USING ONLINE RESOURCES TO IMPROVE STUDENT OUTCOMES IN A LEVEL 4 CONSTRUCTION TECHNOLOGY UNIT

Verity Bird
Southampton Solent University
United Kingdom

Abstract

With a wide range of students, many from non-traditional backgrounds, it is important both to establish good study habits and embed the understanding of construction principles that students will require to function effectively in a work environment. Our virtual learning environment can support a wide range of resources. Online electronic quizzes provide a means of reinforcing learning at regular intervals and the effects of engagement can be measured. The ability to produce videos of construction processes that can be accessed via the web gives us the opportunity to bring the building site into the classroom and site the classroom anywhere.

Introduction

Southampton Solent University is one of the newer universities in the Higher Education sector in the UK. As such, our emphasis tends more towards learning and teaching; employability, alongside with widening participation, is a core element within the University's strategic vision.

Students within the Built Environment programme come from a wide range of educational backgrounds. While a proportion would be classified as traditional university students, we typically have a significant proportion of students from non-traditional backgrounds.

In addition to our full time degree courses, we run a suite of two-year, part-time Higher National Certificate (HNC) courses. These courses are designed, where possible, to lead seamlessly into the third year of our five-year, part-time degree pathways so students can either finish with an HNC, or remain with us and top this up to honours degree level.

This paper explores how online resources, in the form of quizzes used for both formative and summative assessment, and video podcasts currently in development may be used to broaden the student's learning experience by bringing the building site into the classroom, and deepen learning experiences through cycles of review and reflection, thereby improving student knowledge, understanding and ability to apply the construction technology in practical, workplace-based contexts.

Background and Rationale

The construction technology element forms half of a first-year, 20-credit point unit. The unit has been running for six years in its present form. The subject is a core one for Architectural Technology (degree and HNC), Construction Management (degree and HNC), Building Surveying (HNC) and Quantity Surveying (HNC); the ability to apply the principles of construction technology will be essential at a professional level for students progressing into a career in any of these areas. From an employability perspective, therefore, successfully engaging with the activity in this unit is essential to all our students.

Our part-time students come from a diverse range of mainly construction related backgrounds. Some are early-career, future professionals, funded by their employers. These students are generally relatively inexperienced and frequently from non-traditional backgrounds in higher education. A proportion of the part-time students will be actively employed in practice, seeking to up-skill with a view to professional progression. Some of this group will be mature students, some entering higher education for the first time; others will already have related qualifications and be seeking a change of career. Each year within particularly the construction management HNC there will be a few students with a long experience of construction at a very practical level (as bricklayers, joiners, etc.) who have decided that the time has come to leave active site work and move into a management role in construction industry. This group generally have a very sound perspective of the process of construction, with minimal experience academically.

Considering the students' prior experience, some will bring in reasonable academic habits but have a little prior knowledge of the subject area; at the opposite end of the scale others may have many years experience of construction work and minimal academic skills. They tend to have a thorough knowledge of *how* buildings are constructed, but their appreciation of *why* things are done in a particular way, and why it might be necessary to understand this, may be much less highly developed. There is also the group in the middle of this who have not yet developed good habits academically, whose knowledge of construction is also minimal and whose motivation to study is not all that might be desired. One of the functions of the unit is to bring all the students up to a reasonable level to form a sound foundation for their second year.

There are two learning outcomes within the syllabus, the first is surface orientated recognition and memorising, the second requires much higher-level skills in applying construction technology:

- Identify the key elements of dwellings and low-rise industrial buildings.
- Apply various construction technologies to different building designs.

Implicit between these is a third outcome, which is not directly stated:

- Understand the relationships between the key elements of the relevant building types.

The unit is taught as six groups of four lectures and two tutorials each covering a specific area of the construction of houses and low-rise industrial buildings:

- General structural principles
- Ground conditions and foundations
- Walls
- Floors
- Roofs
- Smaller elements (stairs, windows, doors, etc.)

The assessment for the unit was designed to be a single, large assignment with a final hand in, giving students little motivation to engage with it as the unit progressed; various alternatives were explored before the present regime, combining staged formative submissions, and in unit revision quizzes were deployed.

Literature Review

The Nature of Students from Non-Traditional Backgrounds

Prosser and Trigwell (1999) raise an aspect of the deep versus surface approach that is seldom addressed in textbooks relating to learning in higher education. Entwhistle, Meyer, and Tait, (1991) discuss this as follows:

> Among the failing students, however, the expected pattern does not materialise. The first two factors represent bizarre and uninterpretable combinations of loadings. The first factor is particularly strange in that it is defined in terms of high positive loadings on all four of the orientations, in spite of the fact that two are essentially the converse of the others. The second factor makes more sense in relation to the orientations, showing reproducing associated negatively with meaning, but that is then linked to both deep and surface facets of lectures and examinations.

Entwhistle et al. (1991) characterise this third set of approaches as ‘disintegrated’ and the students are simply ‘failing’, that is unable to succeed in the higher education environment. However, with our diverse range of student backgrounds at Southampton Solent University it is likely that it is an issue that affects particularly students from non-traditional backgrounds. One of the gaps that all our teaching design should aim to bridge is that between the disintegrated learner and students exhibiting approaches more characteristic of typical university students.

Much of the emphasis in Prosser and Trigwell (1999) concerns the needs of the student in terms of his or her prior experience of education and educational objectives. It is worth also considering the changing nature of the student cohort, especially taking account of widening participation in access to university.

Design for learning as discussed in Beetham (2007) develops the concept of learning design in relation to the use of digital resources specifically, emphasising that specific approaches to learning should be aligned with different types of subject area.

Biggs and Tang (2007) discuss the difference between educational technology and information technology. The danger of the 'information technology' approach is that it could be perceived as leading to a surface-oriented, quantitative increase in knowledge approach (as in Prosser & Trigwell, 1999), whereas effective use of any resource or activity, including online, should be designed to encourage abstraction of meaning and understanding reality – which characterises a deep approach. It is interesting to note how the language differs between the educational writers touching on the role of technology (Biggs & Tang, 2007), compared to Salmon's perspective (2002) derived from her involvement in an almost entirely virtual community of learning.

Design for Learning

Like any other learning activity, to be effective, e-resources embedded into any learning programme should be one element in the entirety of the programme. Constructive alignment of intended outcomes, the learning environment and assessment practice is widely recognised as key to effective learning and teaching (Biggs & Tang, 2007). If learning is to be considered effective, learners need to change what they do – in relation to how they might approach a situation or a series of problems, for example. To achieve this, there needs to be cycles of engaging with what students know and what they are prepared to develop, between specific details and wider contexts, between practical experience and reflection (Harvey & Knight, 1996). Salmon (2004) continually re-emphasises the key point that learning is not about the content that is 'delivered' to learners by means of teaching. It is what the learners do in constructing their own knowledge base that makes the learning happen.

Learning activities should reinforce approaches that encourage a deep engagement with the subject rather than surface approaches, according to Ramsden (1992) (as cited in Prosser & Trigwell, 1999). Deep learning approaches are associated with high level learning outcomes, such as inferring meaning (as in our second learning outcome), whereas surface approaches are linked to giving rise to lower level outcomes like memorising or basic increase of knowledge (Biggs & Tang 2007; Prosser & Trigwell 1999) as in our first learning outcome.

Higher Education Funding Council for England [HEFCE] (2009) discusses the design of the cyclical learning process as a series of interrelated stages, starting with the design of courses, programmes or modules of learning. This is the level at which the integration of blended approaches may be initiated. The curriculum is then broken down to lesson or session sized elements in a consideration of delivery and assessment, and below that, the tasks or learning activities, which are the things the learner will be doing in the session. The learning objects, reusable items of digital content (e.g., PowerPoints, podcasts,

etc.), will be developed, ideally, in a learner-centred approach, by the learners in developing their own understanding.

Kolb's (1984) model of experiential learning is widely accepted as the key to developing an effective learning experience. Lectures provide the theoretical underpinning to the subject, tutorials an activity addressing an aspect in more depth. This would be the sum of traditional delivery, leaving the concrete experience and reflective stages up to the learner. The approach works for the traditional learner, but increasingly, fewer students fall within this category. Embedding video and podcasts to add an extra dimension and clarity to conceptualisations of construction that may be relatively difficult to grasp, may be one of the simplest ways to provide practical experience. This is particularly the case where it is difficult to involve students directly, as in construction, where access to building sites is necessarily limited because of health and safety concerns. Furthermore, the use of online quizzes to encourage the student to revisit, revise and reflect on the subject forms the final link in the experiential learning loop and should, in consequence, result in a deeper and more effective learning experience.

Medium Term Use and Outcomes of Online Resources

Using Online Quizzes as a Learning Tool

For the first three years in the delivery of the unit, the final tutorial session was a revision quiz covering the whole syllabus, delivered via a PowerPoint presentation and marked in class. The marks were noted, but not used in assessment. Staff delivering the unit recognised that this could form a useful assessment tool and in 2009/10 an online quiz was introduced as 40% of the assessment for the construction technology half of the unit (Bird, 2011).

Development and Nature of Electronic Quizzes

Quiz development is geared primarily to assessing the simpler learning outcome (identification of elements) and the implicit outcome of understanding their relationships. During the course of this development, it became evident that the variety of formats of questions available within our Moodle based VLE could offer, not just a simple and (after the initial setting up) quick means of assessment, but a surprisingly sophisticated tool that could be utilised to reinforce the learning process as the unit developed, testing not just the students' ability to recognise and name different elements in the construction, but also to apply considerably higher level skills in generating responses from a scenario provided (see Figure 1).

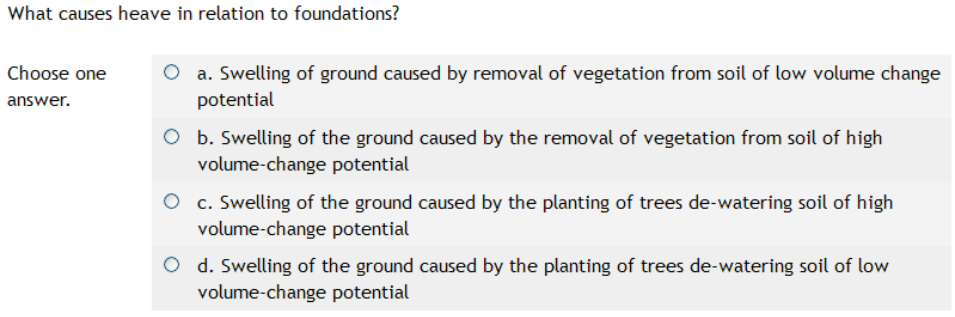

Figure 1. Example question from the final assessed quiz.

To answer this question the student needs to understand that heave is the swelling of soil caused by an increase in water content, that water content increases when vegetation is removed because prior to removal the vegetation would utilise the water in the soil, and that some soils are highly prone to changes in volume and others are not.

Students are widely aware that a 'traditional' multiple-choice test in a paper-based format may be relatively easy to approach in a strategic manner, utilising a combination of probability and a moderate knowledge of the subject matter to achieve a reasonable mark. The electronic quiz is considerably more sophisticated than this. A simple example is that the computer can shuffle the answers, so the correct answer is randomly distributed among the alternatives. As well as multiple-choice, single-answer questions it is possible to include multiple-choice questions where students have to choose 'at least one' answer, so each correct element will give them *part* of the full marks for the question. These questions can be set up so that incorrect answers cancel out correct ones, so the student has to select all the correct options and none of the incorrect ones to get the full marks for the question.

The quizzes also contain matching questions, where the student has to match a name to a description or to a labelled element in an image. The final question type is a question where the student has to enter the name of an element, or, for example a typical dimension (e.g., Q: maximum distance between movement joints in brickwork; A: 15m).

With this range of question types it would be very difficult to achieve even a 40% pass mark with only a superficial, surface-level understanding of the construction under consideration.

Using the Quiz to Reinforce Learning

The quiz has been used, not just for final summative assessment but also as a learning activity to help students engage with the subject material in a structured way as the unit delivery progresses. At the completion of each topic, a short quiz relating to that topic is made available to the students for a limited period. The quiz can be attempted at any time of day or night to suit the student's convenience and the mark and formative feedback is provided as soon as the attempt has been submitted. The student can see immediately which questions they have got right and wrong, but they are not told the correct answers; the feedback gives advice regarding areas that the students need to study further.

The formative quizzes have relatively few questions (10 to 20), especially the early ones, and quite a long duration. Typically in the early stages they will have to be completed within 40 minutes; a student who knows the subject material will be able to achieve a good mark in five to ten minutes.

Throughout the formative stage the quizzes are open book – the students may consult any resources they wish to in completing the quiz. By reading around the subject to find the correct responses to questions the student will be

engaging with a wide range of information, whether this is done as the quiz progresses, or as a revision process between attempts.

However, having observed how young people approach online quizzes on the internet, it was decided to have a gap of several hours (initially 6, but now typically 3 hours) between quiz attempts during which time students can go back over lecture notes and read up on the subject.

Student Outcomes from Participating in Formative Quizzes

At the end of the first year of using online quizzes both formatively and summatively, a review was carried out of the effectiveness of participation in improving student outcomes.

Within a cohort of 129 students, 11 did not sit the final, summative quiz. Figure 2 shows clearly the positive relationship between formative quiz participation and students' final summative outcomes.

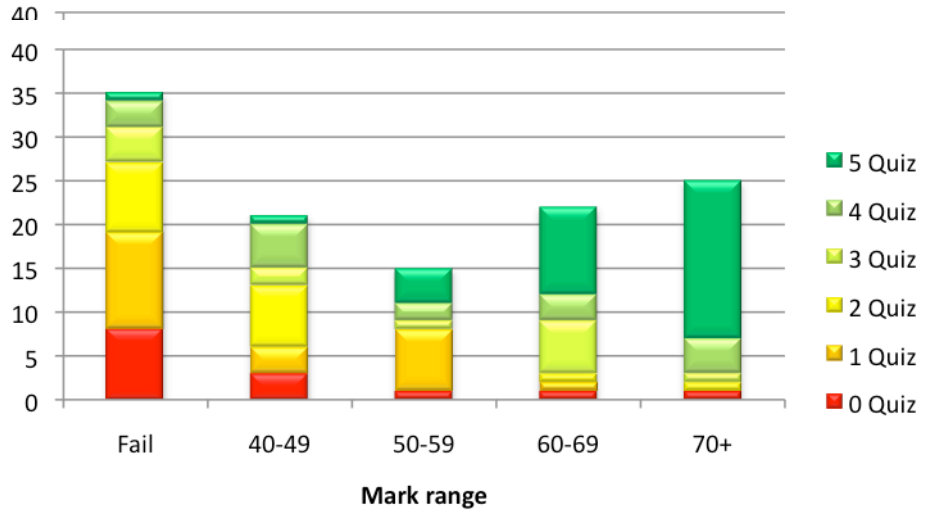

Figure 2. Relationship of participation in formative quizzes to final mark.

A comparative exercise was also carried out to evaluate how students' final marks varied relative to their average formative mark. It was evident, though unsurprising, that participating in more of the formative quizzes gives a more accurate prediction of the student's probable final score. It is more interesting to note that higher participation rates appear to indicate a significantly greater likelihood that any given students' final score will be higher than their formative average.

The availability of these statistics was invaluable in persuading students in the slightly smaller 2010/11 cohort to participate in the formative quizzes. 95 students were active in some form as the unit progressed; 88 did the initial summative quiz and 10 failed (11%, compared to 27% in 2009/10). Levels of participation were significantly higher than in 2009/10, with 76% of students completing 4 or more quizzes and 64% of these scoring 60% or higher in the final summative quiz (compared to 36% the previous year).

What is of greater interest is that evaluating the overall results for the construction technology element of the unit, including the quiz result and the written assignment, of the 32 students scoring above 60% for the subject as a whole only one had completed fewer than 4 quizzes; of the 27 with marks 49% or less, only five had done four or more quizzes. This strongly suggests that participation in the quizzes generates a significantly deeper level of learning than might be expected.

Paul Catley's PowerPoint (2008) discusses the outcomes of a study investigating this point that suggests that there is a clear positive correlation between students' participation in early quizzes, and their marks across not just the unit assessed, but across the year as a whole. While there is not, as yet, clear evidence that this is the case with the construction technology quizzes, it will be useful at the end of this year to correlate outcomes longitudinally of the first cohort to make use of the quizzes.

Student Responses to Use of Quizzes

Each year students are asked to feed back anonymously to the university about how effective they consider each unit has been. Student comments relating to the quizzes from 2010/11 were:

- "The quizzes for construction technology are very useful."
- "It was well organised and gave us the knowledge we needed to complete the assignments and the final quiz."
- "The theory side to the unit is good and the learning resources on mycourse are helpful."
- "The quizzes are helpful but need to be reviewed as the answer methods are not very effective. This final quiz needs to be marked by a person as well as the computer."

There were no comments about the quizzes in the section about how the unit could be improved.

It would be useful to be able to explore the final comment in more depth with the respondent to find out what aspects they find ineffective. This may be in part a reference to the obligation, for the short answer questions, to ensure that the response is correctly spelled. Before the results of the final summative quiz are released to the students the responses are reviewed to ensure that all correct answers will receive the correct marks.

It is useful to note that the comments are all on the positive side, with even the criticism being a qualification of a positive comment, rather than a negative in itself.

New Initiatives

While quizzes show very strong indications of being an effective way to reinforce and deepen learning and teaching at this level, improving the level of understanding of basic construction and recognition of the components; closing the 'concrete experience' section of Kolb's (1984) loop remains a challenge.

During this academic year it has become possible to develop some learning resources to back up the classroom teaching, by modelling constructions using Google Sketchup, a readily-available, free-to-download three dimensional modelling tool. By combining the modelling of components and constructions and recording the assembly of these with a voice-over commentary it is possible to give a good sense of how a particular construction is built up. This can be combined with a recording of a PowerPoint with voice-over if required. In one instance trial was carried out recapping the subject of the previous lecture with a short video (around four minutes) instead of the usual PowerPoint with vocal presentation.

While it is too early to evaluate the long term beneficial effects in the context of this subject area, an anonymous questionnaire completed by 60 students demonstrated considerable enthusiasm for this kind of teaching tool, especially if computer models could be seen in relation to actual construction.

Conclusion

Many students today are much more computer-savvy than previous generations. Learning habits of students from a much wider range of backgrounds than the 'traditional' university student are different from those expected in a 'traditional' learning environment.

While issues of pedagogy, the constructive alignment of teaching, learning activities and assessment, has to remain at the core of all design for learning, the availability of electronic resources can give course designers a new range of approaches which may appeal to our increasingly diverse audience. The positive reaction of students to the online quizzes as a fast and easy means of reinforcing learning and their positive response to the proposal of a wider range of video resources suggests this is indeed the case. There is considerable research demonstrating that the thoughtful inclusion of appropriate e-resources, aligned to the intended learning outcomes and the level of the students involved, when combined into a fully considered programme, can enrich the learning experience and, at the same time, facilitate delivery, and assessment, for the teaching team. While the quizzes take some time to set up, once questions are created they can be re-used and/or edited as required. Marking and feedback are automated, though it is necessary to review responses to ensure that there are no anomalous answers. The length and consequent marking load of the written aspects of the assignment are also reduced, as a consequence, to the benefit of both student and teacher.

The two JISC studies (HEFCE, 2009 and 2010) demonstrate the range of e-resources and associated approaches available to enrich students' learning experiences. It is evident, however, that embedding e-resources in a programme must arise out of a considered reflection on the students needs and prior experience, alongside the learning objectives of the course and the particular unit. E-resources cannot be a 'magic bullet' to engage the uninterested, however appropriately and skilfully used, they can add a dimension of added diversity, accessibility and availability.

Taking this alongside the evidence from the quiz results and Catley's (2008) study confirms that students benefit from the provision of new kinds of learning resources that encourage continual development as the course progresses. Furthermore, feedback from the students confirms that they appreciate the resources, finding them both useful and helpful.

References

Beetham, H. (2007). An approach to learning activity design. In H. Beetham & R. Sharpe (Eds.), *Rethinking pedagogy for a digital age*, (pp. 26-39). Abingdon: Routledge.

Biggs, J., & Tang, C. 2007; *Teaching for quality learning at university* (3rd ed.). Maidenhead: Open University Press.

Bird, V. (2011). Using e-learning resources to 'level the playing field' between traditional and non-traditional learners. *Access and retention: Experiences of non-traditional learners in higher education* (p. 5). Seville, Spain: University of Seville. Retrieved from www.ranlhe.dsw.edu.pl/files/Bird.pdf

Catley, P. (2008). *Online formative assessment: Does it work?* Retrieved from www.ukcle.ac.uk/resources/assessment-and-feedback/online-formative-assessment/

Entwhistle, N. J., Meyer, J.H.F., & Tait, H. (1991). Student failure: Disintegrated patterns of study strategies and perceptions of learning environments. *Higher Education*, *21*(2), 246-61.

Harvey, L., & Knight, P. (1996). *Transforming higher education.* Buckingham: Society for Research in Higher Education and Open University Press.

Higher Education Funding Council for England (HEFCE). (2009). *Effective practice in a digital age*. Retrieved from JISC, http://www.jisc.ac.uk

Higher Education Funding Council for England (HEFCE). (2010). *Effective assessment in a digital age*. Retrieved from JISC, http://www.jisc.ac.uk

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall.

Prosser, M., & Trigwell. K. (1999). *Understanding learning and teaching*. Maidenhead: Open University Press.

Salmon, G. (2004). *E-moderating: The key to teaching and learning online* (2nd ed.). London: Routledge Falmer.

Salmon, G. (2002). *E-tivities: The key to active online learning*. London: Routledge Falmer.