Author(s): Valtonen, Teemu; Sointu, Erkko Tapio; Kukkonen, Jari; Häkkinen, Päivi; Järvelä, Sanna; Ahonen, Arto; Näykki, Piia; Pöysä-Tarhonen, Johanna; Mäkitalo-Siegl, Kati

Title: Insights into Finnish first-year pre-service teachers' twenty-first century skills

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Insights into Finnish first-year pre-service teachers' perceptions of their 21st century skills

Abstract

This study focuses on Finnish pre-service teachers' perceptions of their 21st century skills, especially their learning strategies, collaboration and teamwork, as well as knowledge and attitudes related to ICT in education. The target group consist of 263 first-year pre-service teachers from three universities. The results outline how pre-service teachers perceive their twenty-first century skills, the relationships between different areas of these skills, and the differences among pre-service teachers in terms of perceived skills. The results indicate that the pre-service teachers perceive themselves as skilled learners in terms of learning strategies used as well as collaboration and teamwork. When it comes to understanding how to use ICT in education, they perceived their level of knowledge lower. The strongest variation between respondents was seen in the areas of knowledge and attitudes related to the use of ICT in education.

Keywords: 21st century skills, pre-service teachers, learning skills, collaboration, ICT in education

1. Introduction

Education is facing demands to meet the requirements of todays' working life. Working life consists of tasks that presume seeking and analysing information in order to create new knowledge. These tasks are typically conducted in multidisciplinary teams who work with ill-defined problems (Griffin, Care & McGaw, 2012; Silva, 2009). To cope with the changing demands of the digitalized world, education of the future experts must conform to addressing the key skills of the future working life. Currently, these skills are deemed 21st century skills (see Griffin et al., 2012; Voogt, Ernestad, Dede, & Mishra, 2013; Voogt & Roblin, 2012). Key competencies for coping in today's digitalized world have been defined recently by many expert organizations, such as the Assessment and Teaching of 21st Century Skills (ATC21S™), the Partnership for 21st Century Skills, the

OECD's Definition and Selection of Competences and the European Union's Key Competences for Lifelong Learning (Ananiadou & Claro, 2009; Binkley et al., 2012; Gordon et al., 2009; P21Skills, 2013). Based on these reports, common key competences can be identified to be collaboration, communication, social and/or cultural competences, ICT literacy, creativity, critical thinking and problem-solving (cf. Voogt, Erstad et al., 2013; Voogt & Roblin, 2012).

The need for skills for collaboration and effective learning skills is nothing new. There is a history of extensive research in these areas. As Silva (2009) states, instead of being new, these skills appear to be newly important. It seems that the extent of collective and individual success depending on these skills is new (Rotherham & Willingham, 2009). However, only recently have these skills been combined under the definition of 21st century skills (Silva, 2009), which has provided new insights for education and educational research.

For education, 21st century skills both set new demands and suggest new possibilities. The essence of these skills from a student's perspective consists of "what students can do with knowledge, rather than what units of knowledge they have" (Silva, 2009). In order to support the development of students' 21st century skills, teachers themselves must also be competent in them (Voogt, et al., 2013). Therefore, teachers should be knowledgeable about how 21st century skills, such as learning and collaboration skills, are intertwined with pedagogical approaches and how ICT can be used to support them (Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014). It is also important that teachers have knowledge and skills to implement pedagogical approaches that align with 21st century skills, as well as the use of ICT in education, in practice (Voogt et al., 2013; Author 1).

Our argument is that pre-service teachers play an important role in transferring 21st century skills into school practice. Therefore, more information is needed to understand pre-service teachers' 21st century skills and the development of these skills. This study focuses on the following three areas of 21st century skills. First, *learning strategies* which are crucially important

for todays' and future workforce who have to be able to quickly react and adapt to changing situations, which demands skills for self-regulated and collaborative learning (Ericsson, 2009; Scardamalia et al., 2012). According to Dignath and Büttner (2008), today's students are expected to have skills for self-regulated learning during and after schooling throughout their entire working life. Second, *collaboration and teamwork* which are increasingly important in today's global economy (Scardamalia et al., 2012). For example, collaboration between teachers is important for developing school practices and culture (Ertmer & Ottenbreit-Leftwich, 2010). The third area of interest is *knowledge and attitudes towards the use of ICT in education*. According to Voogt et al. (2013), ICT serves as a hub of 21st century skills, i.e., ICT skills are a prerequisite for successfully acquiring other areas of 21st century skills. In order to enhance students' ICT skills, pre-service teachers need to be provided with opportunities to take advantage of ICT in pedagogically meaningful ways (Ertmer & Ottenbreit-Leftwich, 2014). In sum, this study describes the starting level Finnish pre-service teachers' perceptions of their own skills, how these perceptions are related to one another and what kind of differences there are between pre-service teachers' perceptions in these areas.

2. Theoretical background

2.1. Learning strategies

The area of learning strategies in this study comes from self-regulated learning (SRL) framework. SRL is an individual, cognitive-constructive activity that includes an interplay between cognitive strategies, metacognition, and motivation in which cognitive and personal factors, environment, and behaviour interact in reciprocal ways (Pintrich, 2000). In the literature, various models of SRL include processes, such as, planning, goal setting, monitoring, and controlling one's progress towards learning goals and standards (Pintrich, 2000; Zimmerman, 1989; Winne & Hadwin, 1998). In this study, the focus on self-regulated learning is enacted through pre-service

teachers' perceptions of their cognitive and metacognitive learning strategies (*i.e.* critical thinking, elaboration, and metacognitive self-regulated learning) (Pintrich, 2002).

In general, definitions of learning strategies can vary depending on whether strategy use is viewed as a subcomponent of SRL, or whether SRL is viewed as a part of strategic learning (Winne & Perry, 2000; Weinstein, Husman, & Dierking, 2000). In this study learning strategy use is viewed as a part of SRL; the actual strategy use occurs as a result of comparing the current state of learning with a desired outcome of the learning process (Pintrich, 2000; Winne & Hadwin, 1998). Prior research has compared the function and meaning of different types of learning strategies. In general, cognitive strategies include the use of basic and complex strategies. For example, cognitive learning strategies can be defined as actions that facilitate processing information from texts, lectures, and other types of learning situations for enhancing understanding, learning, and meaningful encoding into memory (Weinstein, Acee, & Jung, 2011). Whereas, metacognitive learning strategies involve purposefully planning, executing, and monitoring learning tasks by attending to and evaluating the degree to which new information is being understood, integrated, and retained (Flavell, 1979).

In all, decades of studies among higher education students show unquestionable evidence that SRL is an effective means of improving student achievement (Zimmerman, 2001; Zimmerman & Schunk, 2011). Many prior studies have reported different relationships between strategy use and academic achievement depending on whether the strategies used are either metacognitive or cognitive based (Proctor, Prevatt, Adams, Hurst, & Petscher, 2006). A metacognitive approach to learning has been associated with deeper processing of information (Evans, Kirby, & Fabrigar, 2003) and may be particularly important to academic success. Empirical evidence indicates that students often do not use strategies in a high-quality way (Glogger, Schwonke, Holzäpfel, Nückles, & Renkl, 2012; Simpson, Olejnik, Tam, & Supattathum, 1994). Tait and Entwistle (1996) have shown that a poor repertoire of learning strategies can even lead to academic

failure during the first year of higher education studies. However, research evidence has also shown that the use of learning strategies can be taught and scaffolded (Perry, 1998; Zimmerman, 2000), and the most successful results have been gained by the training programs that are connected to the authentic learning tasks and the larger framework of self-regulated learning (Dignath, Buettner, Langfeld, 2008). Thus, exploring pre-service students' learning skills, use of cognitive and metacognitive learning strategies, in their first year of teacher education gives information of what kind of learners they are and what kind of support they may need in their learning skill development.

2.2. Collaboration and teamwork

The second focus of this study is on how pre-service teachers' perceive collaboration and teamwork. Several studies and policy papers have emphasized collaboration as a necessary prerequisite for success in the 21st century working life (Loughry, Ohland, & Woehr, 2014; OECD, 2013). There is evidence showing that supporting collaborative practices can have a positive impact on student learning (Weinberger, Ertl, Fischer, & Mandl, 2005), for example, with respect to enhancing cognitive performance and stimulating knowledge construction (O'Donnell & Hmelo-Silver, 2013). In this study, we are focusing on a set of individuals' perceptions related to collaboration and teamwork, which are considered here more as a general orientation towards collaboration and teamwork, instead of being based on particular collaborative situations.

Although collaboration and teamwork are regarded as important in our learning society, there is not much empirical research on these issues, particularly not in longitudinal teacher education settings. A set of questions based on the work of Wang and colleagues (2009), also applied as the PISA 2015 background questionnaire, was created to evaluate pre-service teachers' own perceptions related to various dimensions of teamwork; that is, cooperating, guiding others, and negotiating. In PISA 2015 framework, these dimensions are seen to predict students' performance in collaborative problem-solving activities (OECD, 2013) and, in this way, these

perceived dimensions are considered as *dispositions* in this regard. Accordingly, obtaining a better understanding of how students perceive these dimensions is expected to provide us with grounds for further studies on e.g. how students may acquire these skills and how instruction can be better designed to assist students in developing and applying these skills (Hughes & Jones, 2011).

2.3. Knowledge and attitudes of ICT in education

From the perspective of ICT in education, the study is conducted focusing on Technological Pedagogical Content Knowledge (TPACK) and Theory of Planned Behavior (TPB). From the perspective of the TPACK framework, the study focuses on Technological Pedagogical Knowledge (TPK), that is, how pre-service teachers' perceived general knowledge of how to take advantage of ICT for education (cf. Koehler, Mishra, & Cain, 2013). In the case of the TPB framework, the focus is on pre-service teachers' attitudes (ATT), which are one of the three elements affecting behaviour, in this case the use of ICT in education (Aijzen, 1999).

TPACK is a theoretical framework consisting of three knowledge areas, technology, pedagogy, and content, as well as their combinations, which altogether yield seven areas of knowledge. With this framework, it is possible to describe and study skilled and pedagogically sound teaching with ICT, that is, the heart of good teaching with ICT (Koehler et al., 2013). TPK is one of the knowledge areas. It refers to a combination of technological and pedagogical knowledge, that is, it describes an understanding of the nature of teaching and learning with ICT and the benefits and disadvantages of various ICT tools, software and applications for certain pedagogical practices (Koehler et al., 2013). TPK was chosen as the area of interest in this study because it provides general-level information about how pre-service teachers' perceive their knowledge related to the use of ICT in education, without a specific subject focus. From the 21st century skills perspective this is important, teachers need to have skills for taking advantage of ICT for supporting their students' different learning practices (Voogt et al., 2013).

The TPB framework has been actively used in studying pre-service teachers' intentions to use ICT in education .TPB is a valid model for explaining pre-service teachers' behavioural intention to use ICT for teaching and learning. In this study, the focus is on pre-service teachers' attitudes toward the use of ICT in education. The reason for selecting this one area of TPB is that it clearly has the strongest effect on pre-service teachers' behavioural intentions to use ICT in education (Teo & Tan, 2012). Also, similar results were reported by AUTHOR 2 (2015) in their quasi-experimental study of first-year pre-service teachers. Especially in their pre-test i.e. before the course intervention with ICT, attitudes clearly had the strongest effect on behavioural intentions. These results makes pre-service teachers' attitudes toward the use of ICT in education an important topic, providing perspectives how willing pre-service teachers will be integrating ICT as part of their teaching.

3. Methods

3.1. Aims

The aim of this paper is to outline first-year pre-service teachers' perceptions of their 21st century skills from above described perspectives. The focus is also on how these three areas are related to one another, and what kinds of differences there are between pre-service teachers' perceptions of these areas. These results will provide us with an overview concerning the starting level of first year pre-service teachers 21st century skills. These result provide important information for developing teacher education in order to strengthen pre-service teachers 21 st century skills.

3.2 Participants

In order to provide a more detailed picture of the target group, we first briefly outline some features of the target group here based on background statistics. The target group of the study consists of 263 pre-service teachers' from three Finnish universities. These pre-services teachers will

graduate with a master's degree in education within four to five years. This provides them with a qualification to teach basic education pupils in grades 1 to 6 (pupils start at the school during the year in which they turn seven). The gender distribution in the target groups was $N_{FEMALE} = 202$; 76,8%; $N_{MALE} = 61$, 23,3%. This distribution represents a typical gender distribution for Finnish pre-service teachers, who tend to be female-centered. The mean age of respondents was 21.7 ($SD = 3,6$). Universities select pre-service teachers through a two-phased selection process. First, there is an entrance exam called VAKAVA (scores ranging from 50 to 200), and those passing the VAKAVA exam are asked to participate in the second phase, which includes interviews, group and/or individual assignments, and personal tests. Approximately one-third of the applicants are called in for the second phase. The average VAKAVA score of participants in this study was 114.8 points ($SD = 15.4$). In general, it is rather difficult to become accepted into pre-service teacher education in Finland because a mere 12% of the applicants are accepted.

3.3. Procedures

Data were collected over four months, between October 2014 and January 2015. Data collection was conducted as part of pre-service teacher education courses, and permission to conducting the research was acquired from the head of the department. The aim of the research was explained to the target group by the researchers, as well as in handouts. Pre-service teachers were not obliged to participate. Data collection included two questionnaires: one focusing on perceptions of cognitive and metacognitive learning strategies as well as of collaboration and teamwork, and another focusing on perceived knowledge and attitudes of ICT in education. The whole cohort of first year pre-service teachers from three Finnish universities consists of 309 students. The target group of the study consists of 263 pre-service teachers' from these universities. The missing 46 pre-service teachers didn't either participated on the course were data was collected or did not want to participate the research.

3.4. Measures

Pre-service teachers' cognitive and metacognitive learning strategies, collaboration and teamwork, and knowledge and attitudes of ICT in education were measured using the following instruments. Cognitive and metacognitive learning strategies were measured with the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1993). The MSLQ is an 81-item self-report instrument consisting of nine learning strategies subscales and six motivation scales. This study focused on learning strategy scales based on the Cronbach alpha (α) values and the scales normal distribution: elaboration (ELA), critical thinking (CRI) and metacognitive self-regulation (SRL).

The ELA (elaboration) subscale targets students' use of learning strategies such as paraphrasing and summarising. In this study, four items were used to measure students' views of their elaboration skills, such as *"When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions"* and *"I try to relate ideas in this subject to those in other courses whenever possible."* The CRI (critical thinking) subscale measures students' use of strategies to apply previous knowledge to new situations or perform critical evaluations of ideas. CRI was measured with five items, such as *"I often find myself questioning things I hear or read in this course to decide if I find them convincing"* and *"I treat the course material as a starting point and try to develop my own ideas about it."* The SRL subscale measures perceived self-regulated learning skills, particularly metacognitive control strategies, which are related to the use of strategies that help students control and regulate their own cognition. SRL includes planning (setting goals), monitoring (of one's comprehension), and regulating (adjusting, for example, reading speed depending on the task). Perceived self-regulated learning strategies were measured with nine items, such as *"When reading for this course, I make up questions to help focus my reading"* and *"When I study for this class, I set goals for myself in order to direct my activities in each study period"*. For perceived

learning skills, the scale items were rated on a scale of one to seven (1 = not at all true of me; 7 = very true of me).

Pre-service teachers' perceptions on teamwork and collaboration was assessed with a 20-item self-report (Wang, MacCann, Zhuang, Lydia, & Roberts, 2009) and their perceptions of teamwork were measured with three subscales: negotiation (NEGO), cooperation (COOP), and guidance (GUID). NEGO is seen as a central element in teamwork. An individual must negotiate and adjust his/her actions according to the accompanying group. NEGO was measured with six items, such as *"I enjoy seeing my classmates be successful"* and *"I am flexible when working with a team."* The COOP subscale focuses on pre-service teachers' perceptions towards working in a team and collaboration. Perceived cooperation was measured with four items, such as *"I prefer working as part of a team to working alone"* and *"I find that teams make better decisions than individuals."* The GUID subscale focuses on guiding and mentoring the other team members. GUID was measured with six items, such as *"I like to be in charge of groups or projects"* and *"I convince others to see things my way."* The scale items were rated on one to seven scale (1 = not at all true of me; 7 = very true of me).

Perceived knowledge and attitudes of ICT in education was measured using three subscales: technological pedagogical knowledge (TPK), attitudes toward the use of ICT in education (ATT), and general attitudes toward ICT (ICT-view). The first, the TPK subscale, is part of a TPACK21 questionnaire (see Author 3, 2015). TPK measures pre-service teachers' self-evaluation of knowledge related to the use of ICT in education at a general level, not including specific subject content, such as history or mathematics. The pedagogical knowledge area of TPK was grounded in pedagogical practices aligned with 21st century skills, such as collaboration, problem solving, and reflective and creative thinking. TPK includes six items, such as *"I know how to use ICT in teaching as a tool for students' creative thinking"* and *"I know how to use ICT in teaching as a tool for sharing ideas and thinking together."* The second, the ATT subscale, is based

on a questionnaire used in a study by AUTHOR 2 (2015). Attitudes (ATT) measure whether pre-service teachers value the use of ICT in education positively or negatively. ATT includes six items, such as "*The use of ICT in education is integral to today's society*" and "*It is important for me that my future students learn to use ICT.*" The third and more general attitudes toward ICT subscale (ICT-view) contained four statements, such as "*It is fun for me to use new technologies*" and "*I actively follow new technological developments.*" From these ICT-view statements, we calculated one ICT-view index score to describe respondents' general view of ICT. For TPK respondents, we rated their opinion using a 6-point Likert-type scale (1 = I have very weak knowledge; 6 = I have strong knowledge). For attitudes toward the use of ICT in education and ICT-view, we rated respondents on a scale from one to six (1 = strongly disagree; 6 = strongly agree).

Finally, these three areas of perceived 21st century skills, with their related items in the questionnaire, formed eight subscales: 1) Elaboration (ELA), 2) Critical thinking (CRI), 3) Self-Regulation (SRL), 4) Negotiation (NEGO), 5) Cooperation (COOP), 6) Guidance (GUID), 7) Technological Pedagogical Knowledge (TPK), and 8) Attitudes toward the use of ICT in education (ATT). Subscales 1-3 (ELA, CRI, and SRL) measured learning strategies, subscales 4-6 (NEGO, COOP, and GUID) measured collaboration and teamwork, and subscales 7-9 (TPK, ATT, and ICT-view) measured knowledge and attitudes of ICT in education.

3.5. Data analysis

The internal consistency, descriptive statistics, and correlations were investigated with the use of SPSS v 22. To determine the internal consistency of the measured subscales, Cronbach alpha (*α*) was used. We used a lower alpha level of 0.7 to indicate the adequate reliability of a scale (Nunnally, 1978). We also reported the 95% confidence interval (95% CI). In addition, the descriptive statistics (*M, SD*) and the Pearson's product moment correlation were used. The general

criteria used to interpret correlation coefficients were applied: 0.10 – 0.29 for small, 0.3 – 0.49 for moderate, 0.5 – 0.69 for large, and above 0.7 for very large associations between variables.

4. Results

The results of statistical analysis will be reviewed in the Table 1. The mean values, standard deviations, and the reliability estimates for the subscales of the areas of the 21st skills are represented in Table 1. The reliabilities (measured with Cronbach's α with a 95% CI) for these subscales ranged from 0.74 to 0.95, indicating adequate reliabilities.

[TABLE 1 HERE]

4.1. Learning strategies, collaboration and teamwork, and ICT in education

The results (Table 1) indicate that pre-service teachers rated their use of cognitive and metacognitive learning strategies rather highly. Elaboration was assessed as highest (M=5.45, SD=.78; ELA with four items, such as *"I try to relate ideas in this subject to those in other courses whenever possible"*). Critical thinking was rated slightly lower, yet still highly (M=4.70, SD=.90; CRI with five items, such as "*I often find myself questioning things I hear or read in this course to decide if I find them convincing"),* which was similar to metacognitive self-regulation (M=4.71, SD=.73; SRL nine items, such as "*When I study for this class, I set goals for myself in order to direct my activities in each study period").*

Furthermore, the association between background variables and these subscales was investigated. The older pre-service teachers assessed their use of self-regulated learning strategies as slightly lower than the younger pre-service teacher students' assessments of their own strategic learning (small negative correlation between age and self-regulated learning strategies; $r = -0.24$, *p*

< .001). A better high school diploma average was slightly associated with higher self-regulation ratings ($r = 0.24$, $p < .001$).

The teamwork- and collaboration-related perceptions were measured using three subscales. Negotiation, that is, a willingness to negotiate and adjust one's actions according to the accompanying group, were rated at the highest level of all the subscales (M=5.96, SD=.62; six NEGO items such as *"I am flexible when working with a team"*). Also, guidance, that is, a willingness to guide and mentor the other team members (M=5.39, SD=.93; six GUID items such as *"I convince others to see things my way"*), was rated highly, as was the cooperation i.e. working as a team and collaborate (M=5.16, SD=.74; COOP four items, such as *"I find that teams make better decisions than individuals"*). These results indicate that first-year pre-service teachers have high teamwork and collaboration-related perceptions.

From the perspective of ICT in education, the results show that pre-service teachers indicate the need to learn more about the areas measured in the Technological Pedagogical Knowledge (TPK). Their assessment of the TPK is slightly below three on six-point rating scale, ($M = 2.94$, $SD = 1.12$; six TPK items such as "*I know how to use ICT in teaching as a tool for students' creative thinking*"). In other words, it seems that pre-service teachers evaluate their knowledge as being at a rather low level with regard to the use of ICT in a pedagogically meaningful way. However, the pre-service teachers rate their attitudes toward using ICT for teaching and learning more highly ($M = 4.09$, $SD = .85$; six ATT items, such as "*It is important for me that my future students learn to use ICT*"). The general, ICT-view, based on the pre-service teachers' rating, has a moderate ($M = 3.65$, $SD = 1.12$; four ICT-view items, such as "*I actively follow new technological developments"*). The positive results for ATT and moderate for ICT-view can be considered promising regarding the willingness to develop technological-pedagogical knowledge (TPK). The male pre-service teachers had slightly more positive ICT-views than female pre-service teachers, and this difference was statistically significant ($r = -0.3$, $p < .001$).

4.2. Differences between respondents

Compared to the other subscales, the TPK and ICT-view subscales had the lowest and most deviated values, that is, these results indicate the strongest differences between pre-service teachers. In order to better describe the differences between respondents, we further investigated the deviation, ultimately arriving at three groups based on the responses to the TPK and ICT-view subscales. The grouping for TPK and ICT-view was interpreted based on deviation as follows: the lowest-ranking group included those ranking below the scale mean score of 3.33, the middle-ranking group included those with scale mean scores from 3.34 to 4.49, and the highest-ranking group included those with scale mean scores of 4.5 and higher. Based on the results of the TPK, the largest group 64% ($n = 168$) within the sample assessed their technological-pedagogical knowledge as weak. The second-largest group, 25% ($n = 65$), assessed their TPK knowledge as average, and only 11.4% ($n = 30$) reported having strong TPK knowledge. Also, the results of the ICT-view subscale provided similar results in that 39.2% ($n = 103$) of the respondents indicated having rather negative attitudes toward ICT and being uninterested in ICT in general. The largest group ($n = 106$), 40.3% of the sample reported rather neutral attitudes and interest levels toward ICT. The smallest group of pre-service teaches, 20.5% ($n = 54$), indicated positive attitudes concerning ICT and being interested in ICT.

4.3. The relationships between learning strategies, collaboration and teamwork, and ICT in education

The three areas of perceived 21st skills under investigation (*Learning strategies*, *Collaboration and teamwork, and ICT in education)* seem to be rather weakly associated with one another (see Table 2.). The only associations reaching a moderate level were those between the *Learning strategies* subscales and two of the subscales in *Collaboration and teamwork.* Those pre-

service teachers who rated highly on the *learning strategies subscales (ELA, CRI, SRL)* also rated highly on the negotiation subscales (NEGO; correlations from 0.27 to 0.38, $p < .01$) and guidance (GUID; correlations from 0.29 to 0.36, $p < .01$) but not for cooperation (COOP; correlations from not significant to 0.23). The ICT in education area was even more weakly associated with *Collaboration and teamwork* subscales *(*correlations from non-significant to 0.21) and almost entirely not associated with the *learning strategies subscales* (correlations from non-significant to 0.13). Subscales, TPK and ATT had very small associations with the subscales of *Collaboration and teamwork* and the subscales of *Learning strategies.*

[Table 2 here]

5. Discussion

The results of this study provide a rather positive view of beginning-level pre-service teachers' perceptions for 21st century learning and teaching. The results indicate that first-year Finnish pre-service teachers assess themselves as skilful learners, especially in the area of collaboration and teamwork and also learning strategies. The results show that pre-service teachers believe to be skilled learners regarding the use of various learning strategies. In this study, the results concerning ICT in education indicate that pre-service teachers assessed their skill levels as being lower compared to learning strategies and collaboration and teamwork. Pre-service teachers' assess their knowledge related to teaching with ICT to be especially low. The results align with recent research findings regarding "net generation pre-service teachers", which suggest that today's pre-service teachers need support for developing their skills for using ICT in education (Lei, 2009; Ertmer & Ottenbreit-Leftwich, 2010). However, pre-service teachers' attitudes towards ICT use in education were not negative; rather, the results indicate that they evaluate their knowledge of ICT in

education as being lower than their attitudes toward ICT use in education. We assume that one reason for this is the active public discussion concerning the role of ICT in education in Finland. The role of ICT is well-emphasized, for example, in the new Finnish curriculum.

These results can be partly explained by considering the backgrounds of the respondents. Recent statistical reports from the year 2015 (Finnish National Board of Education, 2015) show that less than 12% of all applicants were accepted into teacher education, especially to become primary school teachers. Teaching is one of the most popular specialisation options in higher education. Finnish pre-service teachers have typically graduated from upper secondary school with high grades. After upper secondary school, they must pass the entrance exams, which only about 10% of applicants pass (Sahlberg, 2011), suggesting that the respondents are skilled learners and also confident in their learning skills. Also, the entrance exams emphasize collaboration skills that may affect the results.

In addition, the results indicated that the perceived knowledge and attitudes of ICT in education causes more variation among pre-service teachers as compared to perceived learning strategies and collaboration and teamwork. One reason for this result may be pre-service teachers' experiences of learning with ICT during their school history. According to Lei (2009), pre-service teachers' previous experiences of learning with ICT affect their abilities to use ICT for teaching. In Finland, there is variation among schools concerning the ways in which ICT is used in education, indicating that the first-year pre-service teachers have also had a variety of experiences concerning ICT-related learning experiences. Even though todays pre-service teachers can be seen as net generation (Lei, 2009) they still should not be considered as a one homogenous group able to take advantage of ICT in education. Rather the differences between pre-service teachers should be considered in order to provide appropriate support for pre-service teachers with different starting points for using ICT in education.

The results also show that the three areas of perceived 21st century skill (learning strategies, collaboration and team work, and knowledge and attitudes of ICT in education) differ in how they relate to one another. Perceived learning strategies and collaboration and teamwork had a moderate, positive association; that is, increasing one increases the other. When compared to perceived knowledge and attitudes of ICT in education, the results were different. The associations between perceived knowledge and attitudes of ICT in education and strategic learning, as well as collaboration and teamwork, were weaker than expected. Relations were weak or non-existent, indicating that in the case of beginning-level pre-service teachers, ICT in education is a rather separate area. According to AUTHOR 4 (2013), pre-service teachers' ways of preferring learning activities, that is, emphasizing collaborative activities or teacher-directed activities, are related to the ways in which pre-service teachers see the value of ICT in education. Unlike the results of AUTHOR 4 (2013), it seems that these areas are separate within pre-service teachers' perceived 21st century skills. The explanation for this may be that the respondents were at the beginning of their professional development. They assessed their knowledge related to the use of ICT in a pedagogically meaningful way, as being rather low; that is, pre-service teachers, at this point, do not yet see the affordances of ICT for teaching and learning. This issue requires further investigation in follow-up studies; that is, do these associations change during a teacher's education, and what are the effects of various learning experiences during teacher education.

The results of this study suggest that respondents have a high level of perceptions of their learning strategies and especially on collaboration and teamwork. These areas must be recognised in teacher education in order to turn these skills into concrete teaching and learning practices. Also, the low results concerning pre-service teachers' perceived knowledge of using ICT in education must be considered in teacher education. In order to provide pre-service teachers with better skills for using ICT in education ICT need to be better integrated, in a pedagogically sound manner, in teacher education courses (Ertmer & Ottenbreit-Leftwich, 2010). Personal experiences

of learning with ICT, along with pre-service teachers' positive attitudes toward ICT in education, provide a way to develop teachers' skills and take advantage of ICT applications in teaching and learning (AUTHOR 2, 2015).

Even though positive findings were obtained, one must acknowledge that self-reports provide information about learners' tendencies and captures how learners think they use learning strategies in general but that they do not necessarily reflect the learners' actual behavior (Hadwin et al., 2007; Bråten & Samuelstuen, 2007). In this sense, even though a learner knows what are the effective learning strategies or group working dispositions, this does not necessarily mean that these are used within a learning process. Nevertheless, self-report data highlight what learners regard as important, and their replies inform researchers about what the learner thinks he/she is doing, despite the possibility of the data being biased (Winne & Jamiesson-Noel, 2002). This study provides an overview of first-year pre-service teachers' perceived 21st century skills. In the future, it will be important to focus on longitudinal studies in order to understand how various areas of 21st century skills develop during teacher education and to recognize factors affecting and hindering their development. An important area for future research is to describe the possible changes in the relationships between various areas of 21st century skills and how these relationships change when pre-service teachers' knowledge, skills, and experiences evolve. Also, an important area for the future research will be the differences between pre-service teachers history in learning with ICT. What kind of differences there are, how they affect pre-service teachers' readiness to use ICT in education. This area would provide important insight into better considering the ways to support the development of ICT skilled teachers.

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Table 1

The subscales for the areas of twenty-first skills, descriptive values

(M, SD), and Cronbach's alpha [95 % CI]

			Descriptive		
			items	*M*	*SD*
Learning skills	1	ELA	4	5.45	0.78
	2	CRI	5	4.70	0.90
	3	SR	9	4.71	0.73
Collaboration and teamwork	4	NEGO	6	5.96	0.62
	5	GUID	6	5.39	0.73
	6	COOP	4	5.16	0.93
ICT in education	7	TPK	6	2.94	1.12
	8	ATT	6	4.09	0.85
	9	ICT-view	4	3.65	1.12

Note. N = 263. *ELA* Elaboration, *CRI* Critical Thinking, *SR* Self-Regulation, *NEGO*
Negotiation, *GUID* Guidance, *COOP* Cooperation, *TPK* Technological Pedagogical
Knowledge, *ATT* Attitudes toward the use of ICT in education, *ICT-view*, ICT-view.

Table 2

Correlations between the areas of 21ˢᵗ skills

Areas of 21ˢᵗ century skills		1	2	3	4	5	6	7	8
Learning skills	1 ELA								
	2 CRI	.50**							
	3 SR	.60**	.45**						
Collaboration and teamwork	4 NEGO	.36**	.27*	.38**					
	5 GUID	.29**	.36**	.33**	.46**				
	6 COOP	.09	.06	.23**	.38**	.42**			
ICT in education	7 TPK	.08	.14*	.13*	.21**	.21**	.21**		
	8 ATT	.08	-.05	.10	.17**	.14*	.20**	.34**	
	9 ICT-view	.07	.05	.04	.09	.15	.13	.39**	. 57**

Note. N = 263. *ELA* Elaboration, *CRI* Critical Thinking, *SR* Self-Regulation, *NEGO* Negotiation, *GUID* Guidance, *COOP* Cooperation, *TPK* Technological Pedagogical Knowledge, *ATT* Attitudes toward the use of ICT in education, *ICT-view*, ICT-view Index Score. Correlation significant at ** p < .01, * p < .05.