch — wasted funding on innovations that aren't adopted, unhappy innovators who leave following frustration (and after consuming special innovation funds), unhappy CIOs who feel challenged by innovators in ways that are unhelpful to their core "basics" IT requirements, and university leaders, who rarely see benefits from disruptive innovation in the short term."

"There is nearly always a slight mismatch or no change would occur, but it is self-balancing in the cases I know of and I have never come across a case where the balance swings too far one way or the other — I guess they wouldn't be hired in the first place if they were wildly at odds with the institution's appetite for creative destruction. SATOs face bigger problems in fighting with mismatches between institutional tendencies and the technologies they support and promote. The kinds of technologies that tend to become centralised in an institution play a major role in structuring the learning experience (notably LMSs/MLEs/VLEs, etc.) so it is more often the technology itself that leads to mismatches — it becomes a force that embeds the status quo. It is often the case that LMSs embed and reinforce norms (e.g. content delivery paradigm, teacher in control, segregation between dialogue and process etc) so they actively work against the SATO's desire to enable radical change and probably that of the institution too."

". . . there is already a tension between what academics want to do with technology in their institution and what that institution sanctions as well as technically supports. This tension is also present in the roles of Academic Development. I think that an effective SATO will necessarily have to be someone who is willing to continually grind away at an institution's natural tendency for delay, prevarication, standardisation, risk over-management, and death by committee."

"I would see the role of a SAT as a leadership role and as such whilst their overall strategy would need to be in-line with the ethos of their institution it could also challenge current objectives and push for further change. So whilst their needs to be a general like-mindedness between senior institutional leaders about the fundamentals of the institution, there can of course be an advantage in a mismatch in some views about how to achieve its overall aims. These should get thrashed out in healthy debate as part of the decision making process."

"I have had to put this appetite on hold in order to get my feet under the institutional table. Ironic given that you get noticed by what I would call creative disruption. However, the world is changing and we (my institution is not even now in catch up mode; and I confess to be getting somewhat twitchy."

Conclusion

Hiring a SATO with an appetite for creative destruction mismatched to that of the institution can have negative outcomes for both parties (Phillips, 1998). So we recommend that institutions clarify whether they require a SATO modelled upon a 'CIO' or a 'CTO' and design the role and recruitment appropriately. However, SATO's must be realistic about how far individuals with large appetites for creative destruction should be promoted to senior management because "among the paradoxes that abound in academia, one of the most curious is the apparent coexistence of radical chic with entrenched conservatism" (Becher & Trowler, 2001, p. 97).

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URBAN CLASS COMPUTING IN HIGHER EDUCATION: PROMISING OR PERILOUS

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Abstract

This paper draws the information communications technology profile of a group of tertiary students in the old, prestigious De La Salle University-Manila situated in an urban setting; gets their premature perception of urban class computing and finally, determines how the idea constructs a new form of learning behavior.

What is Urban Computing

"Urban computing is the integration of computing, sensing and actuation technologies into everyday urban living and lifestyles" (Kindberg, Chalmers, & Paulos, 2007, p. 18). The term has emerged "as a label for research into mobile and pervasive computing situated within urban contexts" (Greenfield & Shepard, 2007, p. 8) Proponents of urban computing are looking into the various ways information communication technologies are used in the urban setting with the intention "to produce fully integrated designs and possibly overcome deployment challenges" (Kindberg et al., 2007, p.19).

Kindberg and his research group see urban setting shaping social behavior. More and more people are engaging in urban computing aside from the typical phone calls or short messaging system (SMS) like exchanging files using Bluetooth technology (Kindberg et al., 2007, p. 20), taking pictures of accidents or relevant events, using the mobile phone to find a restaurant in the city.

Urban computing hopefully leads to the idea of ambient informatics, a state in which information is freely available at the point in space and time someone requires it (Shepard et al., 2007, p.10).

And urban computing is still in its early stages and most of the applications being developed are geared toward addressing city living and public spaces such as supporting pedestrian navigation through a mobile phone, design of music-sharing application for passengers or a mobile social software that may address digital divide between inner-cities and suburban areas using art as a model. And this research area is very much in need of data about urban computing phenomena (Kindberg et al., 2007, p. 20).

The Premise of Urban Class Computing

Envision a wifi-ready campus where students are using laptops in the hallways, in the classroom or in the canteen — accessing online library resources, finding a course elective online, checking project requirements and deadlines set by the professor. A student taking notes in class using a laptop and a student using her phone camera to copy the assignment on the board are common sights. Student interactions rely heavily on the e-groups, instant messaging and the SMS. While these are mental images in the provincial areas, these are concrete experiences of how students perform urban computing in an urbanized ICT-empowered university setting like the De La Salle University in Manila.

While urban computing sees how social behaviors are framed, this paper attempts to deduce how urban computing constructs a new form of learning behavior. Indeed, there are other manifestations but getting the views of the students will be more helpful. Urban class computing (UCC) is coined as a fabric of urban computing. Urban class computing is the natural cohesion of learning and technology among individuals. This scenario commonly takes place in urban setting where there is wide and easy access to technology resources. It is performed by any individual, young or old, that engages in any form of learning.

The Survey of the ICT Tertiary Students of the De La Salle University

The De La Salle University-Manila Campus

The De La Salle University-Manila is one of the oldest, private, Catholic university in the country. It was founded by the Brothers of the Christian Schools, or the Lasallian Brothers of France, in 1911. It is situated in Manila, the capital of the Philippines. The campus has 19 buildings at present situated in a 5-hectare lot and the oldest building, the St. La Salle hall, was built in 1921 (De La Salle University, 2009). Similar to most of the universities in the cities, construction of the buildings were not planned and built at the same time. In the case of the DLSU-M campus, the old buildings have a neoclassical architecture while the others are of less decorative modernist style. The Yuchengco, Gokongwei and Gonzales halls, the Marilen Gaerlan conservatory, as well as the Enrique Razon Sports and the Science and Technology Research Centers were all built after the 1990s. Figure 1 shows the campus map.

Figure 1: DLSU-M Campus Map

http://en.wikipedia.org/wiki/De_La_Salle_University-Manila

The university has over 750 computer workstations of varying specifications spread in 30 different laboratories for student use in the campus. There are wired networks and wireless connections available for computing, Internet and online services' access. Internet infrastructure dedicated to university is 26Mbps bandwidth. (DLSU Web Portal, 2005)

The Survey

To work on the idea of the urban class computing, a survey was conducted among the tertiary junior students of the Information Technology Department of the College of Computer Studies (CCS) of DLSU-M, and CCS is recognized as a Center of Excellence in Information Technology by the Commission of Higher Education (De La Salle University, 2009). The respondents are students of the Information Technology department.

The survey was conducted to determine the profile of the tertiary students in an ideal urban university setting equipped with ICT facilities and to determine their perception of the new ways of learning and/or how they view the strong usage of technology for learning with the premise that certain learning behaviors are also developed in this kind of scenario.

In a survey of 98 students, the following data were derived. (See Table 1.)

Table 1: Basic Demographics of the Students

Gender	M	F	TOTAL		
	63	35	98		
Birth Year	1987	1988	1989	1990	1991
	4	33	47	14	0
Age Entered College	15	16	17	18 and Above	
	10	42	36	10	
Original Birth Place	Metro Manila	Province	Outside the Philippines		
	75	21	2		
Childhood Location	Metro Manila	Province	Outside the Philippines		
	75	21	4		
Study Location	Metro Manila	Outside Metro Manila			
	93	5			
Have Mobile Phone	Yes	No			
	98	0			
# of mobile phones	one	two	three	more than three	
	57	39	1	1	
Have Laptop	Yes	No			
	83	15			
no. of Laptops	one	two	three	more than three	
	38	49	2		

Ninety-three percent stay in Metro Manila while studying and only five percent stay in suburban areas. While everyone enjoys a mobile phone, 39% have an average of two mobile phones, 49% have an average of two laptops and only 7% among the students use a Macbook.

Figure 2: Laptop and Computer Statistics of the Students

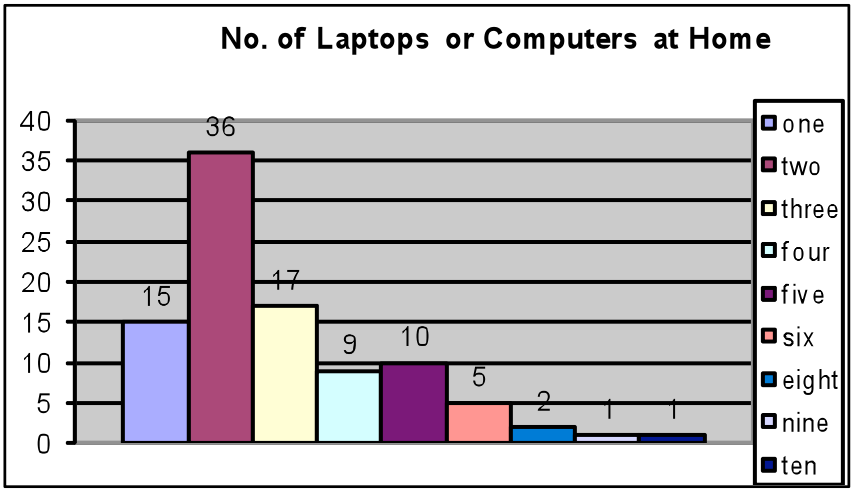
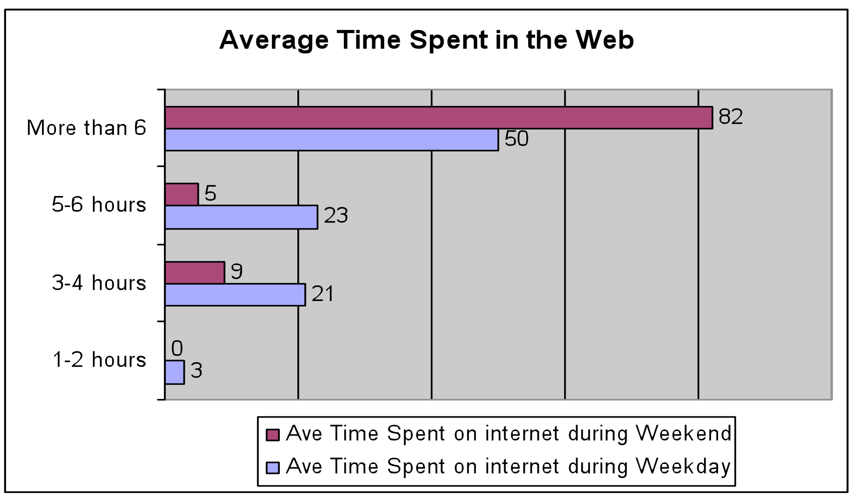


Figure 3: The Students' Average Time Surfing the Web



Over 50% have digital cameras, digital video cameras; have wireless routers, landlines and/or broadband internet connections for their internet service requirements. Aside making local calls (52%) and SMSs (87%), the students commonly use their mobile phones for scheduling their activities (54%), note-taking (30%), reading e-mail (54%) and playing music or listening to radios (51%).

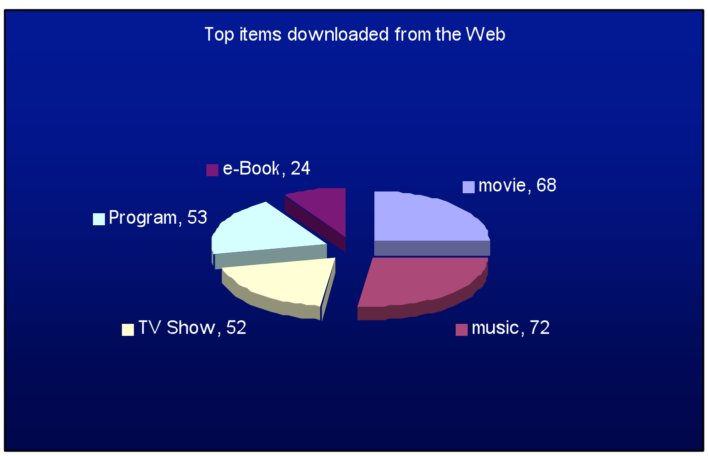
The top three preferred social network sites are Multiply (89%), Friendster (88%) and Facebook (83%).

Top activities that the students do when engaged in the web are the following~ instant messaging, e-mail, social networking, doing research, downloading files, watching videos online, online chat and online games. Common items downloaded from the web are music files, movies, programs/software, TV shows and e-books.

Table 2: Top Web Activities of the Students

E-mail	94%
IM	96%
Online Chat	78%
Doing Research	83%
Downloading files	83%
Online Games	61%
Social Networking	86%
Watching Video online	81%

Figure 4: Top Items Downloaded by the Students from the Web



While 55% prefer to use the web for researching because of the faster way of gathering data or information, 48% still go to the library to research and 58% still use books for references.

Students are motivated to go to school because of the presence of friends and classmates, to get good grades and learn more, having daily allowances and the hope of earning a degree. Top answers why they are not motivated to go to school are because of lack of sleep (20%) and boring classes (19%).

Table 3: What Motivates Students to go to School

<table>
<tr><td>Driving car</td><td>6</td><td>Becoming popular</td><td>3</td></tr>
<tr><td>Daily allowance</td><td>27</td><td>Compliance to req'ts</td><td>20</td></tr>
<tr><td>Presence of friends/classmates</td><td>34</td><td>Get good grades</td><td>28</td></tr>
<tr><td>Good professors</td><td>25</td><td>Learn more</td><td>28</td></tr>
<tr><td>Idea of diploma</td><td>24</td><td></td><td></td></tr>
<tr><td rowspan="2">Others</td><td>Org reponsibility</td><td>Meet new people</td><td>Fun</td><td>Experience</td></tr>
<tr><td>2</td><td>2</td><td>2</td><td>2</td></tr>
</table>

Table 4: Students' View of Urban Class Computing

Top Descriptions of What UCC is	
Emerging trend on data and information gathering	5
Future of education	4
Natural cohesion of technology and learning	4
Helpful	6
Should not be abused	5
very influential when it comes to doing our activities/necessary for learning	4
New way of learning	3
Awesome	3
good	8
Future of education	4
Efficient/effective for students in learning	3
wonderful result of technology	3
Starting a new generation of learning/new way of uplifting education/innovative way of reaching students	3

Synthesis of the Survey

The survey conducted was able to gather relevant preliminary data that serves as springboard to the idea of UCC.

The typical profile of the student studying in an urbanized computing environment and/or engaged in urban class computing would be an individual who prioritizes mobile and web connectivity for communication and information access; gives importance to virtual interactions as part of social activities (exhibited in e-mail, online chat, instant messaging and social networking), has high consideration to quality, traditional educational structure (evidenced by doing research in the library and the web, high level use of books and e-books and preference of physically going to school).

A new form of learning behavior becomes evident — self-service learning skills. Self-service learning skill refers to the habitual ability to get fast, relevant and immediate knowledge and information, manage and organize time and effort, experience online, mobile and physical interactions and views technology engagement as second nature together with learning.

UCC is an acceptable jargon and idea to the students. The survey earned favorable results with the students' perspective of UCC based on the survey as *"good, helpful, an emerging trend of gathering data and information, necessary to learning and that it should not be abused."*

The initial definition supplied as the natural cohesion of learning and technology is acceptable. But UCC can further be described as a condition wherein there is a natural, opportunistic reliance on the ICT tools to facilitate efficient and immediate task and learning delivery be it in the classroom or at home, or anywhere in the campus.

While the profile will show that the students have access to all the ICT tools that will assist them in their studies, the approbation for quality, traditional on-campus educational structure is very evident. Students' view of physically going to school gives high regard to the need for (1) social interaction, (2) more learning, (3) getting good grades, (4) having daily allowances, (5) interactions with good professors and (6) earning a degree,

Learning or studying in an urban university prescribes a technology learning tool. This is favorable to the students who have access to a wide range of ICT tools. For students coming from and staying in the suburban or rural areas while studying with limited technology tools it will be a disadvantage. But having and not having the ICT tools does not guarantee success at this point.

When discussions in urban computing came about, it focused on open and public spaces and city life with little regard on classrooms and/or university systems. The area of UCC should grow and expand. Projects related to the permissible use of ICT in the classroom or campus should start to shape such as an application that can be used in a classroom discussion that can generate instant feedback from students with the use of mobile phones providing real-time statistics of the answers; an application to allow mobile commerce and blogging among young student entrepreneurs; mobile and online student survey or student government elections; or geotagging of campus activities and job openings for student references.

Challenges Faced by the Urban University

According to Larsen in his Organization for Economic Cooperation and Development (OECD) report, there are three major impacts of ICT to education. First, education is a prerequisite to a knowledge-based economy. Second, ICTs are powerful tool for diffusing knowledge and information and third, ICTs induce innovations in the ways of doing things (Larsen, 2005). Higher education institutions will not survive if the role of ICT in education is set aside. For leading urban colleges and universities attuned to the changing needs of the educational system and DLSU that has the highest education level of accreditation in the Philippines, major challenges face these universities.

- Provision for changing ICT infrastructure from wired connection to wireless or wifi connections or adoption of wifi connections will have to be in place. Most universities like DLSU-M has continuously acquired computers, expanded laboratories to provide facilities for digital literacy. The use of these facilities at present will mean acquiring computer skills in the confines of the labs. This setup does not encourage UCC that can take place anywhere in the campus.

- Universities that have been adept to ICT changes in the past have created numerous computer laboratories for ICT related hands-on courses and to cater to student computing needs. These labs may be in obsolescence or may not be as functional or suitable anymore with the availability of wireless connections and advent of mobile computing.

  In the case of the DLSU campus, the building expansion is continuous as well as the design and creation of new, small and big rooms for new purposes. The 30 laboratories that house the 750 computer workstations may be excessive now with the availability of wireless connections that allow students to freely use their laptops anywhere in the campus.

  On the other hand, keeping the wireless connections always available, prioritizing the tasks or the users requiring the connections, sustaining the demand of the connections particularly during the peak of the school term will also be some of the immediate issues to be faced by DLSU-M.

- Classroom policies on the use of technology will have to be studied in the light of what will be more conducive to learning, what is permissible and extent of technology use. For instance, use of laptops or mobile devices like mobile phones or personal digital assistants were never used or not allowed to be used in the classroom during lectures. With the advent of UCC, use of the laptops and mobile devices may augment classroom interactions as well as support learning that will take place.

- Expansion in the form of creation of buildings will have to be planned to accommodate sustainable ICT infrastructure and ambient informatics.

- Sustaining the ICT infrastructure may require urban setting universities to establish linkage with private companies to be able to deliver and sustain quality ICT service facilities for learning.

Conclusions

Is UCC promising or perilous? UCC can be a threat to the ICT infrastructure invested upon by most universities in the urban setting with the old paradigm of learning activities taking place inside the classroom or laboratory. It is because the UCC environment suggested by this paper encompasses not just the lab setup but the entire campus. UCC is supporting and sustaining the immediate learning computing needs of the students.

Universities catering to students in a highly urbanized environment cannot ignore the fact that the profile of their students exhibits individuals adept with technology, constantly engaged in UCC activities and self-service learning skill is inherent.

There are other pervasive learning and computing ideas that may overlap with the idea of urban class computing and the new idea of self-service learning. Crossing and/or metamorphosis of knowledge and ideas may occur but the positive perspective of creating a sustainable, learning computing environment is there. As this study hopes to inspire other related research projects, this should also lead to addressing the under-resourced universities and students in the urban setting.

Universities will have to make sustainable plans of creating ambient informatics structure to further support the drive for self-service skills of the students.

The more favorable response and positive attitude exhibited by the students towards the idea of urban class computing, the easier to create scenarios that will allow the design and development of an urban computing environment.

It is recommended to gather more information from other sets of students like the graduate students and tertiary students from non-IT majors and collect faculty ICT-related teaching experiences.

Finally, the paper was able to draw a good profile of UCC students, coined a more descriptive definition of UCC and had drawn the concept of a self-service learning skill, fundamental to UCC. Self-service learning skill will have to be probed and scrutinized further together with UCC. It was also a very affirmative and encouraging discovery that the students value the traditional on-campus educational system despite having a wide range of ICT resources at their fingertips.

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WHY, WHAT, WHO, HOW: BUILDING UP ONLINE COURSES A REPORT FROM A SOUTHERN ITALY UNIVERSITY

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Abstract

This work is based upon an online experimentation realized by the didactical area of sociology at the University of Salerno (Italy). It seeks to identify its points of strength and of weakness and to establish guide lines for further planning. In particular, it systematically describes and compares two courses which have used different approaches, methodologies and platforms and their results. To conclude the authors underline the importance of the study of the context, of giving an active and significant role to the students as well as to the teachers and of building up a dialogue between traditional and ITC-based tools.

Introduction

This work reflects on some aspects of the online experimentation conducted from 2001 to 2008 at the University of Salerno, in the three yearly studies course in Sociology. The success of the initiative amongst teachers and students determined the on setting from 2008 of the entire three yearly online course, alongside the more traditional teaching (http://www.lettereonline.unisa.it/Sociologia_online/index.php).

Through the systematic comparison of two courses, suitably selected, we endeavour to identify both the weak and strong points within such an experience and to establish guide lines as to improve further courses, making them more consistent to the needs of the students. We also hope that our experience will be of interest to other teachers in different contexts.

Before we go into the specific course's description, it's important to offer some brief considerations on the context to which the courses belong and on the students for which they were created.

The quality of a learning product, that will bring us to a better learning, it is the result of the confrontation and negotiation with specific users and their needs, and specific contexts (Elhers, 2007, p. 8).

The Context

During the academic year 2006–07 the University of Salerno offered to its students 31 first level degree courses, 24 second level degrees, 29 doctorships of research, and 10 first and second level masters.

In the same academic year the students enrolled were 39,029 (2.6% of the Italian university students). The Sociology degree, which belongs to the Faculty of Arts, registered in the year 2006–2007 230 students within the first level and 46 students in the specialist degree.

In the University of Salerno the dropout rates between the 1st and 2nd year have grown over time, from 23.1% in the year 2001–2002 to 30.1% in the year 2006–2007.

For the students enrolled in the Faculty of Arts in their first and second year, the average dropout rate is of 22%. By the third year, however, abandon a further 15%. For the Sociology students drop out rate are still higher, as shown in Table 1.

Table 1: Students Enrolled in Sociology Courses (2001–2004): Early Dropout Rates

	Enrolled	Not enrolled 2°year	% early drop out
a.a. 2001-02	418	151	36.1
a.a. 2002-03	315	124	39.4
a.a. 2003-04	275	129	46.9

These difficulties are much more serious where students are lacking an adequate preparation for third-level study. Here it is relevant to refer to the concept of cultural capital, comprising different forms of knowledge, skills, education and advantages (Bourdieu & Passeron, 1970). Considering as indicators of this capital, parents' educational attainments and the students' final mark in their secondary school diploma, it results that our Sociology students have a very weak cultural background (Arcangeli & Diana, 2008).

Two Courses in Detail

To locate the weak and strong points in the produced experience we confronted two sociology courses, one of which was a methodology of the social sciences and the other the sociology of organization. Both teachers agreed that learning must be a collaborative process and that the students must be at the center of it, but their courses were different under certain profiles. They in fact:

- are addressed to students belonging to different years of the three yearly course in sociology (and partly also to those students belonging to other didactical courses).
- have privileged different priorities and objectives.
- have been built, thanks to a certain freedom of experimentation left to the teachers, on different platforms.
- have produced different results that concern the entire didactical experimentation.

For each course the more general logic will be described clearly and the different needs to whom the teachers and designers have tried to respond and the results of their work. Then, comparing the two courses, conclusions of a general nature will emerge.

The Methodology of the Social Sciences Course

The first course we will discuss is the Methodology of Social Sciences course. This begins on the first year of the Sociology degree. It was proposed to the students in the years from 2001 to 2009, both in the classroom, blended mode, and online (Arcangeli & Diana, 2009). In this section we will dwell only on this last experience even though the parallel running of the two courses has constituted an important experience that profoundly changed our teaching methods and would deserve further discussion, since it would also be of interest to those colleagues that have had no online experiences.

Table 2: University of Salerno, Sociology First Degree. Methodology of Social Sciences Course

Course Title	Methodology of social sciences
Year	1
mode	Online Blended
Time	2001-2009
Adressed to	First year sociology students
Number of online students (average)	30/40
Total number of students enrolled 2001/09	200
Platform used	WebCT
Teacher	Bianca Arcangeli - Paolo Diana
Tutor	1

The course designers were aware that the scheduling of the course at the beginning of the university curriculum implied some general and specific difficulties that needed to be confronted for their significant relapses on the students learning.

As far as the general difficulties were concerned, it was necessary first to confront the disorientation, typical of many students in their transition from school to university (Coulon, 1997), often resulting in the dropping out from the course or in a significant reorganization of the expectations and activities to a medium or lower level. To the "regular" student, entering the university way of schooling and to the working student, to whom particularly the online courses are addressed and also generally lacking reference and support points in the university context, it was necessary to offer simple, meaningful, easy accessible learning contexts and pathways, and the possibility to develop good communicative and collaborative networks with the students and the teachers.

Secondly, the course had to confront the reduced abilities in logical conceptual organization, in writing, in the learning methods, the bad reading habits that were common to many students. It was therefore necessary to produce clearly scheduled learning routes, enriched with the support of reference texts, glossaries, dictionaries etc., but especially to favour the regular, creative, individual and collective use of these tools, building also opportunities for interaction between traditional and multimedia documentation.

Among the problems singled out there were those related to the discipline itself. They stemmed from the "metaskill" character of methodology (Meraviglia, 2004), from the continuous references that it operates in history, epistemology, in the philosophy of the social sciences, that put into difficulties the students who do not possess expertise in these areas.

Other difficulties arose finally by the fact that students must assimilate the language and the theoretical heritage of the discipline and to be able to translate it into operative choices tied to the empirical experiences (Bruschi, 2005).

The course should therefore foster familiarity with disciplinary language and tools and encourage the growth of the disciplinary identities, but also offer to the students the opportunity to put into practice, with some simple exercises, the acquired knowledge.

To achieve the above mentioned program, teachers and designers decided to place the student in the centre of the course, to connect him to collaborative social and learning networks (Siemens, 2008), and on the other hand not to forget the role of the teacher. The latter was considered in fact a central figure in course's content production and design, as well as organizer and manager of individual and collective communication and guidance in the processes of internalization of knowledge.

The online course was organized with reference to a printed Introduction to social sciences methodology. It was first of all divided in areas, modules and units to develop or integrate the manuals subjects and to organize and facilitate the students work.

Particular attention has been dedicated in establishing regular and structured study habits and practices.

A key role in this direction has been attributed to the unit's working page realized on the Web CT platform which has been adapted, as you can see in Figure 1. The original text, enriched with images, animated figures, audio files, graphic images is configured in the two lateral bars that allow and guide the students activity, proposing on the right side the work to carry out, possible web research on the subject, downloaded materials, spot video conferences, on the left side, the access to the general resources of the course (glossary, syllabus, etc.) and to the communicative instruments (mail, forum, chat, virtual class, virtual conference).

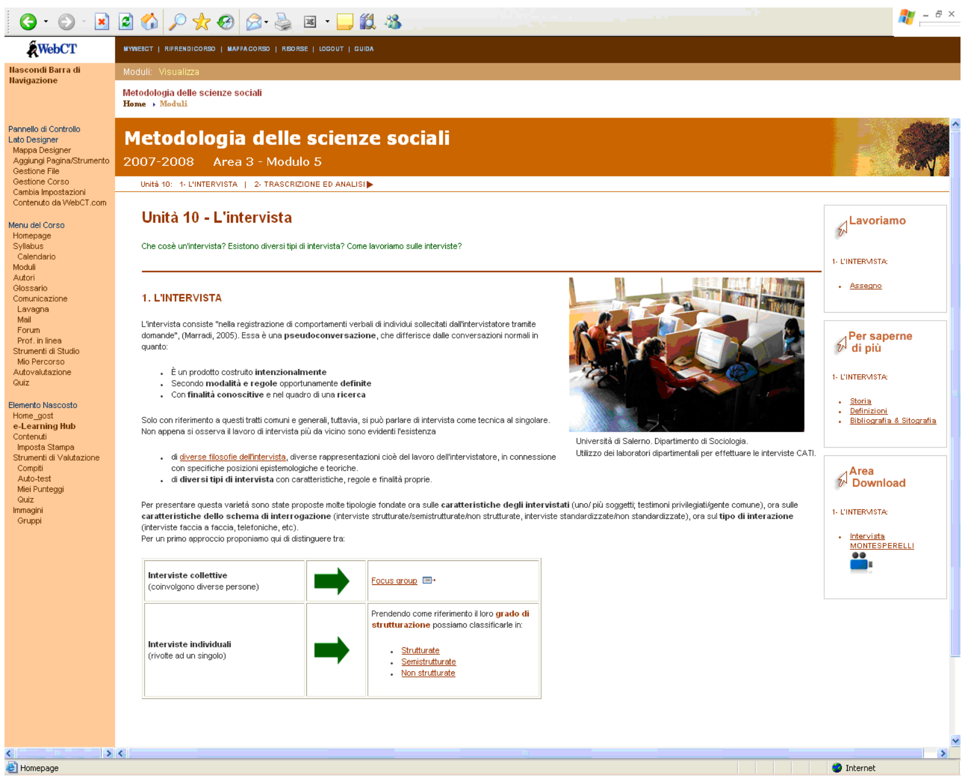
Amongst the work instruments the asynchronous ones, like forums, have been privileged, while not excluding an occasional use, for particular topics of the virtual classroom.

On the whole the results have been quite satisfactory, both for the high rate of passing the final exam as for the low rate of drop outs (10%).

A crucial role was played in this direction from the formation of a compact virtual community that has accompanied the students also from one course to another and helped them to overcome individual difficulties.

It may be noted however that this community was rarely able to move beyond forms of encouragement and support to become an effective learning carrier. A limitation that we feel is due to an inadequate attention in the design, to the construction of specific collaborative processes supported by appropriate tools.

Figure 1: A Page from the Online Social Science Methodology Course



The Sociology of Organization Course

The Sociology of Organization course is foreseen from the Faculty of Arts educational disposition on the second and third year of the sociology primary degree. It is also borrowed from the Communication Course, at the postgraduate level, and from The Faculty of Public Administration in his primary degree. This attendance of students from different faculties, from diverse types of degrees, from different ages represents one of the course more interesting characteristics. The course has been offered from 2005 to 2009 in the “blended” and “online” modality. This double teaching experience however suggests that in the growth of the class as a learning organization, (Argyris & Schon, 1998; Nonaka & Takeuchi, 1997; Chun Wey Choo, 2006) the division between teaching in the classroom, (with the blended learning activities) and teaching online loses much of its relevance and can be considered as referring to learning contexts and environments rather than teaching, to usages rather than methodologies.

What we seem to learn from all of this is that the key words to learning are exchanging, communicating and sharing (Siemens, 2004, 2006). To each student, whether in blended or online classroom, should be afforded the opportunity to take an active part in class, to develop his skills /learning opportunities through interaction, collaboration, participation. In this context, the open source (in the specific case Moodle) seems to favour the constant evolution of the internal and external resources available (You Tube, Facebook, Twitter, Business Exchange, etc.).

Table 3: University of Salerno, Sociology First Degree. The Sociology of Organization Course.

Course Title	Sociology of Organization
Year	2°/3 Sociology primary degree 3° Public Administration. primary degree 2° Communication course, secondary degree
Mode	Online Blended
Time	2005-09
Adressed to	Second and third year sociology students Third Year Public Administration students Second year Communication course students
Number of enrolled students (average)	25/35 (Online) + 40/50 Blended
Number of enrolled students from 2005/09	120 (Online) + 180 Blended
Platforma	Moodle
Teacher	Vincenzo Moretti
Tutor	1

Characteristics of the Online Course

The online course is divided into three modules each of which is divided into 11 didactical units (UD). The first and the second modules are for everyone’s use, whereas the third is for sociology students only.

The main page of the course is divided in three parts. In the central part there are three modules and areas and interactive tools referring to methodology (questions of method), to the contents (adesso forum, adesso wiki etc.), to communication (adesso chat, adesso news), to the evaluation (adesso posso).

On the right side of the page we find, for student's service, calendars, the different course programmes for students belonging to different areas, activities, users profiles etc; on the left hand of the page, instead, a group of containers/contents (think thing, I am a blogger, in the past, to look at) to encourage interaction and participation.

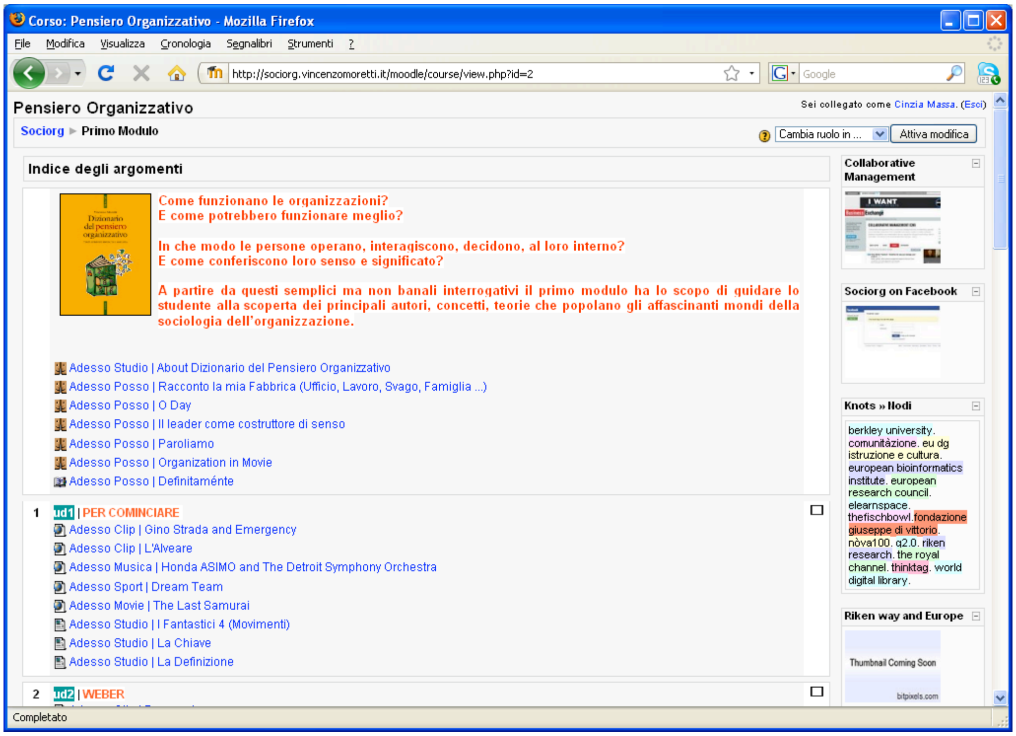
As far as modules are concerned, the page is divided in two parts.

In the main part the course is presented and a guide to the reading and the studying of the text books is offered to students. The contents also of these books and the diverse activities are critically analysed. Finally the contents of the 11 UD are proposed and the different interaction tools regarding the basic texts study (adesso studio, about), its contents (adesso forum, adesso chat), the learning verification (adesso posso).

In order to stimulate the student's curiosity, interest, motivation, their ability to establish relationships and therefore to learn, each UD is opened by a film, video clip or songs linked to the proposed contents. Those latter, also, are structured in such a way to prompt questions, interest, curiosity, interaction and to yield more profitable the study of text books (which still remain an essential component of the learning process). The ultimate objective is to enhance the knowledge and skills of students and to support their capacity to apply to social world what they have learned.

It's with respect to this broader context that find their meaning the lessons, mostly in an asynchronous format and enriched by files, videos, mp3, the weekly discussions on chat with the teachers and tutors and the exercises designed to give students the tools to connect with each other, to contextualise the content of modules and units, to identify causes and consequences of each of them, to establish relationships between what is studied and what happens every day in family, work or social worlds.On the right of the page are proposed instead some containers and contents and some service functions (search in the site , tasks, user profile, etc.).

Figure 2: A Page from the Sociology of Organization Online Course



Results

Together with the specific knowledge, the course has encouraged the acquisition by students of tools useful for their knowledge and understanding of learning, to enhance their identity, to improve their ability to problem solving, to seize the opportunity and then multiply them, to activate a process of conversion between tacit and explicit knowledge (Chun Wey Choo, 2006; Nonaka & Takeuchi, 1997).

A paradigmatic example is that of the AM, a working student, who in the face of the request by the manager of his office to settle "quickly and well" the still unsettled affairs demonstrated that within the decision-making process doing quickly can not be an alternative to doing well and that if you choose to do soon regardless of doing well the outcome of the administrative action can not legitimately be called a decision. (http://www.eformazione.unisa.it/mod/resource/view.php?id=1690)

Conclusion

This discussion highlights the importance of some points that must be placed on the base of our future planning for the three-year degree. Generally, at the primary degree level, good teaching and good learning seems to need:

- an accurate analysis of the context.
- simple didactical pathways enriched with visual aids, clearly structured, enabling regular and methodical studying and working habits and continuous assessments of ones own learning abilities.
- support instruments such as glossaries, dictionaries etc. combined with creative exercises.
- the development of a collaborative learning processes within the classroom, between the students and between students and the teacher and the tutors, as well as outside the classroom by the identification of qualified landmarks into the web.
- the building of a systematic integration between the traditional and new forms of communication based on ICT to facilitate the growth of skills in both areas.
- technological choices based on technology's ability to give voice to the need of relating, connecting, constructing, participating and therefore learning by the people, and to respond to the specific objectives set by the teacher.

On the other hand, it seems important to try to building up new products that achieve, if compared to the examples presented, a better balance between:

- the focus placed on the student in the learning process, on his practices and processes of internalization of knowledge (with all the consequences that this implies for the course structure) and
- The awareness of the central role to be attributed to the teacher, and of its many dimensions. The teacher in fact can not be regarded only as a content's producer or as a regulator of collective communication, but rather as: 1. a producer of contents that are conceived and designed according to the specific needs of users, both in language and in the exposure and that must to be translated into activities, thus requiring a continuous and creative relationship with the designers and multimedia

developers. 2. an organizer and facilitator of the collective communication 3. a fundamental guide to the acquisition and internalization of knowledge of individuals and groups.

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FROM SMALL TO LARGE HITS: SPREADING THE ONLINE MESSAGE TO ACADEMIC AND ADMINISTRATIVE STAFF VIA STRATEGICALLY-TARGETED DEVELOPMENT ACTIVITIES

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Abstract

This paper reports on how a university is implementing a capacity-building academic staff development program using a three-pronged approach that draws on adult learning, social learning and capacity-building literature. This approach was designed to enable staff to provide engaging and pedagogically sound online experiences for the students at the University of Newcastle, NSW Australia. Data have been gathered throughout the implementation of this program to evaluate its impact and to inform future refinements of the program. The paper concludes with reflections from staff facilitating the program about the challenges, successes and future of the program.

Introduction

The University of Newcastle is committed to enhancing the availability and quality of its online course offerings to increase flexibility for students in all programs. Like many institutional aspirational documents, the University's Strategic Plan includes as a core aim, to provide an advanced curriculum and outstanding scholarly teaching that inspires and transforms our students (University of Newcastle, 2006). A significant challenge associated with achieving this aim is to spread the online message to colleagues involved in course development and administration. The Educational Resources Support and Development (ERSD) team in the University's Centre for Teaching and Learning (CTL) plays a central role in addressing the challenge.

In this paper, we outline the program of strategically-targeted development activities we have implemented using a capacity-building approach to provide staff across the University with a range of opportunities for skill development and confidence enhancement. Our suite of activities focus on facilitating online learning, online teaching and online assessment, and on the development of online and multimedia resources that can be integrated in their course curricula.

Background

Prior to 2007, the University offerings in online teaching and learning were relatively few in number. Support for online learning and teaching was provided within a “production house” model that was ignorant of pedagogy, unrelated to course curricula, and relatively ad hoc; the benefits flowed to only a select few.

In response to the need to increase the number and quality of courses offered online or in a blended mode of delivery, we have formulated a three-pronged strategic approach and an associated comprehensive suite of activities that seek to build capacity of both inexperienced and experienced staff.

Theoretical Framework

The approach we have adopted has been deliberately designed to encourage academic staff to view their courses in a more holistic way in which relevant activities, assessment tasks and resources are integrally aligned and systematically embedded. Our approach is informed by the theoretical and research literature on capacity building pedagogy and by the theories of adult learning and social learning. This theoretical framework forms the foundation of our enabling approach that supports staff to develop skills in the design and facilitation of online learning environments.

Capacity-building pedagogies often inform school reform processes (Fullan, 2000; Mitchell & Sackney, 2000; Youngs & King, 2002) and form the basis of commonly used approaches in the field of health (Jackson et al., 1994; Poole, 1997) and community development field (Eade, 1997). In higher education contexts, capacity-building governance models enable institutions to independently implement quality assurance and sustainability actions (Rupert, 2001; Symes, 2005). Capacity-building models can enable academic staff to facilitate engaging online learning experiences for their students and to design online courses and resources which are relevant and customised (Harasim, 2000). The academic staff development approach outlined in this paper is strongly underpinned by these capacity-building pedagogies. They are used to empower academic staff to facilitate high quality online learning experiences and to create engaging, interactive resources for the University’s students.

According to the tenets of adult learning theory, or androgogy (Knowles, 1990), staff members can be supported to progress from a state of possible dependency through to a state of self-direction. As a consequence of this process, staff become capable of autonomously solving problems associated with online learning environments. This approach to academic staff development leads staff to a point where they can independently create resources and design learning experiences for students in their online courses. During the capacity-building process of supporting staff to develop their own online learning and teaching skills, staff in the ERSD team deliberately lead by example to demonstrate varied methods of online course design and facilitation techniques. This process adopts modelling as a method of learning, based on Bandura's (1977; 1986) theory of social learning. This theory complements the underlying capacity-building model that drives the practical implementation of the approach outlined in this paper.

Three-Pronged Approach to Academic Staff Development

Our three-pronged approach to academic staff development in the areas of online learning and teaching has been made possible by our strategic harnessing of the broadly-based skills, talents and interests of staff in the CTL's Educational Resources Support and Development (ERSD) team. The approach has enabled the ERSD team to be, and be seen to be, leaders and to model for academic staff the quality learning experiences that they can in turn provide for our students, especially in the online environment.

Our approach involves the implementation of three strategic initiatives:

- a comprehensive series of online and technology-supported learning and teaching course and workshop offerings;
- web-based and other online resource development; and
- publications and drop-in sessions that increase awareness and assist in the development of an appreciation of the opportunities provided by engaging and pedagogically sound online experiences for quality student learning.

Course and Workshop Offerings

Consistent with a capacity-building model, a workshop series has been designed to enable staff to develop skills in the facilitation of online learning and the development of online courses. The workshops are both generic and customised to suit specific faculty- or school-based needs. The workshops are practical and interactive in nature, using materials that are underpinned by sound pedagogical guidelines relevant to online learning and teaching contexts in higher education. During these workshops, staff are provided with opportunities to explore a range of online learning and teaching examples. As well as offering a series of workshops about online learning and teaching, with later follow-up workshops, the team also designed and facilitated a number of customised workshops for various Faculties throughout the University.

Online Learning Workshop Series. The suite of workshops designed to support staff develop online teaching skills cover nine areas of development (see Table 1) and cater for both experienced and inexperienced staff.

Table 1: Online Learning Workshop Series

Workshop type	**Workshop titles**
Getting started	1) Getting started in online learning
Facilitating online learning	2) Designing online learning activities 3) Designing online assessment
Effective online course design	4) Online course design 5) Converting current courses to online contexts 6) Quality assurance in online learning
Integrating multimedia into online courses	7) Using graphics in online learning contexts 8) Using audio in online learning contexts 9) Using video in online learning contexts

Follow-up workshops. Feedback gathered from staff who have attended workshops has indicated the need for follow-up workshops to supplement the work being done as a result of the Online Learning Workshop Series. So, to enable previous participants the opportunity to share their online teaching skills and resources with other colleagues at the University, the following two types of workshops have been added to the workshop offerings outlined in Table 1:

- follow-up session for course design, course conversion and quality assurance workshops.
- follow-up session for graphics, audio, video workshops.

These follow-up workshops have enabled staff from a range of faculties across the University to benefit by exploring each other's online course examples. Due to their informal and collaborative nature, these workshops have frequently resulted in fruitful discussions about how to solve commonly encountered challenges in online learning environments. In these workshops, the facilitators model how learning can be facilitated rather than "delivered" and how resources can be created by those teaching in online courses rather than produced in a "production house" model.

Customised workshops. At times, staff in various faculties and divisions request workshops that are customised to suit their specific needs. In these cases, workshops such as the following are designed and facilitated:

- Using rubrics for assessment and learning for staff from Wollotuka (School of Aboriginal Studies)
- Using the Virtual Classroom function within Blackboard in online courses to support synchronous communication between students and lecturers. This workshop was requested by the staff in the Joint Medical Program in the Faculty of Health.
- Using Blackboard's GradeCentre for staff from the School of Nursing and Midwifery.

Feedback from staff who attend these workshops indicates they appreciate the opportunity provided in the workshops to solve problems within a supportive environment as a faculty or school group. Such workshops often involve a collaboration between Faculty and CTL staff to explore and solve issues that occur in online learning environments. Examples shared in these sessions often become the focus of later workshops in the Online Learning Workshop Series and the Follow-up Workshop Series. This style of workshop enables a collaborative approach to be adopted and modelled for all staff involved.

Web-based and Other Online Resource Development

We have worked closely with staff across the University to develop online resources for staff and students that support online learning and teaching; and support Faculty staff to design and create their own resources that can be embedded in their online courses.

By modelling a capacity-building approach to online resource development (Northcote & Huon, 2009), we have developed a Framework for Online Resource Development. Using this Framework, the ERSD team have worked together with other CTL and Faculty staff to create these resources:

- Learning in the online environment (launched August 2008);
- Diagnostic Academic English Language Test (DAELT) (currently being launched); and
- Teaching in the online environment (currently under construction).

To support high quality online and technology-supported learning and teaching at the University, the Centre for Teaching and Learning staff have used their combined expertise in online teaching and learning to design, develop and distribute these three online resources.

Learning in the online environment (LOE). This web-based resource has been designed to assist commencing students to become effective learners in online and technology-supported learning environments (Huon, Northcote et al., 2009).

The resource has three core modules:

- Module 1 encourages students to consider what it means to be a learner at university and the implications of using technology for learning in today's world.

- Module 2 is a virtual tour through a range of available information and communication technologies, with reflections on how best to capitalise on such technologies for learning.

- Module 3 introduces students to the online learning environment at the University of Newcastle (that is, Blackboard).

The resource has been accessed more than 2000 times per month since it was launched in August 2008. Its success can be measured from the evaluation data gathered about this resource that reflects students' appreciation of the self-paced, accessible and interactive nature of the resource.

Teaching in the online environment. This web-based resource is currently in the design phase, in consultation with Faculty staff. The resource will support staff in the use of online teaching and learning technologies. Early consultation with Faculty staff indicates they prefer a resource that includes an easily accessible collection of topics about online teaching, with supporting guidelines and case studies. This resource is currently in development and will be launched at the beginning of the second semester in 2009.

Online Diagnostic Academic English Language Test (DAELT). In collaboration with colleagues in the CTL's Learning Support team, we have developed this resource to better inform academic teaching staff about the English language needs of their students (Dennis, Stratilas, Yardy, & Huon, 2009; Huon, Dennis, Stratilas, & Yardy, 2009). The resource specifically targets the learning needs of non English-speaking background International students. This post entrance test has been developed and made available to a wide group of Faculties in 2009. The DAELT serves to emphasise the importance of the ability to communicate successfully as a core graduate attribute and as a University-wide responsibility.

Supporting faculty staff to design and create their own resources. By supporting staff to understand the design principles involved in the development of online resources, the staff themselves become the resource designers and developers, rather than depending on an external consultancy to create resources for them. The other major advantage to this capacity-building approach to supporting academic staff, is that academic staff are then empowered to embed these resources in their own online courses. In this way, staff are in the prime position to provide students with the rationale for using and interacting with these resources in their online courses. Additionally, when students provide feedback to staff about these online resources, staff are in an ideal position to either modify the resources to suit specific course or discipline contexts. As a result, staff are able to acquire resource development skills and they also have the benefit of embedding these resources into their online courses in a relevant and authentic way. By being involved in a range of activities that support staff to create online educational resources including graphics, audio and video components, staff have developed resources for use in complementary therapies, music education, art education and community services research courses.

Publications and Drop-in Sessions

To increase awareness of the opportunities provided by sound online experiences and to enhance appreciation of their contribution to high quality student learning, a range of publications have been designed and a suite of informal drop-in sessions have been offered to staff. These publications and drop-in sessions have been distributed and facilitated to provide staff with an additional way in which to access support for their online learning and teaching.

Principles for Teaching, Learning and Assessment. Staff in the CTL have also led the University in formulating the University of Newcastle *Principles of Teaching, Learning and Assessment*, and the *Principles that Should Guide Practice in Online Assessment*. These two policy documents have been endorsed by the University Senate and are incorporated into on-campus and online workshops and activities facilitated by staff in the CTL.

Publications. To provide the University with regularly communicated information about their activities, the CTL publishes an annual report of teaching and learning activities. This report provides a detailed account, along with evaluations, of the Centre’s activities. In addition to this annual report, other regular publications are distributed throughout the University including newsletters, brochures and bookmarks.

Drop-in sessions. Drop-in sessions are regularly facilitated throughout each semester to provide opportunities for staff to gain specific and timely advice about online learning and teaching. During these sessions, members of the ERSD team are available to work with academic staff on particular online teaching and learning issues as nominated by staff who attend the session. These sessions enable staff to explore the range of online learning and teaching technologies available at the University of Newcastle in a supportive and collaborative atmosphere. Staff are encouraged to drop-in at any time during this two hour period.

University-wide events. We have conducted a small number of University-wide events that have played a critical role in culture change. In particular, *Showcasing Online Learning and Teaching* was designed to increase the profile of online learning and teaching at the University. In addition to this event for staff, University-wide events for students also focus on online teaching and learning issues. For example, during February and March 2009, staff from the CTL facilitated sessions for new first year students and students in Open Foundation courses to assist them to become familiar with online and technology-supported learning and teaching contexts. These activities and events are planned in a way that promotes a community of practice model of collaboration for both staff and students at the University.

Showcasing internal University expertise. To encourage other University staff to develop their own online educational resources, ongoing opportunities are provided for staff to demonstrate and share their own expertise in online learning and teaching. Large university-wide events provide a context in which online learning and teaching exemplars can be demonstrated and discussed. Ongoing Follow-up workshops also enable staff to demonstrate how they use skills developed during the Online Learning Workshop Series to other colleagues.

Our Reflections

Overall, our new approach to supporting academic staff in their online learning and teaching endeavours has been met with a very positive response from academic staff in the faculties across the University. Administrative staff across various divisions in the University have also been regular participants in the range of support activities offered for staff. Our paper concludes with the achievements and challenges we have faced.

Achievements

Our achievements have covered a range of leadership, operational, and teaching and learning practice changes.

Leadership. We now provide strong leadership in and modelling of the principles and practices of online and technology-supported learning and teaching by staff in The Centre for Teaching and Learning.

Engagement. Attendance at workshops and general feedback from workshops have been positive. There is high engagement by participants during workshops due to customised, interactive and collaborative activities used during these sessions.

Reputation. Due to an increased recognition of our contribution, we have received increased requests for customised workshops as the team's reputation spreads.

Collaboration. We now enjoy strong collaborative partnerships with some staff in Faculties within the University. For example, collaborative research projects on blended learning, online curriculum development and online student assessment are currently underway. We look forward to this continued collaboration between Faculty and CTL staff to develop resources, facilitate workshops and implement University-wide events that promote the effective use of technology-supported online teaching and learning within online courses and courses with online components.

Consultation. Staff and students across the University have been regularly consulted and involved in the process of designing resources, planning activities and organising workshops. This consultation ensures that the support we provide is tailored to the needs and interests of staff and students at the University.

Connections. We have observed positive responses when staff are invited to share their online learning and teaching expertise with other colleagues in workshops, drop-in session and University-wide events. This recognition of staff within the University ensures that effective teaching and learning practices are acknowledged, valued and showcased.

Resources. We are involved in the ongoing development of University-wide resources that support the advancement of and innovation in online and technology-supported learning and teaching at the University. The development of support resources is ongoing and they are regularly incorporated into online resources and workshops. At times, they are used by staff as self-paced instructional modules. Examples of these resources include printed and electronic booklets, online Blackboard courses that support on-campus workshops, tip sheets, case studies, course exemplars, instructional guides and animated instructional videos.

Variety. We have strong support for the varied activities we offer and for the way in which we can facilitate support activities in a range of venues and across a range of campuses. To enable this strong support program, we offer workshops in the CTL, workshops in Faculty locations, online support, daily support through phone, email and face-to-face interactions with staff, customised advice about using multimedia in teaching and a range of printed material.

Research. Our team is now actively involved in providing ongoing support for research into online learning and teaching issues, including the design and evaluation of online educational resources.

Challenges Encountered

Throughout the process of implementing the new capacity-building approach for academic staff development in the areas of online learning and teaching, some challenges have been encountered.

Spread. Some faculties have been more involved than others.

Attitudes. Longstanding school staff continue to ask that we produce resources for their teaching. Some understand that the CTL has changed its functions whereas another small group would like the old style "production house" approach to be revived.

Recommendations for the Future

In consideration of both the achievements and the challenges encountered, a set of recommendations has been identified for future development of this academic support program.

Evaluation. We plan to continue to the systematic evaluation of online and technology-supported learning and teaching through online evaluation tools.

Further collaboration. We plan to extend to extend the amount of collaborative projects involving both CTL and Faculty staff across the University in order to further investigate online teaching and learning issues.

Policy. We plan to make recommendations to review policies related to online teaching and learning in the University. When it is clear that new policies are necessary, for example, in the use of social networking tools and emerging Web 2.0 technologies, we will provide advice to University policy making bodies and relevant teaching and learning committees.

Online workshops. Existing versions of on-campus workshops in online learning and teaching are being converted to online contexts for remotely located staff and staff at non-Callaghan campuses. We are currently consulting with Faculty staff about the possibility of facilitating more workshops within Faculty locations, in addition to central CTL locations.

Conclusion

The impact of this strategic implementation of a capacity-building approach to academic staff development is growing. Feedback from staff and students at the University indicate that this approach is having wide ranging effects on student learning and academics' teaching and course design skills. By enabling academic staff to develop online facilitation and resource development skills, they can tailor their online courses to provide interactive and flexible online learning experiences for students at the University.

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PEDAGOGIES OF USING INTERACTIVE WHITEBOARDS (IWBS) IN EXEMPLARY TEACHING IN ONE HIGHER EDUCATION INSTITUTION

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Abstract

This paper reports findings from a case study in one UK University of innovative teaching practices using Interactive Whiteboards (IWBs). The study involved observations and interviews with teachers at the University who were using IWBs in particularly interesting or innovative ways. Findings report wide ranging pedagogies in practice. These are categorised against Haldane and Somekh's (2005) typology of IWB pedagogies. Findings suggest that the pedagogies demonstrated span the typology according to the learning need perceived by the teachers and contexts of use. Thick descriptive examples of pedagogies in practice are given. An adapted typology of pedagogy in Higher Education is proposed.

Literature Review: In Context

Teaching technologies are updating faster than academics can write about them. As UK policy currently acknowledges, in Higher Education further research in the field is essential to make the most of ICT in teaching, teaching staff need to be encouraged to experiment and innovative research is needed into pedagogy (DfES 2005). The vast majority of research reported in this field is conducted in schools and there is little literature examining the pedagogic benefits of using IWBs in Higher education. This research project was designed to capture the innovative ways IWBs are being used in teaching in several departments in one University.

Identifying Good Practice

In order to identify good practice, it is important to identify scales of the full range of practice. There are two significant papers which offer a scale of use specific to interactive whiteboard technology. The first paper (Kennewell, 2006) is a synthesis of research in the field categorised into the associated pedagogies reported when using IWBs. He does not report any new empirical evidence but attempts to classify the current evidence published in the field. He categorises the pedagogies into lower level and higher level uses.

By contrast, Haldane and Somekh (2005) describe a five-tiered model scaling teaching practice. These scales were derived from group discussions based on observations in practical settings by trainee teachers and tested by subsequent research projects. The model classifies teaching from low-level ‘foundation’ use, where practice replicates what is already possible with display technologies, to best practice full integrated ‘flying’ use, where teachers demonstrate confidence in technology facilitated interaction. It is suggested that at the highest level a new pedagogy emerges where lesson design is constructed with interactive technology fully embedded. (see Figure 1)

Figure 1: Typology of Interactive Whiteboard Pedagogies

Haldane and Somekh (2005)

Lower Level Use

At the lowest level of Haldane and Somekh’s (2005) typology ‘Foundation’ the lecturer may replicate uses of a data projector and screen. However there is evidence that even at this low level there are significant affordances offered by the IWB technology over other technologies.

Kennewell (2006) sub-categorises the literature relating to low-level functionality of the IWB. The role of described at this level are ‘Consultant’ — providing information; ‘Organiser’ — providing tight structure; ‘Facilitator’ — providing looser structure, and ‘Repository’ — enabling student ideas to be stored and recalled.

In this first ‘consultant’ role described by Kennewell (2006) the whiteboard is a tool to ‘provide information.’ The unique benefit of technology is the way it can be used to visually supplement presentation and interaction. There is significant literature around the benefits of digital visualisation in education broadly and at the level of Higher Education. Bayne (2008) suggests “The incursions of the digital add a mutable new dimension to decades of theorising of the visible and visual in culture” (p. 26).

Wall et al. (2005) suggest from their evidence that visualisation of any concepts aid the learning process and reports a number of positive comments from students about the way you can see movement rather than imagine it, see demonstrations rather than listen to descriptions and understand by seeing 3D models.

Higher education students of the future are currently being exposed to more technologies than ever before much earlier than ever before (Oblinger & Oblinger, 2005). Prensky (2001) argues that as a direct result of their early digital engagement students will be actively seeking engagement through technology. There are positive findings from a wide range of studies (Beeland, 2002; Burke & Ray 2008; Moss et al., 2007) to suggest IWBs can promote engagement; however there are arguments against this generalisation. Moss et al. (2007) acknowledge that increases in pupil engagement reported were limited to the “novelty period” (p. 235) immediately after the technology was implemented.

Smart (2004) suggests that the biggest benefit of using IWBs is the chance to integrate a wide range of resources to meet a wide range of learning styles and needs. The report refers to learning styles as visual, auditory and kinaesthetic. Although there are critics of these theories, it is broadly accepted that using a range of teaching approaches and resources reaches a wider range of learning needs.

These lower-level affordances can broadly be categorised as visual representation of concepts, increasing engagement and motivation and appealing to a wide range of learning styles.

The Kennewell (2006) model distinguishes between the board’s role as organiser, providing a tight structure, and facilitator, providing a loose structure. There is opportunity within both roles to use the board to stimulate interaction with the learners. The findings from Moss et al.'s (2007) evaluation of IWB use in primary schools are in parallel with Kennewell's 'organiser' role for the board finding that effective interactivity requires structured lesson planning, with stepped conceptual learning, pace in activities and a cognitive review. There are also parallels with the 'facilitator' role as they observed tight structure complemented by the ability to move backwards or forward spontaneously in the learning to recap where necessary or answer questions. Their conclusion, as with Bayne (2008) and Beeland (2002), is that the quality of interaction with the board or resources is dependent on the teacher as expert facilitator.

Personalisation is a hotly prophesized benefit of the new digital era in education (DfES 2005) the board allows direct through use of a pointing device allowing live and dynamic interaction between the teacher or student and IWB. The evidence of the dynamic interaction is stored and can be recalled later as a personalized learning resource. This is equivalent to the second and third level of the Haldane and Somekh (2005) typology where the lecturer is making increased use of the interactive functions of the board. At the second level teachers are working from the board using the pen and eraser and inviting students to contribute where appropriate. At the third level teachers are adapting and creating resources to take advantage of these interactive potentials.

Higher Level Use

At the fourth level of the Haldane and Somekh (2005) typology of use, 'Fluency', teachers are "becoming hunter-gatherers, actively seeking out and harvesting new ideas, new content" and into the fifth level of the model the practitioner builds confidence and "a repertoire of skills to exploit the benefits of the technology and begin thinking about them in innovative ways." Some of the specific pedagogies which may meet these descriptions are presented here.

At the highest level of the typology, teachers using the technology must be responsive and lessons have high levels of interaction with students. The benefit of personalisation suggested by Kennewell (2006) was suggested as low-level use. However at this level Haldane and Somekh (2005) suggest that the teacher should use expertise interacting skills to stimulate as well as facilitate beneficial personalisation during class teaching.

Hennessey et al. (2007) identify top-level use of technology to facilitate deeper learning. They suggest that expert teachers create, on their own or with students, dynamic objects on or with the IWB. The findings of their study indicate that these interactions may include setting challenges, building representations, evaluation of ideas and speculation. The learning objects created have a range of benefits and can facilitate student independence. This suggests that the lecturer operating at the higher level will construct dynamic teaching resources both before and during the session which facilitate independent and therefore deeper kerning but will also respond to students needs. Moss et al. (2007) propose that to embed IWB use and fully reap the benefits will require changes to whole approaches in teaching.

In order for technology to gain maximum benefit, it should meet an already established need (Slay et al., 2008). One particular need highlighted in the HE sector is preparing students to be ready for the workplace. Many courses which are very visual may also be very practical. Rich multimedia material available can provide an excellent link between theory and practice.

Therefore at the reconceptualisation level specific pedagogies are likely to be subject-specific learning experiences. However they are likely to involve collaborating (with students, colleagues or both) to redesign lessons stimulated by pedagogic need. Sessions would be pinned to include active learning with the teacher as facilitator and IWB as focus. Most importantly reconceptualisation involves bringing together expert subject, pedagogic and technological knowledge to enhance the teaching and learning experience.

Research Approach

This report was conducted as the original research for a dissertation award as part of an MA in Educational Research Methods sponsored by the Visual Learning Lab Centre for Excellence in Teaching and Learning at the University of Nottingham.

Methodology

The project sought to identify "exemplars of good practice teaching in IWB use." A gatekeeper in each department was contacted to ask them to identify any practitioners using Interactive Whiteboards, and in particular those using them in 'exemplary teaching.' Six academics were identified in different subjects, all based in Science Faculties (as opposed to Arts). They were interviewed about their teaching practices, skills development and motivations for using the Interactive Whiteboard. Two were also observed teaching in practice. The interview was conversational and data was audio-recorded, transcribed, coded and thematised.

Findings

The findings report on the motivation for teachers in each case to use the IWBs and their perceptions of the potential affordances for teaching and learning.In each case the IWB is sought as a tool to meet a pedagogic need.

The analysis considers how each teacher perceives their use of the IWB in terms of the typology of use proposed by Haldane and Somekh (2005) Findings show exemplary practice in using IWBs in HE span the full range of the typology proposed and is wholly dependent on meeting learning needs. Examples are given, in rich description, as to the exact nature of IWB use in a range of teaching scenarios providing potential impact on practice as a useful grounding for staff development activities and further research. Removing the information from detailed contexts of use to categories can sometimes reduce the impact of the phenomena studied (Bryman, 2004) A brief contextual description is therefore necessary to support understanding of the ways in which the technology is used and benefit perceived within each individual setting.

Lecturer A (Vet School) has developed IWB resources for small group clinical teaching sessions and has school-owned facilities in each small group teaching room. Lecturer B (Physics) uses a mobile device for cross-site teaching and meetings. Lecturer C (Engineering) has adapted existing resources to use innovatively with a mobile whiteboard in the unusual setting of a lab environment. Lecturer D (Pharmacy) has a wide range of devices to use and uses in a range of contexts including whole class teaching (100+ students). Lecturer E (Biomechanics) uses a portable IWB to promote interaction during off-site outreach sessions.

The emergent interview data has been categorised for analysis and presentation to reflect against earlier identified themes.

Pedagogies

The interview data is thematised against the earlier pedagogic categories proposed from the two models in the research (Haldane & Somekh 2005; Kennewell, 2006). These categories are redefined according to their relevance in HE.

Representation. Lecturer C cites the benefit of visualisation in the lab environment: “the students can’t visualise how it all comes together.” He suggests the IWB can display visually complicated technical concepts. Lecturer A also finds the IWB useful for small groups to engage with visual concepts such as x-rays. Lecturers B and C both report on the benefits of writing live on the board to offer visual demonstrations of mathematical concepts, as proposed by Beeland (2002). *“I think that is the best way to teach maths, to produce stuff in real time and to make mistakes on the fly because students follow it and engage with it. So it’s good to use an IWB for that because you can capture it t hen put it on the web so students can access it later”* (Lecturer B)

Lecturer E suggests she uses the IWB since the visualisation of concepts is imperative to science learning. She further argues that visual stimulation can stimulate and engage those with a wide range of learning preferences. Lecturer E explains how she believes using the IWB can especially engage learners with text-based learning deficiencies (such as Dyslexia).

Therefore there is evidence that practitioners use the IWB with intended benefits of visualisation, engagement and meeting a range of learning needs.

Route and Recap. Building on the concepts introduced by Kennewell (2006) and Smith et al. (2005) this section of the typology refers to the benefits of providing learning structure (route) and opens up semantic movement through resources (recap).

Lecturer C confirms the findings of Smith et al (2005) that a benefit of using the IWB in lectures is *"it's a fairly good way to control the pace and flow of the lesson"* and the other respondents agree. Lecturer D uses the IWB in conjunction with software to control the flow of whole group teaching to 100+ students. Lecturer E reports that for small group teaching the IWB materials structure both facilitated and unfacilitated sessions. Furthermore lecturer E suggests that the students benefit as the material is available for recall later when required to facilitate problem solving both during the session and after. This links with the benefits identified in the literature review and links to the next session of the typology — using the whiteboard as a repository.

Repository. All participants, without prompting, cited the functionality and benefit of the using the IWB to personalise class resources to be saved and retrieved later. Lecturers B and C both cited the benefit of handwritten Maths concepts. This is particularly important for Lecturer B who delivers lectures cross-campus via video link.

In the literature review the benefits of the repository were considered as a reflective tool for use by students. However Lecturer D introduces an interesting perspective by describing the way he uses the IWB repository to aid reflective practice amongst teaching colleagues "I've got a complete record of the session when one of the staff saves the files back for me . . . so that when I come back to revise the module, next year's classes can benefit as well by saying . . . 'well last year that was an area which we needed to concentrate on' and perhaps that would otherwise have been lost in 12 months in academia."

Lecturer D suggests that the IWB can gather data about teaching to feed into a reflective cycle which might otherwise have been lost. Kennewell (2006) reports that teachers share more materials when sharing the challenge of implementing new technologies and do not use the exact same materials year after year because using ICT they easily improve their presentations and activities as they learned more about the features and techniques of using the IWB.

Therefore it seems there are significant potential benefits for reflective learning within both the learning process and the teaching process.

These sections of the findings have reported on pedagogies associated with lower level use of the typology proposed by Haldane and Somekh (2005). Pedagogic practice has been identified which can be build hoping to develop deeper learning at the higher level of the typology and these are summarised in the following sections.

Responsiveness. At the top end of the typology responsiveness relates to the use of a range of techniques, pace and interactions to stimulate learning and the role of the teacher in responding to student needs by improvising on demand.

Lecturer B describes using the portable device to respond to needs in a range of scenarios. He promotes the benefits of the device in use with large groups to magnify written diagrams explaining concepts which may arise during the lecture from student questioning rather than planned into the lesson. He also describes its usefulness with tutees in a 1-2-1 or small group scenarios to respond to the need for explanation which can be recorded for later reflection.

Lecturer C also highlights the benefit of using the IWB to respond to particular student needs. In his lab he needs to work with students on a low ratio (1-2-1 or 2-2-1) to demonstrate certain equipment and therefore these are on a rotation throughout the year. As a result the students’ conceptual understanding varies and the mobile IWB allows the teacher to recall, personalise and explain resources as required according to their knowledge in context.

Haldane and Somekh (2005) suggest well-planned lessons incorporate the opportunity to stimulate reflection and reaction. As Burke and Ray (2008) suggest this may include the use of particular questioning techniques. These were seen in practice in the observation of Lecturers A and E in small group teaching.

Although these interactions may seem hard to incorporate in larger group practice, both Lecturers A and D described using keypads to stimulate questioning and reflection, in this context.

Reconceptualising. At the highest level of the Haldane and Somekh (2005) typology is the teacher who has built on experiences of responsiveness to positively improve their practice. The technology becomes embedded into the teaching and learning process to benefit from maximum pedagogic gain and facilitate deep learning.

As Maor and Zirski (2003) propose, at this level the focus may move from the teacher to the board. Lecturer D is convinced that board can become the focus of the teaching with the teacher in a supporting role He feels this is an efficient way of developing deep learning, especially where sessions are often repeated to multiple small groups. Lecturer A agrees that this is a reconceptual focus which enables greater sharing of good reflective teaching practice and facilitates consistency. Several participants specifically describe the way they are reconceptualising teaching using the board to focus on the IWB with teacher as facilitator.

As Olive (2002) proposes specific pedagogies in practice observed are subject-specific. Lecturer C describes the way he has redesigned the way he teaches a very subject-specific process around using the IWB to link theory to practice in the lab setting. He confirms this is a new way of addressing this learning problem: *"It's a completely different way of conceptualizing."*

Lecturer B believes the IWB allows the reconceptualisation of single location teaching. He shares lectures over videoconferences with the IWB offering the opportunity for shared explanation and reflection. The learning materials and adpations are providing to stimulate cross-site discussion, reflection and interaction in an efficient way.

At these higher levels of pedagogic practice, teaching is responsive and reconceptualised.

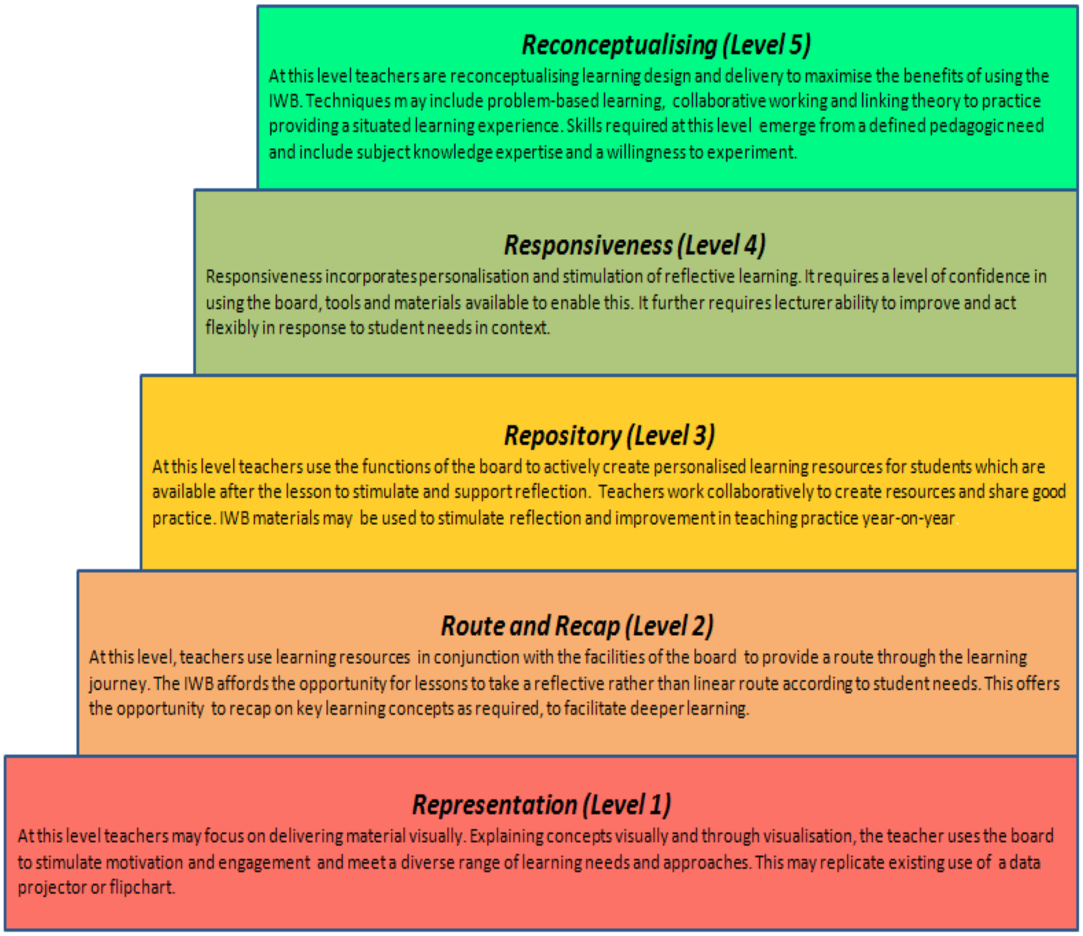
Non Pedagogic Benefits

Glover et al. (2005) dedicate one third of their literature review to the non-pedagogic benefits of the board on teacher effectiveness and they arose in this research. The respondents listed several examples of effective working facilitated by the board. These include time, energy and cost efficiency and are clear benefits which will promote and endear its use to both teaching staff and management. For example, Lecturer B is convinced that he has significantly reduced his carbon footprint as a result of using the IWB for cross-site teaching and meetings thereby reducing his need to travel.

Summary and Recommendations

This paper does not seek to report generalisable findings since all teaching contexts are different. However it is hoped that by painting a picture of pockets of exemplary practice in using the IWB from across the University I might identify benefits and practices which are transferable to other contexts and beneficial examples in training. The new typology below (see Figure 2) describes the recategorisation of Haldane and Somekh's (2005) typology according to my findings and may be used usefully to stimulate discussion in training scenarios.

Figure 2: Typology of Interactive Whiteboard Pedagogies in Higher Education



(adapted from Haldane & Somekh (2005) Typology of Interactive Whiteboard Pedagogies)

There are many areas still to be explored in relation to pedagogies of interactive whiteboard use which would be of benefit to higher education research. These include the student voice on the benefits of visual learning and the potential of the IWB to facilitate deep over surface learning.

It is hoped that by considering the Haldane and Somekh (2005) typology of use and examples from Kennewell (2006) against the practice observed and discussed in this research, I have been able to usefully categorise practice and the potential pedagogic benefits of using the IWB.

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RETHINKING THE CONCEPTUALISATION OF ONLINE EDUCATION

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Abstract

This paper deals with the question of how to conceptualise online education. To answer this question data from an online course were interpreted through a theoretical frame consisting of interactional and transactional approaches to human action. Consequences for understanding and conceptualise the environment, technology, and communication in online education were unfolded. Conceptualisations building on the concept of learning environment were found to be problematic.

Introduction

A search of Google Scholar shows that there are a growing number of studies that focuses on students and teachers actions in online education. There are a significant number of studies each year that focuses on such actions, particularly in terms of participation in computer-mediated communication (CMC). The discussions of action in these studies are often linked to the term “learning environment” (e.g., Anderson, 2009; Merriënboer & Kirschner, 2007; Moreno & Mayer, 2007). This performance of action in learning environments could be discussed in terms of being a part of or an aspect of a conceptualisation of education. However, all conceptualisations of education bring ontological assumptions about how to understand the relation between human action and the environment. In the case of discussing performance of human action in terms of learning environments these assumptions build on an interactive approach. Nevertheless, studies of online education usually leave these ontological assumptions unquestioned. However, to avoid a naïve understanding any analysis needs to pay some attention to the ontological assumptions of the key concepts. Here we will go deeper into the consequences of these assumptions. Therefore, this paper utilises transactional assumptions of human action to discuss conceptualisations of online education and to challenge the prevailing interactional approach (Altman & Rogoff, 1991; Dewey & Bentley, 1949/1960). This discussion starts with unfolding the relation between man and the environment and then moves on with a description of the paper’s empirical frame, an online course where students and teachers apply CMC. The following sections discuss issues that relate ontological assumptions of the environment to education, technology and communication. Finally, conclusions are drawn from the paper's elaboration of key concepts in educational conceptualisations.

How the actions of man are to be understood has been debated at least since the philosophical writings of Plato. It includes issues such as how to relate the mind of man to the surrounding environment. Through history, at least three different positions have held favour (Wartorfsky, 1979). The first two positions, idealism and empiricism, make dualistic claims about the relation of mind to the environment. Idealists such as Plato emphasised the mind as the location where the real world exist. The environment outside is just a shadow world, a mirror of the ideas that exist solely in the mind of man. The empiricist position, popularised by Francis Bacon in the 17th entury, is that the environment consists of matter in motion. In this view, the mind is a separate mental world, which is subject to the influence of external experiences. These dualist positions encountered critical remarks over the strong separation of mind, body and environment. Empiricists were criticised for reducing human beings to machines and idealists were criticised for ignoring the materiality of the world. In other words, these two positions emphasise a perspective where human action is a product of man acting on a surrounding environment independent and external to the mind of man.

The third position rejects the dualism between mind and body or mind and environment. Instead, it embraces a dialectical and ecological view that emphasises the relation between mind and environment as a dynamic whole. There is a necessary relationship between man and the environment embracing the idea that human action cannot be separated from its surroundings. In challenging interactive views of human action this position is taken. The following section elaborates this view further.

During the late 19th and the early 20th centuries, scholars rejected the dualist view of man and the world by linking human action to social life and societal development (e.g., Dewey, 1916; Vygotsky, 1934/1987). They regarded "every historically developed social form as in fluid movement, and therefore takes into account its transient nature not less than its momentary existence" (Marx, 1867/1990, p. 11). These scholars emphasised the social, cultural, and historical transformations that occur through human activity. Building on this dialectical and materialistic view of the world, they highlighted the link between man and the surrounding environment. Dewey criticised the empiricist dualist position of mind and the environment and claimed that it isolated people from each other and the communities in which they exist. In other words, there is no escape from either the physical or the social aspects of the environment. Human action occurs as part of this environment and is a condition for the emergence, in a human being, of "a mind of his own" (Dewey, 1916, p. 344). Mind and the surrounding environment are inseparable and "the self achieves mind in the degree in which knowledge of things is incarnate in the life about him; the self is not a separate mind building up knowledge anew on its own account" (Dewey, 1916, p. 344). Humankind is in symbiosis with the environment while "the influence of nature on man, asserts that man, in turn, affects nature and creates through his changes in nature new natural conditions for his existence" (Vygotsky, 1978, p. 60). Therefore, being part of the world is to live as part of the emerging cultural, historical, and social patterning of the world. In this view, human action is inseparable from the culturally, historically, and socially transformed configuration of the surrounding environment (Vygotsky, 1934/1987).

However, the dualist and non-dualist positions could be distinguished on their conceptualisation of human action. These two positions affords two different approaches to the analyses of human action, interactional and transactional approaches (Altman & Rogoff, 1991; Dewey & Bentley, 1949/1960). Interaction derives from the Newtonian laws of motion where "action and reaction are equal and opposite . . . classical mechanics is such a system of interaction involving particles, boundaries, and laws of effects" (Dewey & Bentley, 1949/1960, p. 68). Such an interactional approach to human action "shatters the subjectmatter into fragments in advance of inquiry" (Dewey & Bentley, 1949/1960, p. 68). In other words, the interactional approach retains a dualistic division of elements or variables, for example man — environment or mind — environment.

An alternative non-dualist approach to human action includes transactional observations which reach across time and space. These are historical and comprise "the right to see together, extensionally and durationally, much that is talked about conventionally as if it were composed of irreconcilable separates" (Dewey & Bentley, 1949/1960, p. 69). Transactional approaches incorporate a wider view of human action. In these approaches "there are no separate elements . . . the whole is composed of inseparable aspects that simultaneously and conjointly define the whole" (Altman & Rogoff, 1991, p. 24). Furthermore, transactional approaches focus on situations, which occur where actions and environment intersect. Therefore this approach not only incorporates temporal and spatial processes but also change.

By contrast, interactional approaches are committed to a narrow study of human action which takes no account of cultural, historical, social, or temporal conditions or motives. In other words, interactional approaches separate human action from environmental and situational aspects of the action. The rest of the paper explores the consequences of applying these two different approaches of human action for understanding participation in online education through CMC.

The Online Course

The data discussed below arise from a course “Flexible Learning” offered as a fulltime 5-month course by a department of Education at a Swedish university. The majority of the collaborative actions in the course were supposed to be performed through what some scholars call a learning management system (LMS). These systems include an assembly of different technological features, such as chat, electronic conferences, and e-mail (e.g., Paulsen, 2003).

The course consisted of four 5-week modules. The study guide consists of five documents, which describe the course extensively. There is one document for each module and one describing the general structure of the course. The general guide and the first module guide were distributed in hard copy to the students ahead of the start of the course, and they were also made available online as PDF files.

This article includes discussion of the participation of 15 students and 3 teachers. Fourteen lived in Sweden, and one had recently moved abroad. One of these students was a male. Some students were training to be teachers while others were participating in a course in Education for the first time. The students’ age ranged from 21–43, with a majority between 30–35. Students’ experience of participating in online courses ranged from nothing up to two years. All three university teachers had at least nine years online experience.

At the beginning of the course, the teachers randomly divided the participating students into three study-groups. All willingly agreed to be part of the study, but two of the students could not be reached to give permission for their postings to be used in this paper. However, all student names are fictional. Since I was one of the teachers in the course, and since I subsequently decided to use the course data in my research, none of the exchanges with myself is included below. Finally, and for the same reason, the other two teachers were responsible for the selected tasks given to the students.

Sampling Online Utterances

The study was conducted as an instrumental single-case study insofar as it could provide insights into online courses in higher education. In this approach the examined course was “looked at in depth, its contexts scrutinized, its ordinary activities detailed” (Stake, 1994, p. 237). Therefore, the investigation adopted an approach that was sensitive to the specific educational conditions of the online course. It embraced descriptions of critical incidents and a theoretical sampling procedure that focused on the written utterances within one task. This task was chosen since it could provide rich information about the phenomena of written online educational communication (Jones, 1999; Patton, 2002). Further, these tasks embraced the full range of online performances — synchronous as well as asynchronous — likely to be encountered on the course.

The data comprised written online utterances such as study-guides and syllabuses, and postings exchanged within the study-groups and between students and teachers. These utterances were seen as constituent aspects of the inter-personal computer-mediated communication (e.g., Buzzelli, 1996; Mercer & Wegerif, 1999; Wertsch, 1998).

Communicative features such as chat rooms, computer conferences and e-mail furnish the utterances examined in this study. They were recorded within the LMS (FirstClass) and, to a lesser extent, within web-based chat (e.g. Yahoo Messenger). Within the LMS, much of this record-keeping was linked to a range of conference sites which were designed to provide opportunities for student collaboration, submission of task documents, sourcing of course documents and the exchange of links to web-sites and other software. In addition to exchanges within the LMS, the course included three face-to-face meetings that introduced students to the content and structure of the course. These sessions were not recorded.

The empirical illustrations are taken from a collaborative task, an online seminar divided in two sections: preparatory work and seminar. The textual material related to the task consisted of approximately 190 pages comprising 44 000 words and 1000 utterances.

Environment and Education

As discussed above, interactional and transactional approaches to human action emerge from different positions of understanding the relation between man and the environment. From this we could also discuss consequences for understanding human action in education, particularly participation in education through CMC. In the interactional approach dualistic claims of participation in education are possible. Ontologically it is possible to separate man from the environment. From this dualistic assumption it follows that man and the environment are separate elements that can be understood independently without reference to each other. A consequence of such dualistic reasoning is that there also is possible to discuss the environment in terms of several different environments. The interactional ontology allows the appearance of such different environments. We can consider that agents are simultaneously performing actions in a world divided into different environments, for example geographical environments, physical environments, psychological environments, and social environments. Another environment frequently discussed in the research and practice of online education is the learning environment (e.g., Anderson, 2009; Merriënboer & Kirschner, 2007; Moreno & Mayer, 2007). Consequently, if we assume that there is more than one environment, we also accept a fragmented view of online education there the learning environment is separated from other environments.

From a transactional approach a dualistic separation of man and the environment is unreasonable if a more coherent and dynamic understanding of education is sought. Man and the environment are aspects of and belong to a common whole that is not possible to divide. This means that man participates in a single integrated environment, an environment that embraces aspects of, for example, geographical, physical, psychological, and social features. Discussions of different environments, such as geographical environments and learning environments, in education are therefore not compatible within a transactional approach. Transactional approaches need to find other concepts for discussing participation in online education. These concepts must be compatible with a dynamic and holistic view of the relation between man and the environment.

Environment and Technology

Interactional conceptualisations of online education afford discussions of different environments. Therefore we could discuss educational practice, for instance, in terms of online learning environments (OLE) or virtual learning environments (VLE). However, this conceptualisation raises ontological questions on the relation between the technology and these environments. This discussion is illustrated with an excerpt from the online course.

> Excerpt 1: An asynchronous exchange of utterances during the preparatory work for the online seminar.
>
> Anja (The 9th of April, 08:55:17) Good, I am available anytime. Another thing, Last night I read that we should use Yahoo Messenger (I don’t know anything about it, and some of us had problem with it last Monday) otherwise the seminar will be performed through telephone. That will not suits you too well (Karla) though you have to pay for 90 minutes international call to Sweden? Should we ask if we could use this forum instead, posting and replying to each others emails(together with the teacher). Alternatively, do you have another suggestion?
>
> Karla (The 9th of April, 10:20:13) I am grateful for not having to sit by the phone during 90 minutes — it will be expensive! I am happy to perform the seminar in this forum. Will you check with the teacher or should I do it? Think that we are so lucky to have such a wise Anja in our group. Hugs Karla

According to the study guide, one of the assessments was performed at a seminar. The performance of this seminar was flexible according to location, time and technology. Students were offered to choose between couples of points of time, and decide if the seminar should be located at campus or online. If they choose to perform it online, they had to choose what kind of technology they should use. Two of the three groups participated through Yahoo Messenger. The third group also discussed chatting, but reconsidered when the teacher suggested a telephone conference as an alternative in the event of troubles with the technology. Telephone conferences are expensive if you live abroad, which Karla did at that time. This was noticed by Anja, who mentioned it to Karla. To be on solid ground both economically and technologically, they asked the teacher to run the seminar through a FirstClass-based electronic conference. The excerpt above illustrates that the conditions for using the technology differ between the students. These differences relate to aspects such as access, experience, and skill. Moreover, the teacher identified the technological solution that had been chosen as itself problematic. When discussing the threaded discussions used during the electronic conference he said that the *"delays were worse for those of you that use the web-version than for me as a client-user."* However, if we understand this educational situation in terms of an online learning environment (OLE) or virtual learning environment (VLE) we encounter problems while we limit our understanding of what is included in the virtual or online space. The existence of these learning environments depends on a technology. A technology that needs to be up and running for the environment, which Anja referred to as being problematic. Therefore, this limitation yields questions about how technologies operate in education. From a transactional approach these issues are important in attempting to reach a coherent understanding of the situation. Nevertheless, from an interactional approach these issues of technology and environment raised by Anja and Karla may be de-emphasised as less relevant for understanding their action.

In a transactional analysis we could take it one step further and challenge the interactional approach by raising the question of what happens with the OLE when the technology fails? Without the technology these environments did not exist and are impossible to create and shape. Outside the technology they could not appear. This raises issues of the ontological status of these environments. Is there any difference between the technology and the OLE? It is a tricky question to make a distinction between these concepts. If we admit that these environments are understandable without reference to the students and teachers that use them we made a dualistic claim. The consequence of this is that we also say that the OLE is the same as the technology. This makes the concept OLE unnecessary; instead the concept technology is more appropriate to use.

Further, this focus on the OLE also emphasises the role of technology in solving educational problems. A departure in the technological opportunities is problematic since “if we are always technology-led we get sub-optimal solutions” (Laurillard, 2008, p. 139) to these problems. To get the best solution we first need to understand the educational problem. Consequently, the educational problem that the excerpt above illustrates should not be discussed in terms of technology. The identification and reflection from the teacher about the educational problem of using different technologies focuses on getting a suitable solution that insures that all participants get access to the seminar. This solution includes conditions for the performance of communication from both the teacher as well as all the students in the study group. The educational problem needs to be superior to the technological solutions.

However, if we take an interactional stance and argue that learning environments in online courses are not the same as the technology we must at least admit two things; that OLEs are totally dependent on the technology for their existence and that these OLEs also need to reference the students and teachers that use the technology. If we take a closer look at the implementation of technology in an online course, we will see that the course embraced different technological solutions to support communication between agents and the performance of their different actions by the agents. Two of the seminars were performed through a chat and the third through an electronic conference. However, if the OLE is understandable as something other than the technology, it needs to reference the students and teachers that use the technology. Then the OLE will become a tool, a conceptualisation of technology that embraces its use by humans (e.g., Wertsch, 1998; Vygotsky, 1978).

A tool is a non-dualistic transactional concept that mediates human action. The function of tools “is to serve as the conductor of human influence on the object of activity” (Vygotsky, 1978, p. 55). Agents use and extend “tools and practices inherited from previous generations. As people develop through their shared use of cultural tools and practices they simultaneously contribute to the transformation of cultural tools, practices, and institutions” (Rogoff, 2003, p. 52). Therefore the tool is a concept that emphasise the inseparability between the agent and the environment. This means that if we discuss technology with reference to human action the OLE will, whether we want it or not, become a mediating tool for the performance of human action. In the illustrating online course tools were a crucial feature of their operation. While participants took an online course the performance of their collaborative action, such as in the seminar, were conditioned by the technology. In other words, what we call learning environments cannot be distinguished from the concept of tools. Or, as Lillefjord and Dysthe (2008, p. 80) emphasise, such courses are about “text production with a VLE as a mediating tool”. Therefore, it is more appropriate to discuss the above-mentioned technological solutions in terms of tools instead of online or virtual learning environments.

A conceptual discussion of technology from an interactional perspective is problematic. It is hard to tell the difference between learning environment, technology and tools. Therefore this paper suggests that online education should use concepts that links technology to human action, for example terms such as artefact, means, or tools. These concepts emphasises that human action needs technology for its performance. Nevertheless, even if the action of students and teachers are discussed in terms of being mediated by tools, we have not yet mounted an adequate challenge to educational conceptualisations that build on dualistic concepts such as "learning environment." Aspects of this tool-mediated communication also challenge these interactive dualistic claims.

Environment and Communication

Education that physically separates agents from each other has a long tradition of employing new tools for communication. Research has shown that "nearly every communication medium has been adapted" (Anderson & Garrison, 1998, p. 101). To this tradition recent decades of technological development has added an extensive array of new communication tools. The deployment of such tools conditions performance of communication in different locations and for different purposes. In the online course studied in this paper, students and teachers used an assembly of tools, for example chat, e-mail, electronic conferences, and telephone conferences for different communicative purposes such as academic support, assessment, online seminars, and tutoring. They communicated with each-other between their homes, and within and between different campuses and study-centres. How could we understand this feature of online courses? From a dualistic conceptualisation of education this issue is not particularly problematic. In an interactional approach the actions of students are only dependent on what is happening online. The physical location of the students is of less importance. The environment is divided into at least two different environments, the physical environment and the online environment. Actions are defined as the interaction between students in the online environment. Learning is supposed to occur in this environment or at least through this environment. Therefore the online environment could be discussed in terms of online or virtual learning environments. From an interactional approach we could also argue that the each agent has a personal learning environment and that this learning environment geographically is based in their home. Communication in online courses could therefore be understood as being performed in as many learning environments as the number of participating students.

Nevertheless, if we still have the intention of using the concept of learning environment to understand communication in online courses it is a tricky question to understand the dualistic boundary of the particular learning environment.

However, whether each agent has a personal learning environment or belongs to a common OLE, the dualistic boundaries of these learning environments makes it a difficult task to use this concept in design and research of online education. Overall, an inclusion of features from the homes of the student extends the level of complexity of education. This complexity is ignored in an interactional approach. From a transactional approach personal aspects and features of students home is important for understanding actions in online courses. Therefore transactional approach solves this complexity by adding these features from the homes of the students to the conditions in the surrounding environment.

As discussed above the conditions for using tools in educational communication has changed. However this communication still relates to ontological and epistemological assumptions taken by agents of online courses. In the online course we have discussed, some of these assumptions were explicitly expressed in the study-guides. The course team declared that actions are processes that depend on social and cultural aspects of the surrounding environment, that knowledge develops through critical evaluation of information, and that steering of the learning process is a tool for enhancement of learning. However, the teachers are not alone in having particular assumptions about human action. Students also have assumptions that influence their actions. In the course different ontological positions were emphasised by participants in their way of communicating. Results from another study of the same empirical material showed that two different communicative genres emerged. These genres were linked to particular study-groups. It seems likely that the ontological assumptions within these groups influenced their approach to communication. One of these genres embraced participants taking a transactional approach to communication. This genre was student-centred and included students taking responsibility for communication. Mainly the communication within these groups had a dialogical functionality. Excerpt two below illustrates a dialogic pattern that is typical for the communication within this genre. This genre embraces communication between the agents, through the online features, as a tool for collaboration around both curricula and private issues. The responsibility for steering communication were shared between students and teachers in a patterns similar to the ID-pattern identified by Dysthe (2002). This pattern comprises initiation from the teacher followed by a dialogical exchange of utterances within the group of students (1–3, 5–11). The steering of this dialogical pattern involves both students (7) and teachers (4).

Excerpt 2: A synchronous exchange of utterances during the online seminar.

1. Marta (10:20:59): I am not sure if education should be compulsory for everybody, but everybody should be treated equally.

2. Betty (10:21:18): We can never require the same from all pupils …

3. Betty (10:21:36): It is good to be aware of the conceptions of the pupils.

4. TEACHER (10:21:43): Should we really treat everybody equal, or should we respect everyone as an equal and act accordingly?

5. Eva (10:21:44): this means that a pupil with low expectations gets high quality attention when he or she is treated as equal to the one with high expectations.

6. Marta (10:21:58): Maybe not everybody needs to be good at maths. It seems like we are back on the educational goals of the pupil.

7. Andrea (10:21:58): But how do we today treat the pupils who perform badly academically but are good in practical training?

8. Betty (10:22:07): it is important to start with the pupil then help him or her to set reasonable and reachable goals.

9. Marta (10:22:20): Respect everybody. Differences facilitate the process of learning!

10. Eva (10:22:46): but not always.

11. Andrea (10:22:53): Yes, but the society of today has high academic expectations.

The other genre was teacher-centred and included students treating communication with other agents instrumentally and therefore they avoided extensive communication with other agents. As excerpt three below illustrates the teacher alone steered the exchange of utterances (12, 14, & 18). The students answered shortly (13, 15–17) and were less interested in following the thread from the co-students. To nurture and sustain the exchange, the teacher had to feed students with comments and questions. Alternatively, one student took the position of the teacher and the rest of the group treated this student as if he/she was the teacher. Overall the communicative patterns in this genre showed similarities to the IREpattern extensively found in research of classroom communication (e.g., Buzzelli, 1996; Mehan, 1979). In this pattern the teacher initiate the discussion with a question, task or so on, followed by responses from students, finally the teacher evaluate this response. In the teacher-centred genre students' considered education as an individual endeavour.

> Excerpt 3: A synchronous exchange of utterances, taken from the online seminar.
>
> 12. TEACHER (09:46:27): What do you think?
>
> 13 Kristen (09:47:55): hum. I believe that some people are conservative and have problems with new lines of thought…
>
> 14. TEACHER (09:48:16): and the rest of you?
>
> 15. Charlene (09:48:21): From my point of view the teacher must adapt to the learner's needs. For good and bad.
>
> 16. Marcus (09:48:23): interesting, I think the idea of competence is a given winner. It is all about finding new forms of assessment, not merely starting with how it works today.
>
> 17. Kristen (09:48:35):…then it is hard to use the available resources.
>
> 18. TEACHER (09:49:06): in general, how much time has a teacher for each student?

The emergence of these two different genres of communication in the studied online course reveals a problem for designing educational communication through online tools. The involved agents had different assumptions on human action that influenced their approach to communication and collaboration. These assumptions interplayed with the predetermined design of the online course. In this course it consisted of a well-considered design in so far as the teachers worked out a detailed plan of the course before the introduction of the course, including study-guides that describe tasks, assessments, tools, supposed communication and so on. However, if we believe that learning relates to the social aspects of the environment such as communication, design problems appear if we discuss design of online courses in terms of learning environments. If participation is defined as being performed in an online learning environment, the emergence of different genres reveals the problems of linking that particular learning environment to a preferred result of learning; for example, in terms of how particular features in the learning environment lead to a particular learning result. As this illustration shows education is more complex than thinking in these terms. The empirical data reveals a complex view of actions in the online course. Aspects from students' social life and physical aspects of the environment extensively influence their actions in the online course. Therefore, aspects linked to both the educational organiser and the student are important for understanding why these two different genres emerged in the online course. These aspects could not be separated as in the case of discussing the performance of communication in terms of learning environments. Instead, education embraces interplay of different aspects.

Conclusion

In this paper human action, such as participation in computer-mediated communication, has been put under scrutiny. The investigation emphasised the ontological assumptions of two different approaches, interactional and transactional. The consequences for conceptualising online education were discussed.

To summarise: the message of this paper is that interactional approaches to online education face ontological challenges from transactional approaches. These challenges have their roots in how to understand the relation between human action and the environment. Interactional approaches emphasises a dualistic understanding of this relation. This understanding has subsequent consequences for participating in online education. Use of interactional concepts such as learning environment in the research and design of online education neglects problems related to the dualistic position of human action. Interactional approaches offer an individualistic view of human action where human beings are separated from the surrounding environment, including other humans. It also separates communication from cultural, ecological, historical, and social features of human life. This leads to understandings of online education that are open to critique from transactional approaches.

The focus of this transactional critique, as developed in this paper, emphasises differences in the understanding of how to relate both online and offline features of the environment to aspects of communication and technology. From a transactional approach online education is a boundless activity that needs to incorporate aspects of both online and offline character. Therefore, communication and technology needs to be understood in terms of being an aspect of this activity. This activity embraces that human actions, communication, and tools belongs to a common whole. An understanding of each of these aspects could only exist in the light of the other aspects.

From this it follows that conceptualisations of online education need to embrace suitable concepts that emphasises this character of being boundless. Such conceptualisation can comprise concepts such as agents, computer-mediated communication and tools. A common feature of these concepts is that they center "on the individual's ongoing transaction with meaningful features of the environment" (Heft, 2001, p. 7). Such conceptualisation should underwrite the idea that "the reciprocity of the environment and the person, is a central feature" (Heft, 2001, p. 7).

These concepts should therefore simultaneously relate to human action, and the environment. However, such concepts with a transactional character, for example CMC and tools are used in interactional approaches. Nevertheless, the logic of using these concepts in such approaches to design and research online education is unclear. While de-emphasising offline features of the environment interactional conceptualisations of online education face ontological problems of how to relate human action to communication and technologies. The use of concepts such as CMC and tools did not solve that problem. The ontological status of human action in general and participation in computer-mediated communication in particular is still unclear in such approaches. The transactional approaches offer a solution to these ontological problems. Since these approaches emphasises both offline and online aspects of the environment they seem to be more suitable to support a coherent conceptualisation of online education. Therefore, transactional approaches benefit a clearer understanding of online education than interactional approaches. This understanding could be utilised by designers and researchers of online education.

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COMBINATION OF EDUCATION TECHNOLOGIES FOR THE ENHANCEMENT OF AN ASYNCHRONOUS SYSTEM

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Abstract

In this paper we will present an asynchronous educational system, with navel point an enhanced form of Webcast. This enhanced Webcast form is broadcasted through a webpage, which has been appropriately modulated with Hypertext, Java-Applets and Internet services and application such as forum, portals, e-libraries, blogs, etc. This combination of technological tools will be implemented according to the modern learning theories and the didactical rules of each teaching material. So, we will have greater efficiency of the asynchronous system.

Introduction

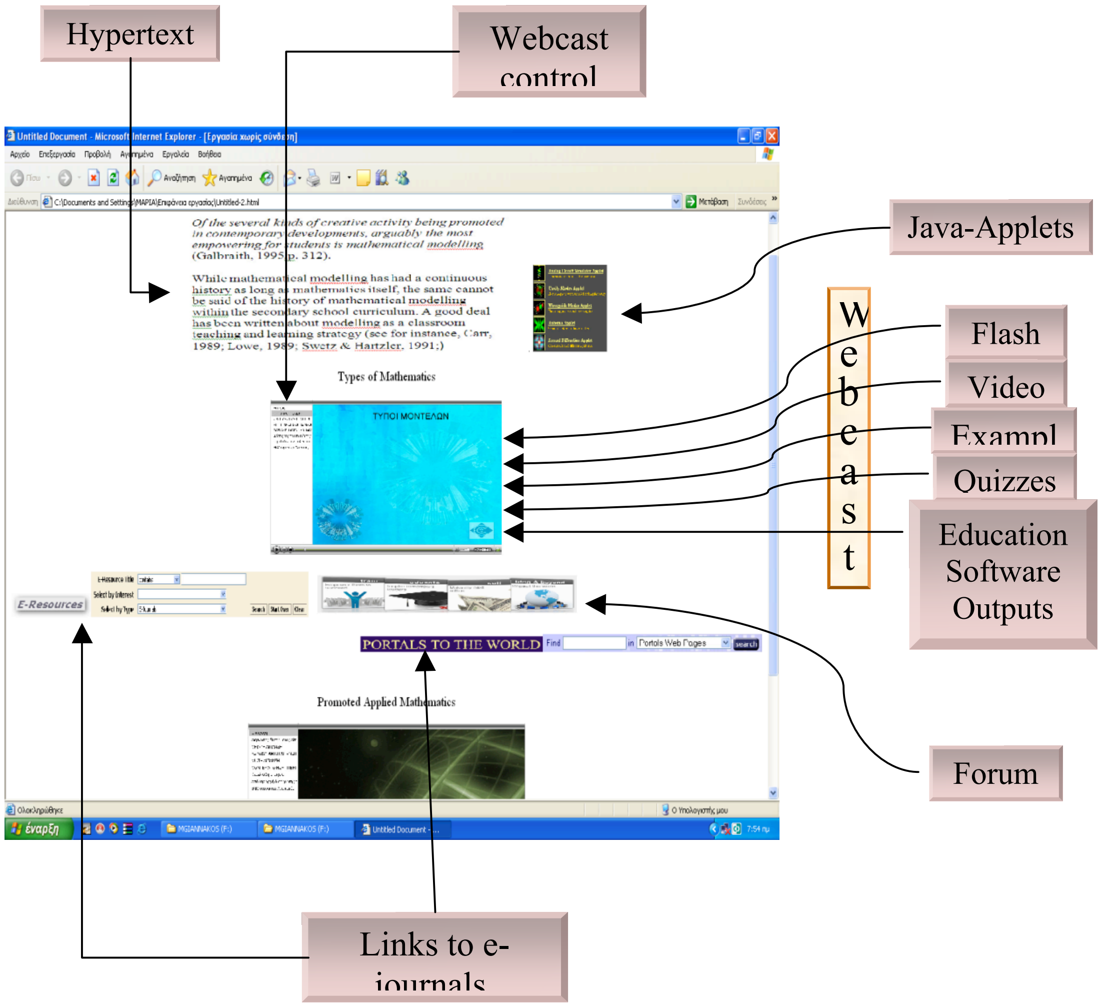
In the 21st century, long distance education is developing with great rhythms. An element of this development is the mass amount of software and systems (e-class) that have been produced for education purposes. The media that has been produced can in several occasions be proven (Gillies, 2003) as useful tools so for the teacher and also for the student. By combining technologies such as Flash, Java-Applets, portals, e-journals, e-libraries and educational software (Baralis, Malafekas, Rappos, & Vlamos, 2000), in the context of creating Webcast and on a webpage, on which we will incorporate the Webcast, we make the system friendlier and more efficient.

System Presentation

As we have mentioned our system consists of a webpage, with navel point an enhanced Webcast and at the same time it will have other capabilities, like Java applications, connections on the Web in selected applications and services. By looking at the interface (Figure 1) we can easily see the format that our system will have.

As we can see clearly from our figure (Figure 1), the system will be user friendly (Arkün & Akkoyunlu, 2008); it doesn't require any special computer skills from the user. We also suggest that the study of this educational material be linear, exactly like the creator has designed it. Of course, the system isn't restricted only to the study of the material the Webcast provides, because of the other media that are been utilised, mainly through the Web.

Figure 1: System's Interface



Research for the Didactical Needs of the Educational Material

The first step we should undertake is to select the material that we are going to teach with the Webcast. Then we should elaborate the particularities and the needs of this material (mathematics, need for representation) and find the methods that will enable us to cover these needs (Bruner, 1960).

Furthermore, the creation (of the educational material) that we present is based on the modern aspects of Discovery Learning, the theory of constructivism and on features from the theories (Cobb, Von Glasersfeld, & Steffe, 1988) about the use of the computer as a cognitive tool or a mind tool.

Research on the Students

To increase the Webcast's efficiency the student group that the Webcast applies to, should be a cohesive group. Furthermore, the conduction of a research on the "a priori" knowledge, experiences and the cognitive structures of the students would help to specify the problems they are facing and could help the creation of the material (Deliyannis, Floros, Vlamos, & Tsiridou, 2008) and this would result to an efficiency increase on the particular student group.

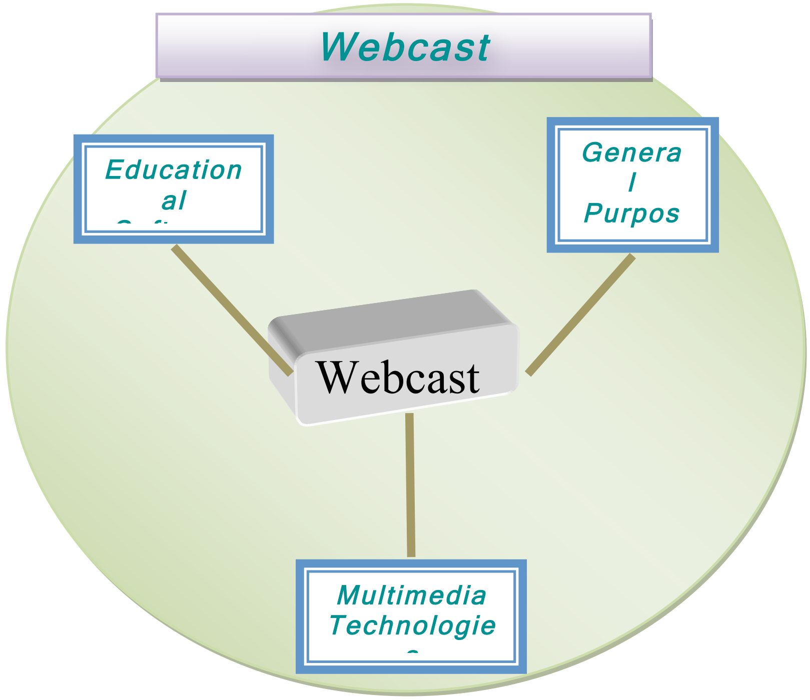
Webcast Creation

The core of our system is the Webcast and so we will start the implementation with its creation, which will revolve on the educational needs, as they have been studied in the previous step.

Webcast Enhancement

With the creation of a primary from of Webcast we must choose and implement the applications that we are going to inset into it. This can easily be accomplished when the application form is compatible with the Webcast (Fly, Awf, Avi, etc.) and the incorporation can be easily achieved with an image processing programme or a Webcast creation programme. If the form is not compatible we can use a Screen Capture programme, although this fact is rare to occur because most Webcast creation programmes have the ability to incorporate almost all the applications on the Webcast. In the case we have created interactive material we have to pay attention to the Webcast's final form so it will also support interactiveness (Fly, Swf). To facilitate us during the Webcast enhancement we created three categories, in which we have divided the technological tools that contribute to the enhancement (Figure 2).

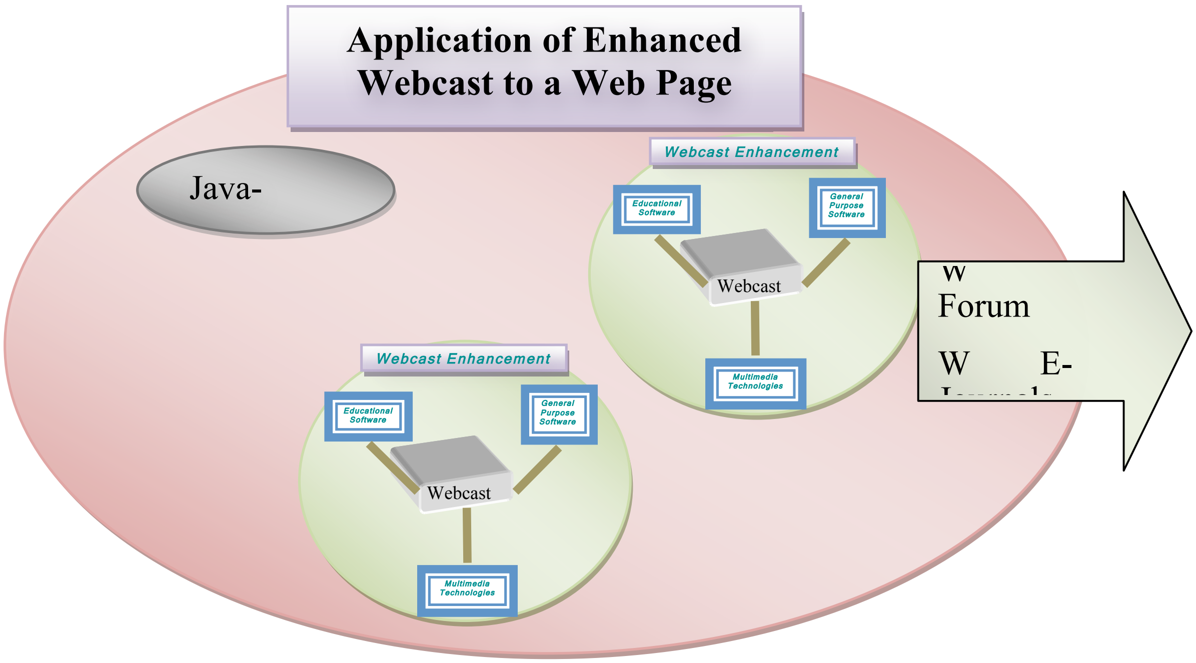
Figure 2: Webcast Enhancement



Application of Enhanced Webcast to a Web Page

After we create the enhanced forms of Webcast, we will create a Web Page, which will broadcast the Webcast and guide the student's study and comprehension of the material through the pre-selected Java applications and the instructive Hypertext. In addition, the internet applications (e-libraries, e-journals, blogs, forums) provide the student with the ability to study further more, to communicate and discuss on subjects referring to the Webcast material**.** Below we can see the schematic representation of the introduction of enhanced Webcast to the Web Page.

Figure 3: Application of Enhanced Webcast to a Web Page

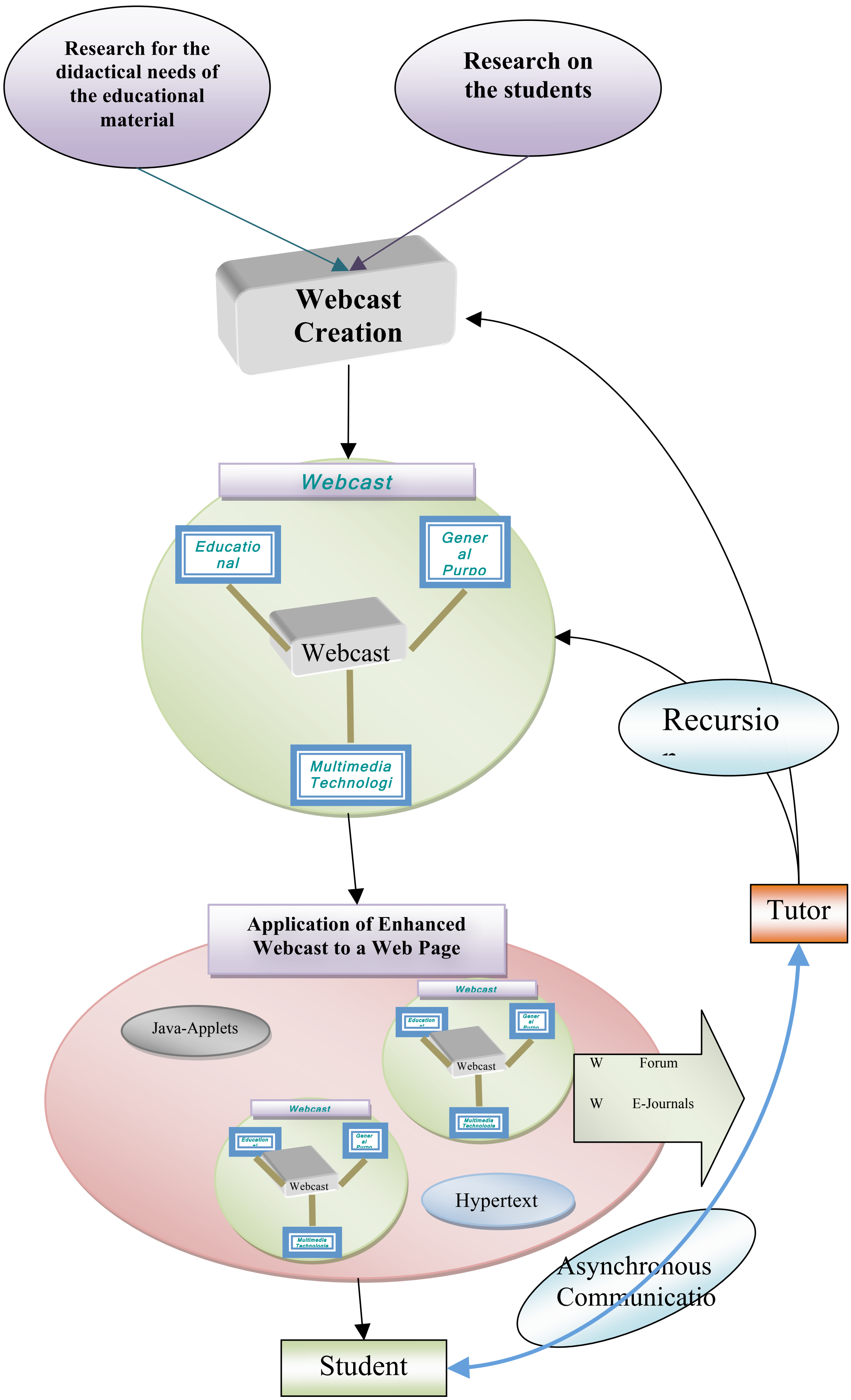


Integrated System

We have analysed all the creation steps of the recommended system. Now, we will see all of them in one structure, in which can distinguish the steps of creation and also the role that the tutor plays on the smooth functioning and the life of the system. This system has been applied for the case study of mathematical modelling procedures. We have used it in order to demonstrate who to construct Webcasts in various applications, more specifically in Bioinformatics (Panayotopoulos & Vlamos, 2008), Thermodynamics (Kontogeorgis, Vlamos, & Bilchev, 1999), Reaction-Diffusion Processes (Vlamos, 2003) and Heat Conduction (Vlamos, 1999).

As we can see the system is supplied with information about the teaching material and the group we aim to watch the Webcast. Then, having this information in mind a primary form of Webcast is created (Giannakos, 2008). At the next step the Webcast is being enhanced with the multimedia application. We then apply the Webcast to the specially modulated Web Page, from where the student uses the material and also has an asynchronous communication with the tutor. Then the tutor in his turn, with this asynchronous communication with the student receives information about the success or failure of the material; and with this way the material by usage can be improved and become better.

Figure 4: Integrated System



Conclusion

Our objective with this project is to present a new form of technological material, which by combining the potentials of many technological tools it will offer new possibilities in this department. The form of this technological material is at the evaluation phase and the earliest results have shown positive elements in regard to the acceptance point from the students. This primary form of this educational material is considered to be used as the base for a future improved edition, which will try to cover some of the needs in education.

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