TEACHERS' DIGITAL COMPETENCE IN UPPER SECONDARY SCHOOL: (WORK IN PROGRESS)

Rune Krumsvik and Lise Jones
University of Bergen
Norway

Abstract

The SMILE study presents the results from one of the largest ICT studies in secondary school in Norway, of 17,529 students and 2, 524 teachers. In addition, school owners, school leaders, student council and the Norwegian Student Organization are represented. The study focuses on how school owners and school leaders exercise leadership and how teachers teach and students learn in technology-dense classrooms in the seven counties in the Eastern Norway County Network. It also focuses on how the national curriculum (LK06) has changed some of the underlying premises of school leadership, teaching and learning in secondary schools. This has been important to explore; as a result of a very good technology density in Norwegian classrooms (1:1), students' digital lifestyle, and the national curriculum's focus on digital tools as the fifth basic skill in all subjects, from first to third grade (6-19 year). The main objective of the study was therefore to investigate the implementation of ICT, teachers' educational use of ICT and student learning outcomes when ICT is used, and to develop primary and secondary indicators for learning when ICT is used. The study is based on a mixed method design, and this paper has a special focus on teachers' digital competence and the coherence between a theoretical model and empirical testing of this model. The results show that there is coherence between the theoretical model and the empirical findings. However, further research is needed to validate these preliminary findings.

Keywords: ICT; teachers; digital competence; upper secondary school

Introduction

This SMILE-study is carried out on request from The Norwegian Association of Local and Regional Authorities (KS) and Eastern Norway County Network and presents its results. The SMILE-study is one of the largest ICT studies in secondary school in Norway of 17, 529 students and 2, 524 teachers and was undertaken in the period 2012-2013 in seven counties in Norwegian upper secondary schools. The study focuses on how school owners and school leaders exercise leadership, how teachers teach and students learn in technology-dense classrooms in these counties, and on whether the national curriculum (LK06) has changed some of the underlying premises of school leadership, teaching and learning in upper secondary schools. This has been important to explore because of a very good technology density in Norwegian classrooms (1:1), students' digital lifestyle, and the national curriculum's focus on digital competence as the fifth basic skill in all subjects, from first to third grade (6-19 year). The main objective of this paper is to focus on a part of the SMILE-study attached to teachers' digital competence. In this part of

the project we wanted to test a theoretical model of digital competence empirically. The study is based on a mixed method design, and the research question is: What is the relationship between a theoretical model of digital competence and empirically findings and how consistent is this relationship?

Conceptual Framework

A range of studies, both nationally and internationally, show that teachers still only to a small extent integrate ICT in their own classroom teaching (ITU Monitor, 2009; Bauer & Kenton, 2005), and the National Center for Education Statistics (NCES) found that only half of the teachers who had access to PC and Internet used this in their teaching (Judson, 2006). It seems that one main reason for this situation is the lack of necessary digital literacy among teachers. Internationally, a number of important contributions have been made to the definition of ***digital literacy*** in recent years. Lanham (1995), Gilster (1997), Tyner (1998), Knobel (1999), Lankshear and Knobel (2003), and Buckingham (2003, 2006) in particular have made contributions to the concepts of computer literacy, media literacy, and digital literacy. Other important contributions have focussed more specifically on teachers' ICT competence. Christensen and Knezek's Will, Skill, Tool (WST) - model is one such promising attempt, according to which the teacher's will (attitude), skill level (technology competency), and access to technology tools are vital elements when integrating ICT into teaching (Christensen & Knezek, 2008). One assumption that is shared by the different positions dealing with digital literacy and ICT competence is that teachers' digital competence is more complex than digital literacy in other occupations and among average citizens (Hooper & Rieber, 1995; Egeberg et al., 2012). Krumsvik (2012) suggested a model of digital competence model for teachers and pupils developed on the basis of empirical research in the Norwegian *context* in the period 2004-2012, which has been used as underpinning for the instruments in this SMILE-study. At the same time one has to be aware of that different ICT-policies in different countries influence our perception of how to define digital literacy based on its attachment to curricula. So, "(…) Context is not always everything, but it colors everything" (Pajares 2006, p. 342) and the Norwegian context will be specially considered in this paper. Since the SMILE-study has a special focus towards digital competence, we will elaborate this in the following section.

This requires an awareness of this complexity of digital competence, and the way in which teachers carry out and experience the pedagogical use of ICT will very often depend on their high or low digital competence. However, recent studies indicate some confusion around what actually digital competence means for teachers and pupils when it comes to their everyday practise. What is digital competence in school contexts and what is digital competence in society in general? Is it the same? These are often questions raised by teachers in today's digital era were pupils' digital lifestyles in their spare time merge together with their actions in school. We know from teacher education that ICT is often perceived only as a tool that can be handled with elementary ICT skills (Tømte, Hovdhaugen, & Solum, 2009). And both in teacher education and in school there seem to be a confusion and discrepancy between the concepts *basic ICT skills* (which is similar to OECD's term ***key***

competencies - which means decisive for learning and development and attached to the national curricula in school) and *elementary ICT skills* (which means a simple, first step of ICT skills). Ottesen and Møller (2010) found that this mismatch is common among teachers in school—especially concerning digital skills. There seems to be some of the same confusion among students, and in the SMILE-study we have chosen to elaborate this more in depth.

To incorporate the implications this situation and context will have for individual teachers' digital competence, we suggest a definition that describes the digital competence of teachers': "Digital competence is the individual teacher proficiency in using ICT in school with good pedagogical judgement and his/her awareness of its implications for learning strategies and the digital Bildung of students (Krumsvik 2012, p. 466). This definition is attached to a visual model (Figure 1) of teachers' digital competence. We will elaborate the theoretical underpinnings of the model in the section below.

Today there is a need to link macro, meso, and micro levels within our understanding of teacher' digital competence. Hence, we will reduce the complexity in this varied area by focussing on what are considered the most important parameters to understand digital competence for teachers. My digital competence model is based on my own and others' research and theories and is an attempt to categorise the most important parameters within digital competence for teachers. Categorising happens with the identification of typical traits of phenomena, and two conditions are considered the basis for making categories. These are common traits in objects or phenomena and differences to objects or phenomena from contrasting figures (Rosch, 1978). The consequence is that we develop prototypes as a kind of compromise, and this digital competence model is an attempt at this. The prototypes are made explicit and hence given a label. The categories "high" and "low" in the model belong to what Rosch (1978) calls the "superordinate level," the superior level of the category. At the "basic level" we find the prototypes we perceive as "high" or "low," often personified in a "competent teacher" or "incompetent teacher," while the more explicit distinctive marks of high and low competence belong to the "subordinate level" of the category. In the model we can see that "high" is synonymous with high self-awareness and high practical proficiency (localised in the two axes) and the synthesis of the four levels in the centre of the model (digital Bildung), that in turn are described as the digitally competent teacher. These thus become Rosch's (1978) "subordinate level," while the popular descriptions at the subordinate level are built based on experiences with digitally competent teachers as common traits, and differences from others are identified.

According to Hacking (1999), categories are, like in this model, socially constructed, but these kinds of categories also affect practice. The establishment of "low digital competence" as a category in which researcher-identified traits belong can affect how teachers in this category are treated, for example, given more resources for further in-service education in digital competence. The categories in this model have been developed as descriptions of a phenomenon from my own and others' research of practice, but the category also has implications for teachers' actions, which in turn can

challenge the category and inspire adjusted or new categories (Hacking, 1999). As Hacking (1999) underlines, categorisation and use of categories are useful both in terms of cognition and communication, in institutions, and for setting the basis for development of theory. This digital competence model is therefore inspired by a semantic conception of theories (Suppe, 1977, 1989; Giere, 1979). This means that theories are not intended to correspond with reality directly. However, semantic conceptions of theories still have their origin in practice and can be used to understand practice, as this model is intended for. It can be used as a lens to analyse teachers' digital competence. As a consequence of this, the objective of the theoretical underpinning for this digital competence model is not to describe a phenomenon of digital competence with all its complexity. Rather, it was developed to characterise digital competence phenomena for teachers' by means of selected parameters. This kind of digital competence model therefore presents abstractions of the parameters that are seen as most relevant to understand a phenomenon of digital competence in school. A consequence of selection is that parameters descriptive of the phenomenon are not represented in the theory (Kvernbekk, 2005). In the development of this kind of model based on a semantic theory perspective, I am forced to select out substantially more than I select in. The parameters in the model are therefore the building blocks of the underlying theory perspective.

Though this kind of semantic theory perspective that underpins this digital competence model is inspired by practice, it still describes more abstract systems (Kvernbekk, 2005). Suppe (1977, 1989) points to the contra-factual relationship between theory and practice, which means that theory does not characterise actual phenomena, but describes what the phenomenon would have been if the selected categories were the only ones with influence. The solution, according to Kvernbekk (2005), is to be aware of what parameter or category is selected and what consequences this has for the validity and the underlying theory perspective.

With these premises as a backdrop, I will in the following section describe the model in depth. Particularly important in this model is the intersection between a "mental digital competence journey" (self-awareness, vertical axis) and a "practical competence journey" (proficiency, horizontal axis). The theoretical foundations of this model were inspired by Apple Classroom of Tomorrow (ACOT) (Dwyer et al. 1991), distributed cognition (Hutchins, 1995) and situated learning (Lave & Wenger, 1991). The essence of the model is that cognitive processes are continuously offloaded to digital artefacts when we are using computers, and that this kind of learning is situated everywhere in today's digitised society. In this way, the computer becomes an "intellectual prosthesis" for each and every one of us because we have access to technology anywhere, at any time.

This "competence journey" begins with the teachers being relatively unaware (*adoption*) of what they can or cannot do in relation to ICT but gradually becoming more aware and reaching the different stages of *adaptation*, *appropriation*, and *innovation* over time (some teachers can of course be placed directly into the model at the appropriation stage, for example, because

they already are quite digital competent). This takes time for novices (several years) and is a great challenge for teachers; the majority have never been taught (in their own teacher education) how to achieve such digital competence, and it has not been a natural part of their professional development. In addition, even if psychological obstacles such as technophobia and scepticism have decreased among teachers the last decade, we still find some tendencies of this documented through Egeberg et al. (2012) and Krumsvik et al. (2011). However, this seems to be gradually fading away as a barrier in teacher education, as in school.

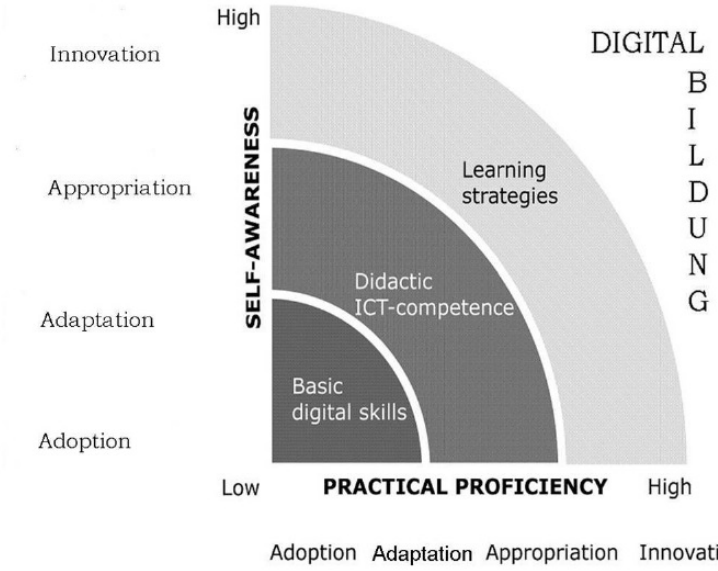

Figure 1. Teachers' digital competence (Krumsvik, 2007; Krumsvik, 2012).

This "mental" part of the model has to go hand in hand with the "practical competence journey" (proficiency, horizontal axis), which consists of *adoption*, *adaptation*, *appropriation* and *innovation*. This often becomes the explicit part of the *tacit knowledge*, *know-how*, and *awareness* that are acquired throughout the "mental competence journey." In the first part of this process (adoption and, to an extent, adaptation, on the horizontal axis), the teachers' are mostly occupied with elementary ICT-skills and basic ICT skills and overcoming the obstacles that have previously prevented them from handling ICT artefacts. At this stage, ICT artefacts are not immediately comprehensible to the teacher, and the importance of overcoming this stage is obvious. Even if this stage presents a struggle for many teachers, in comparison with 10 years ago, these technological thresholds are considerably lower. This is a result of more user-friendly technology, decreased technophobia, and the more frequent use by teachers (like other citizens) of ICT outside of schools in their spare time. In the SMILE-study we found that 32.6% of the teachers (N=2,524) had a screen time (use of laptops, IPAD's, PC, Mobilephone, TV, etc.) of 4-6 hours and 27.2% had 6-10 hours per day. This indicates that teachers' usage is considerably higher than for few years ago, and that they are handling their elementary ICT-skills in a good way.

Therefore, the first significant obstacle occurs during the appropriation phase (third phase, horizontal axis). This particular phase presumes that the teacher has solid basic ICT skills as a premise for "recognising" the value of the "invisibility" of ICT in subjects. According to Lave and Wenger (1991),

> Invisibility of mediating technologies is necessary for allowing focus on, and thus supporting visibility of, the subject matter. Conversely, visibility of the significance of the technology is necessary for allowing its unproblematic – invisible – use. (p. 103)

This can be related to Kirschner, Martens, and Strijbos' (2004) concept of *real affordance*, which means that teachers are able to recognize and utilize the technology's potential in an optimal way in teaching, while *perceived affordances* is often related to teachers' inability to recognize and utilize the technology's potential in teaching. The pedagogic implications of this are that the teachers have reached the stage of recognizing the real affordances and are permitted to use their professional competence and authority in a way that is not interrupted by technical obstacles or form over content. Some case studies have shown that when teachers in school reach the point where ICT is clearly understandable to them, they more easily recognise the potential to acquire a broader view of knowledge (Krumsvik, 2006a, b; 2008a, b).

Until now, I have focussed on the two axes of the model—the vertical axis, which is tied to teachers' self-awareness, and the horizontal axis, which relates to teachers' proficiency. Focusing on the centre of the model, we can see that teachers distinguish themselves from other technology users by their focus on the pedagogical use of ICT for education and instruction rather than entertainment, social communication, etc. In relation to teachers' qualifications, didactic ICT competence (related to the pedagogical use of ICT, in the middle of the model) stands in the centre. The crux of this is that the teachers have to possess a double dimension as an important part of this didactic ICT competence in teacher education. This means that teachers will, in one way or another, be role models for the students with regard to the didactic and pedagogical use of ICT. To "teach as they preach" will be an important guiding star for the students. At the same time, the teachers must continually make didactic judgements that focus on how ICT can expand the learning possibilities for students. This double dimension involves didactic ICT competence, which is similar to other occupations, but distinguishes itself because teachers are preparing students for both a certification in school (summative assessment, exams) and a future practice in the society.

The next part of teachers' digital competence is the focus on the digital learning strategies that are required for their own professional development as teachers, as well as for being able to guide the students towards achieving new learning strategies through the use of ICT. The point here is that the teachers have the necessary digital competence to guide and to be a mentor for the students in the physical classroom as well as in the virtual classrooms. This implies that the teachers must utilise the students' basic digital skills as a starting point, but must also maintain a strong focus on the metacognitive

aspect, which enables students to delve deeper into the pedagogical use of ICT as an entry point for developing new learning strategies.

The final part of teachers' digital competence is linked to ethical considerations with regard to the use of ICT and digital Bildung. For today's upper secondary students in Norway (the majority are between 16 and 19 years old), the network society, the media, and technology are important building blocks in their Bildung journey, as they are digital inhabitants. This, of course, has an impact on how schools should meet and utilise this new reality positively, even if many teachers are digital immigrants and have witnessed the difficulties of weaving technology constructively into their teaching. In many ways, the context of school has changed radically over the last decade, but at the same time, we can see that teachers all over the world are fumbling in their response to this development, remaining static and protected against technology, even if the students are surrounded by technology in their leisure time. School leaders and teachers should therefore utilise this situation positively in regard to the pedagogical use of ICT, but at the same time, should establish debates and reflections on the ethical pitfalls of the use of technology. Such ethical considerations, pitfalls, and dilemmas include for example how students' digital lifestyles affect how they communicate with each other (face-to-face versus virtual communication), how we can use social media positively in school and at the same time be aware of the ethical pitfalls among pupils (e.g., digital bullying, etc.), and how ethical dilemmas attached to assessment (e.g., "cut and paste") can be tackled before they become a problem for certain pupils.

To conclude, the model (Figure 1) is grounded on a semantic conception of theories that imply that it cannot correspond directly with the reality (practice), but it is inspired by practice and aims to understand digital competence in school on an abstract level.

Methodology

The SMILE-study is based on *mixed methods research*. The study used both qualitative and quantitative data as basis for data collection and analyses. Qualitative and quantitative data were collected in sequences, and it was an important goal to give equal emphasis to both types of data and combine them in the analyses. In this paper we only present quantitative data since the focus and the research question is directed towards the development of a digital literacy scale.

The sample was based on *purposeful selection* (Maxwell, 2005) and data from the survey among all teachers from all public high schools in the seven counties in Eastern Norway County Network (N=2,524) for teacher sample.

Analyses

The quantitative part of the research questions aims to investigate whether there is a relation between a theoretical model of teachers' digital competence and the empirical findings. The statistical analyses were carried out in this way. Six of the questions measuring different types of digital competence

were factor analysed to reveal possible common factors for a digital competence index. An exploratory factor analysis was chosen, as it was a newly developed scale. The questions in the index were then analysed for their internal consistency by means of Cronbach's alpha. To interpret effect sizes Cohen's guidelines were used. A correlations coefficient of .10 is considered to represent a small correlation whereas a correlation of .30 is considered medium and correlations above .50 as large (Cohen 1964). To analyse whether the teachers' age, work experience, screen- time or ICT-education could predict digital competence regression analyses were completed. All statistical analyses were conducted in SPSS version 20.

Results

The factor analysis was conducted with an oblimin rotation, as this allows the factors to be correlated (Russell 2002). The six questions came out as one factor explaining over 60 percent of the variance. The digital index includes how teachers perceive own digital competence, elementary ICT skills, basic ICT skills, subject related ICT skills, digital learning strategies and their overall digital competence. Together the index represent a mean of these five types of skills on a scale ranging from 1 to 7 where 1= no skills and 7= very good skills. A Cronbach's alpha value of .86 indicates that internal consistency of the digital competence index is high. Table 1 gives an overview over mean scores and standard deviation for digital competence related to gender, work- experience and the teachers' age. As can be seen, women have a higher mean score of digital competence than men. Teachers with over 15 years of work experience have the lowest mean score of digital competence. Digital competence drops for teachers 49 years and older.

Table 1

Teachers' Digital Competence, Gender, Work Experience And Age

Digital Competence		
	Mean	Standard Deviation
Gender*		
Men	5.0	0.93
Women	5.2	0.83
Work experience*		
3 years or shorter	5.1	0.77
3-7 years	5.2	0.82
7-15 years	5.3	0.87
15 år or more	5.0	0.93
Age*		
20-31 years	5.3	0.79
32-37 years	5.3	0.76
38-43 years	5.3	0.79
44-49 years	5.3	0.82
50-55 years	5.2	0.86
56-61 years	5.0	0.88
Over 61 years	4.8	0.91

Note.* p< .00.

In Table 2 we see that teachers' formal ICT-education impacts their level of digital competence. Teachers with the longest formal ICT-education are those with the highest level of digital competence.

Table 2

Teachers' Digital Competence and Type of ICT Education

Digital Competence		
	Mean	Standard Deviation
Formal ICT-education*		
No formal ICT-education	5.0	0.85
Inntil 5 vekttall/15 studiepoeng	5.3	0.81
5-10 vekttall/15-30 studiepoeng	5.4	0.84
10-20 vekttall/30-60 studiepoeng	5.7	0.79
Etterutdanning in ICT*		
Yes	5.4	0.85
No	5.0	0.86

Note.* p< .00.

In Table 3, we see how the digital competence varies with teachers' screen-time. Teachers with low screen-time are those with the lowest digital competence. The digital competence rises with a rise in screen-time. However, the digital competence does not rise among teachers with a screen-time between 10-12 hours day.

Table 3

Teachers' Screen-Time and Digital Competence

Digital competence		
Screen-Time*	Mean	Standard Deviation
0-2 hours	4.6	1.09
2-4 hours	4.9	0.86
4-6 hours	5.1	0.78
6-8 hours	5.3	0.80
8-10 hours	5.5	0.82
10-12 hours	5.7	0.81
12-14 hours	5.6	0.77
14-16 hours	5.3	1.30
Over 16 hours	5.5	1.09

Note.* p< .00.

In the regression analysis in Table 4 we find that screen-time and formal ICT-education are the two variables that most explain teachers' digital competence, statistically. Age is number three and is negative; meaning that rise in age reduces the digital competence when the other variables are controlled for. Teachers with in-service ICT- education have higher digital competence when all others variables are controlled for.

Table 4

Regression Analyses of Teachers' Digital Competence

Variable	Digital competence	
	B	Beta
Age	-0.08*	-0.16
Work experience	-0.02	-0.03
Screen-time	0.14*	0.22
Formal ICT-education	0.18*	0.21
Etterutdanning i ICT	0.27*	0.13
R^2	0.174	

Conclusion

The main objective of this paper was to focus on a part of the SMILE-study attached to teachers' digital competence. In this part of the project we wanted to test a theoretical model of digital competence empirically. The research question in this paper was: What is the relationship between a theoretical model of digital competence and empirically findings and how consistent is this relationship? The factor analysis was conducted with an oblimin rotation, as this allows the factors to be correlated (Russell 2002). The six questions came out as one factor explaining over 60 percent of the variance. The digital index includes how teachers perceive own digital competence, elementary ICT skills, basic ICT skills, subject related ICT skills, digital learning strategies and their overall digital competence. Together the index represent a mean of these five types of skills on a scale ranging from 1 to 7 where 1= no skills and 7= very good skills. A Cronbach's alpha value of .86 indicates that internal consistency of the digital competence index is high. This shows that there is coherence between the theoretical model and the empirical findings. However, further research is needed to validate these preliminary findings.

References

Bauer, J., & Kenton, J. (2005). Toward technology integration in the schools: Why it isn't happening. *Journal of Technology and Teacher Education,* 13 (4), 519-546.

Buckingham, D. (2003). *Media education: Literacy, learning and contemporary culture.* Cambridge: Polity Press.

Buckingham, D. (2006). Defining digital literacy – What do young people need to know about digital media? *Digital kompetanse* [Nordic Journal of Digital Literacy], *1*(4), 263-276.

Christensen, R., & Knezek, G. (2008). The importance of information technology attitudes and competencies in primary and secondary education. In J. Voogt, & G. Knezek, G. (Eds.), *International handbook of information technology in primary and secondary education* (pp. 321-331). New York: Springer.

Creswell, J. W. (2003). *Research design - Qualitative, quantitative and mixed methods approaches.* Thousand Oak, CA: Sage Publications.

Cohen, J. (1969). *Statistical power analysis for the behavioral sciences*. NY: Academic Press.

Dwyer, D. C., Ringstaff, C., & Sandholtz, J. H. (1991). Changes in teachers' beliefs and practices in technology-rich classrooms. Educational *Leadership*, *8* (48), 45–52.

Egeberg, G., Guðmundsdóttir, G. B., Hatlevik, O. E., Ottestad, G., Haug, J. H., & Tømte, K. (2012). *Monitor 2011. Skolens digitale tilstand*. Oslo: Unipub.

Erstad, O. (2009). Addressing the complexity of impact — A multilevel approach towards ICT in education. In F. Scheuermann & F. Pedró, (Eds.), *Assessing the effects of ICT in education* (pp. 21-38). Luxembourg: Publications Office of the European Union.

European Commission. (2013). *European Survey of Schools: ICT in Education.* Retrieved from https://ec.europa.eu/digital-agenda/en/survey-schools-ict-education. Brussel: European Commision.

Gilster, P. (1997). *Digital literacy*. New York: Wiley Computer.

Giere, R. N. (1979). *Understanding scientific reasoning*. New York: Holt, Reinhart and Winston.

GSI. (2011). *Grunnskolen Informasjon System 2011. IKT. Elever pr. PC*. Oslo: GSI.

Hacking, I. (1999). *The social construction of what?* Cambridge, MA and London: Harvard University Press.

Hooper, S., & Rieber, L. P. (1995). Teaching with technology. In A. C. Ornstein (Ed.),*Teaching: Theory into practice* (pp. 154-170). Needham Heights, MA: Allyn and Bacon.

Hutchins, E. (1995). *Cognition in the wild*. New York: MIT Press.

ITU Monitor (2009). *Skolens digitale tilstand.* Oslo: ITU, University of Oslo.

Johnson, R. B., & Turner, L. A. (2003). Data collection strategies in mixed methods research. In A. Tashakkori, & C. Teddlie (Eds.). *Handbook of mixed methods in social and behavioral research* (pp. 297-319). Thousand Oaks, CA: Sage.

Johnson, R. B., & Onwuegbuzie, J. A. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33* (7),14-26.

Johnson, R. B., Onwuegbuzie, A.J., & Turner, L. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research*, *1* (2), 112-133.

Judson, E. (2006). How teachers integrate technology and their beliefs about learning: Is there a connection? *Journal of Technology and Teacher Education*, *14*(3), 581-597.

Kirschner, P. A., Martens, R. L., & Strijbos, J. W. (2004). CSCL in higher education? A framework for designing multiple collaborative environments. In P. Dillenbourg (Series Ed.) & J. -W. Strijbos, P. A. Kirschner, & R. L. Martens (Vol. Eds.), *Computer-supported collaborative learning: Vol. 3. What we know about CSCL: And implementing it in Higher Education.* Boston, MA: Kluwer Academic Publishers.

Knobel, M. (1999). *Everyday literacies – Students, discourses and social practice*. New York: Peter Lang.

Krumsvik, R. (2006a). *ICT in the school. ICT-initiated school development in lower secondary school*. Doktorgradsavhandling, Dr. Philos-graden. Universitetet i Bergen.

Krumsvik, R. (2006b). The digital challenges of school and teacher education in Norway: Some urgent questions and the search for answers. *Education and Information Technologies, 3-4*(11), 239-256.

Krumsvik, R. (Ed.) (2007). *Skulen og den digitale læringsrevolusjon* [The school and the digital learning revolution; in Norwegian]. Oslo: Universitetsforlaget.

Krumsvik, R. (2008a). The emerging digital literacy among teachers in Norway (The story of one digital literate teacher). In R. Kobayashi (Ed.), *New educational technology* (pp. 105-125). New York: Nova Science.

Krumsvik, R. (2008b). Situated learning and digital competence. *Education and Information Technology*, *4*(13), 279-290.

Krumsvik, R., Westrheim, K., Sunde, E. & Langørgen. K. (2012). Teach as we preach: Lærerutdannerens digitale kompetanse. *Högre utbildning,* 2(2), 107-122.

Krumsvik, R. J., Ludvigsen, K., & Urke, H. B. (2011). *Klasseleiing i vidaregåande opplæring* (DLC-rapport nr. 1/2011). Bergen: University of Bergen.

Krumsvik, R. J. (2012). Teacher educators' digital competence. *Scandinavian Journal of Educational Research*, *1* (12), I first article. DOI:10.1080/00313831.2012.726273

Kunnskapsdepartementet [Ministry of Knowledge, MOK]. (2006). *Læreplanverket for Kunnskapsløftet (LK 06)* [National Curriculum for Knowledge Promotion in Primary and Secondary Education and Training (LK 06)] [Online] Available from: http://www.regjeringen.no/en/dep/kd/Selected-topics/andre/Knowledge-Promotion.html?id=1411 [Accessed 8th October 2008].

Kunnskapsdepartementet (2008). *Kvalitet i skolen. St.mld. nr. 31 (2007-2008).* Oslo: Statens forvaltningstjeneste.

Kunnskapsdepartementet (2011). *Motivasjon – Mestring – Muligheter. Ungdomstrinnet. Stortingsmelding nr. 22 (2010-2011).* Oslo: Statens Forvaltningstjeneste.

Kvernbekk, T. (2005). *Pedagogisk Teoridannelse. Insidere, teoriformer og praksis*. Bergen: Fagbokforlaget.

Lanham, R. (1995). Digital literacy. *Scientific American*, *273*(3), 160-161.

Lankshear, C., & Knobel, M. (2003). *New Literacies : Changing knowledge and classroom learning*. Buckingham: Open University Press.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Leech, N. L., & Onwuegbuzie, A. J. (2009). A typology of mixed methods research designs. Quality & Quantity. *International Journal of Methodology, 43* (2), 265-275.

Maxwell, J. A. (2005). *Qualitative research design: An interactive approach*. London. Sage Publications.

Merriam, S. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass Publishers.

Ottesen, E., & Møller, J. (2010). *Underveis, men i svært ulikt tempo: et blikk inn i ti skoler etter tre år med Kunnskapsløftet.* Delrapport 3.

Underveisanalyse av Kunnskapsløftet som styringsform (Vol. 37/2010). Oslo: NIFU STEP

Pajares, F. (2006) Self-efficacy during childhood and adolescence – Implications for teacher and parents. In F. Pajares, & T. Urdan (Eds.). *Self-efficacy beliefs of adolescents.* Greenwich, CT: Information Age Publishing

Plano Clark, V. L., & Creswell, J. W. (2008). *The mixed methods reader*. Thousand Oaks, CA: Sage Publications.

Rosch, E. (1978). *Cognition and categorization*. Lawrence Erlbaum Associates.

Suppe, F. (Ed.). (1977). *The structure of scientific theories*. Urbana, IL: University of Illinois Press.

Suppe, F. (1989). *The semantic conception of theories and scientific realism.* Urbana, IL: University of Illinois Press.

Tashakkori, A., & Creswell, J. W. (2007). Editorial: Exploring the nature of research questions in mixed methods research. *Journal of Mixed Methods Research*, *1*(3), 207-211.

Tyner, K. (1998). *Literacy in a digital world: Teaching and learning in the age of information*. New Jersey: Lawrence Erlbaum Associates.

Utdannings- og forskningsdepartementet (UFD). (2003b). *Program for digital kompetanse 2004-2008*. Oslo: Statens Forvaltningsteneste.

Utdanningsdirektoratet. (2011). *Gratis læremidler i videregående opplæring*. Oslo: Utdanningsdirektoratet. Retrieved from http://www.udir.no/Regelverk/Tilskudd/Laremidler/Gratis-laremidler-i-videregaende-opplaring/

Utdanningsdirektoratet. (2011-2012). *Grunnskolens Informasjonssystem (2011-2012).* Retrieved from http://www.udir.no/Upload/ Statistikk/GSI/GSI_2011_2012_notat.pdf? epslanguage=no

Utdanningsdirektorartet. (2012). *Rammeverk for grunnleggende ferdigheter. Til bruk for læreplangrupper oppnevnt av Utdanningsdirektoratet*. Retrieved from, http://www.udir.no/Upload/larerplaner/lareplangrupper/RAMMEVERK_grf_2012.pdf

Van de Ven, A. H. (2007). *Engaged scholarship: A guide for organizational and social research*. Oxford: Oxford University Press.

Author Details

Rune Johan Krumsvik
Rune.Krumsvik@psych.uib.no

Lise Øen Jones
Lise.Jones@uib.no