Facing Challenges with New Teachers' Use of ICT in Teaching and Learning

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Abstract— **This paper outlines challenges that today's teacher education is facing. Information and communication technology holds a central position in today's society posing also demands for today's schools and teachers. Teachers need skills and pedagogical models to be able to take advantage of various information and communication technologies for supporting their students' learning at schools and also outside of schools. Teachers ought to be able to provide their students with the skills for the 21st century. In order to meet these challenges, this paper introduces a longitudinal research plan with preliminary results, where the aim is to explore and support the development of new teachers' use of technology in pedagogically meaningful ways. Also, the aim of this paper is to introduce our aims and ideas for researchers and designers with similar interests.**

Index Terms— **Educational institutions, Educational technology, Student experiments, Teacher training**

I. Introduction

School education has been criticized for focusing on irrelevant skills and knowledge and ignoring the demands of today's world. Today's world has been described as a knowledge society, referring to the fast development of information and communication technologies (ICT) and associated practices [1]. In order to prepare students for this knowledge society they should be provided with what are called skills for the 21thst century. These skills refer to abilities such as critical thinking, collaboration and skills to use different information and communication technologies [2].

From this perspective the use of ICT for teaching and learning along with collaborative pedagogies can be seen very well justified. Also, an ongoing discussion that addresses the characteristics of today's student generation can be seen as adding to the importance of bringing ICT into teaching and learning.

Digital Natives and the Use of ICT in Learning

Today's students have been described as digital natives and net generation [3], [4]. The assumption is that these students have automatically gained skills to use ICT as they have grown up in the knowledge society. Tapscott [4] assumes that the net generation students are ready and willing to study with ICT and that they also prefer discovery-based and collaborative learning practices. Prensky [3] criticizes today's schools and teachers as immigrants in the digital world, suggesting that teachers are using outdated language and methods in their work. He presents that we have to change teaching methods or wait for digital native students to do it by themselves as they grow up "*So unless we want to just forget about educating Digital Natives until they grow up and do it themselves, we had better confront this issue" (p. 3)*.

This idea is tempting but also challenging because in addition to the great expectations there are also doubts concerning today's students. For example, Bennet et al. [5] argue that assumptions concerning the net generation are not based on academic research but rather on authors' everyday observations. Also, it has been argued that even though the net generation students have better readiness to use ICT than the previous generation they still do not know how to use ICT in their learning [6].

In the light of the discussion concerning knowledge society, 21st century skills and net generation, today's schools would do well to place emphasis on using ICT in teaching and learning. In Finland, measures have been taken in an official level as can be seen in the national strategies and curriculums highlighting the role of the ICT in teaching and learning. ICT should be used as part of everyday school work in all school levels from kindergarten to higher education. However, the use of ICT in teaching and learning in Finnish schools is less frequent than expected. Despite the success in PISA studies, Finnish teachers and schools are far behind in the use of technology in classrooms compared to that of several other countries [7].

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Teachers' Beliefs and Skills of Using ICT in Teaching

Recent studies indicate that traditional teaching beliefs that teachers and students hold have a negative influence on the use of ICT in classrooms [8],[9]. This suggests that we should focus on teachers' and teacher students' beliefs of teaching in order to enhance the use of ICT in classrooms. Based on the results of the report, Finnish teacher students may even today graduate without adequate skills for using ICT for teaching and learning [10]. This sets demands for the very teacher education that ought to be regarded as the pioneer in the use of new technology in teaching and research. So far, even the required infrastructure is behind the schools which usually are better embedded with new technology. At the same time, the Finnish National Board of Education and local education administrators are putting pressure on teacher education to better prepare beginning teachers to use technology in teaching.

Technological Pedagogical Content Knowledge

Use of ICT for teaching and learning from teachers' perspective has been studied widely using different theoretical backgrounds. One often referred framework is the technological pedagogical content knowledge (TPACK) model introduced by Koehler and Mishra [11]. TPACK is an extension of the pedagogical content knowledge model by Shulman [12]. According to Koehler and Mishra [11], teachers need knowledge about technology, pedagogy and content in order to successfully support students' learning with ICT. TPACK implies knowledge that extends beyond the three areas. It denotes teacher's ability to combine these areas in order to build and organise environments and situations that facilitate and support students' learning. With technological pedagogical content knowledge teachers are able to utilise a range of ICT to support students' learning. These can be for example students' personal devices such as laptops, tablet computers and smart phones, various online and physical environments and classroom devices such as interactive white boards.

In a review study, Voogt et al. [13] looked at fifty-five TPACK studies and brought up six different types of studies using the TPACK framework: 1) studies focusing on the development of TPACK as a concept; 2) understanding TPACK in subject specific domains; 3) views on technological knowledge; 4) TPACK related to teachers' beliefs; 5) studies measuring TPACK; and 6) strategies for supporting the development of TPACK. From our point of view, the category 'strategies for supporting the development of TPACK' is central. It is important to find ways to support the development of new teachers' TPACK in order to provide them with skills to meet the need of the 21st century. Even though teacher students can be seen as the net generation, we believe that they have to be provided with support and training for developing their abilities to use ICT in pedagogically meaningful ways for teaching and learning.

In the following chapter we present our research and development project which aims to develop teacher education and the use of ICT in teaching and learning in a way that teacher students are better provided with skills required in today's schools.

II. Research and Development Work within Teacher Education

The challenges described above have been noticed at the Department of Teacher Education in the University of Eastern Finland. All the teacher students from kindergarten level to adult education level have obligatory courses which especially focus on the use of ICTs in teaching and learning. Courses contain shared lectures and seminars for teacher students in two campuses supported with practices where students are instructed to design and accomplish lessons that utilize technology and collaborative learning approaches. The aim is to support teacher students to learn to use ICT in teaching and learning in authentic contexts. In addition, the administration of the University is widely encouraging the university teachers to use ICT in their teaching. In this way, we can provide teacher students authentic experiences of pedagogically sound ways about how to use ICT for teaching and learning. Instead of treating ICT as its own and separated subject the aim is to embed ICT in everyday practices. Also, the students who own a smartphone and/or a laptop, are encouraged to use their own devices in their university studies. This way they can have experiences of using their own devices for learning purposes. This is one way to encourage them to think creatively and in what ways their everyday devices can be useful for learning, too.

Three Research Units: Use of ICT before, during and after University Studies

This development work provides interesting opportunities for research focusing on the development of teacher students' skills and attitudes toward the use of ICT. At the moment, we are designing a longitudinal study consisting of three sub-research units using the TPACK model as the main theoretical framework. The first unit focuses on teacher students' use of technology at their previous academic education path and in their non-academic activities. The aim is to outline starting points and background factors where students start to build their TPACK. Research data will be collected using online questionnaires and essay writings. The second research unit continues through the university studies, where the aim is to outline students' use of technology in their university studies and the development of students' TPACK. This unit focuses on the effects of obligatory ICT courses and also the use of ICT during other courses and studies as well as during their teacher training in schools. We will investigate how the experiences of, for example, using wiki-environments as part of biology courses affect teacher students' TPACK and their attitude toward the use of ICT in teaching and learning. During their studies in the university, students will go through several courses were the role of ICT is emphasized as the use of ICT in teaching has been highlighted by the administration of the University. Several different courses with different ICT will be used as case studies that provide possibilities to gather students' experiences of the ICT for learning. ICT used can vary from personal devices such as, for example, iPads to social software and interactive white boards. Also, data will be collected during teacher students' training periods in schools. Teacher students using of ICT in their own teaching will be

observed. Data collected from the courses and training periods will be added to the data from the first research unit. The goal is that the research database will cumulate during the university studies so that at the end of the studies there will be large profiles of each student's TPACK development. This will provide ample material to study the factors related to the development of TPACK. During the second research unit, the data will be collected with a questionnaire, interviews and observations, also the contents produced by students during different courses will be used as research data. This data provides a starting point for the last research unit i.e. the use of technology in their first years as a teacher at school.

The aim of this third part is to provide insight into how the knowledge and attitudes gained in the university studies meets the reality in schools: How new teachers can carry out their ideas and aims of using ICT for their work, how the practices in schools affect newcomers' work and how can a novice teacher influence school's practices. Altogether, this longitudinal study will work as a frame for the research work to be carried out within our department. This frame will contain several smaller studies focusing on different aspects of the development of teacher students' TPACK from novice to the expert. The longitudinal study will take from 8 to 9 years and provide possibilities for researchers but also for students to be part of the research and development work. Students are encouraged to participate in the research by providing them an active role in the research projects (project works, master theses etc.), which might enhance them to improve their teaching practice by developing and studying their own teaching and students' learning (lifelong learning) and even encourage them to continue with doctoral studies.

Teacher Students' Experiences and Ideas on the Use of ICT before Their University Studies

This longitudinal research project is on its early stage. So far, we have collected data in order to gain a preview of our new students' ideas and experiences of ICT in education to outline the starting points for their studies. Based on essays by first year teacher students (n = 149) the results suggest that teacher students have rather limited ideas about using ICT for teaching and learning. Either ICT is mentioned on a very common level i.e. using computers for teaching without any specification, or then ICT is seen mainly as teachers' tool. Students usually bring up ICT as a tool for lecturing type of teaching, such as data projectors and PowerPoint software. ICT for students' use is in a minor role, for example social software and games [14]. Also, students seem to rarely see the possibilities for using ICT to connect school learning to outside school authentic learning contexts. These results suggest that despite the suggestions by Prensky [3], we cannot merely wait that net generation students grow up and fix all the challenges related to today's education and ICT. Instead, we have to provide students with inspiring and motivating experiences of how to use ICT in pedagogically meaningful ways for supporting learning during their teacher education at the university.

REFERENCES

[1] P. Sahlberg, "Rethinking accountability in a knowledge society," *Journal of Educational Change*, vol. 11, pp. 45–61, 2010.

[2] M. Binkley, O. Erstad, J. Herman, S. Raizen, M. Ripley, and M. Rumble, "Defining 21st century skills." *Assessment and Teaching of 21st Century Skills project draft.* White Papers. (2010). Available: http://atc21s.org/wp-content/uploads/2011/11/1-Defining-21st-Century-Skills.pdf

[3] M. Prensky, "Digital Natives, Digital Immigrants," *On the Horizon,* vol. 9, pp. 1–6, 2001.

[4] D. Tapscott, *Grown Up Digital: How the Net Generation is Changing your World*. New York: McGraw-Hill, 2008.

[5] S. Bennett, K. Maton, and L. Kervin, "The 'digital natives' debate: A critical review of the evidence," *British Journal of Educational Technology,* vol. 39, pp.775–786, 2008.

[6] T. Valtonen, S. Pöntinen, J. Kukkonen, P. Dillon, P. Väisänen, and S. Hacklin, "Confronting the technological pedagogical knowledge of Finnish net generation student teachers," *Technology, Pedagogy and Education*, vol. 20, pp. 1–16, 2011.

[7] M. Kankaanranta, and E. Puhakka, *Kohti innovatiivista tietotekniikan opetuskäyttöä – Kansainvälisen SITES 2006 -tutkimuksen tuloksia*. Finnish Institute for Educational Research, University of Jyväskylä, 2008.

[8] R. Hermans, J. Tondeur, J. van Braak, and M. Valcke, "The impact of primary school teachers' educational beliefs on the classroom use of computers," *Computers & Education*, vol. 51, pp. 1499-1509, 2008.

[9] K. Mäkitalo-Siegl, C. Kohnle, and F. Fischer, "Computer-supported collaborative inquiry learning and classroom scripts: Effects on help-seeking processes and learning outcomes," *Learning and Instruction*, vol. 21, pp. 257-266, 2011.

[10] V. Meisalo, J. Lavonen, K. Sormunen, and M. Vesisenaho, *ICT in Initial Teacher Training. Finland*. OEDC CERI, New Milleniun Learners. Department of Teacher Education, University of Helsinki and School of Applied Education and Teacher Education, University of Eastern Finland, 2010.

[11] M. Koehler, and P. Mishra, "What is technological pedagogical content knowledge?" *Contemporary Issues in Technology and Teacher Education,* vol. 9, pp. 60-70, 2009.

[12] L. Shulman, "Those who understand: Knowledge growth in teaching," *Educational Researcher*, vol. 15, pp. 4-14, 1986.

[13] J. Voogt, P. Fisser, N. Pareja Roblin, J. Tondeur, and J van Braak, "Technological pedagogical content knowledge – a review of the literature," *Journal of Computer Assisted Learning*. doi: 10.1111/j.1365-2729.2012.00487.x

[14] S. Kontkanen, T. Valtonen, M. Vesisenaho, and P. Väisänen, "Student Teachers' Views and Experiences about ICT in Everyday and School Context," presented at the ECER conference, Cádiz, Spain, Sept. 2012.

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