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Finnish student teachers' perceptions of their development of 21st-century competencies

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ABSTRACT

This study examined student teachers' perceptions of how well their Teacher Education (TE) had prepared them for 21st-century competencies, and how well they applied these competencies to their teaching. In addition, the study sought to identify best practices, major obstacles, and suggestions to achieve these competencies. The study was implemented in two universities and three universities of applied sciences in Finland that have TE programmes. This study used a mixed-method approach. Data were collected both quantitatively and qualitatively from student teachers (n = 227), who assessed 21st-century competencies with a structured questionnaire that included open-ended questions. Quantitative data analysis used descriptive statistics and correlations, while qualitative data analysis used content analysis. The study found that based on the student teachers' self-assessment, the student teachers achieved successfully 21st-century competencies despite differences between competencies. The best-achieved competency was 'Collaboration' and the least well-achieved was 'Global connections.' The study illustrated student teachers' perception of their success in applying 21st-century competencies to their teaching at schools. Answers to open-ended questions produced convincing evidence that courses involving collaborative and interactive learning, high quality, sufficient support, related 21st-century competencies, certain pedagogical methods used by teacher educators, and integrating theory and practice can contribute strongly to the development of student teachers' 21st-century competencies.

Introduction

The urgent demand for students' 21st-century competencies has been recognised globally (e.g. Binkley et al. 2012; Griffin et al. 2012; OECD 2013). Many researchers (e.g. Voogt and Roblin 2012; Darling-Hammond 2006) have stressed the importance of preparing and educating teachers to support their students' learning of 21st-century competencies. Teachers must be both familiar with these competencies and capable of applying them to their teaching.

In this study, we investigated student teachers' perceptions of their success in acquiring 21st-century competencies in their teacher education (TE) programmes, and how well they applied these competencies to their teaching. In addition, the study sought students' perceptions of the best practices, major obstacles and suggestions to achieving 21st-century competencies.

Theoretical framework

21st-century competencies in teaching and learning

Changes in sciences and technology, competencies in the future workforce and the continuous need for lifelong learning create an urgent need to cultivate students' development and growth regarding 21st-century competencies. Big Information and Communication Technology (ICT) enterprises and international organisations, such as Cisco, OECD and the EU, have initiated projects related to 21st-century competencies. These projects aim to prepare students for their future work in the 21st century. Defining future competencies has been regarded as important (e.g. Gordon et al. 2009; Voogt and Roblin 2012; Niemi, Nevgi, and Aksit 2016; Lee and Tan 2018). This idea is not new. Even in the 1970s, a report on 'Learning to be' was initiated by UNESCO (Faure et al. 1972), opening up a discussion of how important it is to prepare people for future demands. However, the picture is complicated and critical voices have also been raised (e.g. Mehta, Creely, and Henriksen 2020; Patterson 2015). Important concerns have been that technology companies are dominating education without real connections with local circumstances of teaching and learning, and strengthening neo-liberal policy in education. Skills and competencies also have limitations: they can be either too vague or narrow; and may not comprehensively understand human growth and development. However, in most countries both policymakers and representatives of education see the importance of preparing people for changes. Consequently, national curricula refer to 21st-century competencies, generic skills, transferable skills or transversal competencies (e.g. Gordon et al. 2009; Voogt and Roblin 2012; Niemi, Nevgi, and Aksit 2016). Despite the different terminology, all countries aim to prepare students with 21st-century competencies to face recent and future changes, which sets expectations for the whole educational system (e.g. Binkley et al. 2012; Griffin et al. 2012; Lee and Tan 2018).

There has also been a concern that these skills become normative standards for curriculums, demanded and controlled by contemporary politicians, without a deeper analysis of their meaning for people's lives and wellbeing and without real changes in schools. Voogt and Roblin (2012) state that 21st-century competencies require fundamental changes in schools and teaching culture because they are not separate skills but are integrated with all teaching subjects and activities in schools. Therefore, the teachers' capacity to work towards these goals in practical implementations is decisive and changes also in teacher education are also needed. Our study aims to provide new perspectives how these competencies can be learned and acquired in teacher education.

In this study, future competencies are considered wide and comprehensive, covering more than a direct connection with technology and the market economy. Consequently, teaching and learning have become more demanding for both teachers and students.

Teachers are expected to not merely transmit knowledge to students but also to support students' growth into independent and responsible citizens with future competencies and capabilities.

Researchers (e.g. Lee and Tan 2018; Voogt and Roblin 2012) reviewed the main programmes focusing on 21st-century competencies: the Partnership for 21st century Learning in the P21 project (P21 2015); the Assessment and Teaching of 21st Century Skills (ATC21S 2012); key competencies of The Organisation of Economic Co-operation and Development (OECD 2005); and key competencies of the European Union (EU 2006). Despite the different emphases and foci, the frameworks have common competencies concerning the following four areas: (1) technology, ICT literacy; (2) relating to others, including communication, collaboration; (3) personal abilities, including creativity, critical thinking, self-direction; (4) in relation to the society and the world, including global and local citizenship, social and civic responsibilities, etc.

In our study, competency conceptualisation refers to Hixson, Ravitz, and Whisman (2012) and Ravitz (2014) concerning professional development in project-based learning and support of students' growth in developing 21st-century competencies. The eight categories in the above-mentioned research cover a wide range of important competencies which can be identified either explicitly or implicitly in the 21st-century competencies defined by P21, ATC21S, OECD, and the EU. Further details of these, and definitions, are available on request from the corresponding author, as are other details of findings indicated thus [*] in the text. The survey was designed to include two major components: teachers' perceptions on how well they acquired 21st-century competencies and how well they applied them to their teaching. The same survey was used for measuring 21st-century teaching and learning in the West Virginia 21st century Teaching and Learning Survey (WVDE-CIS-28) (Ravitz 2014).

Ravitz's (2014) inventory of competencies included Critical thinking, Collaboration, Communication, Creativity and innovation, Self-direction, Global connections, Local connections, and Using technology as a tool for learning. The first four competencies are defined in almost all the 21st-century frameworks mentioned earlier (e.g. P21, ATC21S, OECD, the EU). Self-direction is an important competence involving leading oneself, regulating one's own actions, and taking responsibility, and is mentioned either explicitly or implicitly in many 21st-century competencies frameworks (e.g. P21, ATC21S, OECD, the EU). The competency of using technology as a tool for learning is a wider concept for ICT literacy, which is defined in all the 21st-century frameworks (e.g. P21, ATC21S, OECD, the EU). Global and local connections competencies were not explicitly defined in other 21st-century competencies frameworks but were implicitly implied in the competencies of social responsibility and citizenship (local and global) in all 21st-century frameworks (Lee and Tan 2018; Voogt and Roblin 2012). Due to the rapid development of telecommunications, modern transportation and the global economy, the world is highly interconnected. Education can shape students' global and intercultural perspectives (Barrett et al. 2014; Boix Mansilla and Jackson 2011; Deardorff 2009; UNESCO 2013, 2014, 2016). The (OECD 2018) has emphasised the importance of globally competent citizens who interact successfully and respectfully with others and take responsible action towards sustainability and collective wellbeing.

Teachers' competency development: integrating theory and practice

Various approaches exist regarding the development of teacher competency, both during TE and generally in the profession (e.g. Whitty and Willmott 1991; Korthagen 2004; Struyven and De Meyst 2010). Westera (2001) argues that teacher competencies include two dimensions: a knowledge component and a skilled behaviour component. It encompasses the ability to apply such knowledge and skills to actual work situations (Toom 2017). Additionally, the willingness to responsibly apply competencies in real situations is involved (Blömeke and Delaney 2012). Shavelson (2013) identified a key facet of competency as *performance* – the capacity to know and be able to act or perform. The ultimate goal of TE programmes is to educate teachers to be able to apply their learning to various teaching situations; this is a constant and dynamic process (Caena 2014; Blömeke, Gustafsson, and Shavelson 2015). Korthagen (2017) and Darling-Hammond (2017) highlighted the importance of applying theory to practice in teachers' professional development. Ball (2000) also emphasises the significance of integrating knowledge with action. Other researchers also cited the integrative concept that includes knowledge, skills, decision-making and the ability to act in professional tasks and situations (Pantic and Wubbels 2010; Struyven and De Meyst 2010; Westera 2001). Consequently, student teachers' competency development can be enhanced through their learning of theories; however, strengthening and deepening their learning in practice is also important. Teachers absorb knowledge and theories, applying their learning to internalise the competencies.

This study investigated student teachers' perceptions both of acquiring 21st-century competencies in TE, and of how they applied their competencies to their teaching practice. Gender differences and differences between perceptions of student teachers at universities and at universities of applied sciences were also investigated. In addition, we analysed what were the best practices and major obstacles in acquiring 21st-century competencies.

Finnish education related to teacher competency development

This study concerns Finnish Teacher Education (TE). Finnish TE programmes prepare student teachers to implement the objectives of Finnish education, to support learners' growth towards becoming ethically responsible members of society, and to facilitate the achievement of future competencies (Niemi et al. 2018; FNAE 2014). The latest Finnish national core curricula for different school levels (FNAE 2014) include transversal competencies which are a detailed version of 21st-century competencies. This means that student teachers and teachers' 21st-century competencies are crucial in supporting their students in achieving them. Häkkinen et al. (2017) and Valtonen et al. (2017) conducted research related to student teachers' acquisition of 21st-century competencies in the Finnish teacher education programme. Häkkinen et al. (2017) presented a theory-based pedagogical framework for the 21st-century learning practices in teacher education which related to the process and strategies for collaborative problem-solving skills and strategic learning skills. Valtonen et al. (2017) indicated that Finnish student teachers assessed themselves as skilful learners, especially in the area of collaboration, teamwork and learning strategies.

In Finland, all basic education teachers need to complete a five-year academic master's degree programme (300 ECTS). In this article, the term university denotes universities that offer bachelor's, master's and doctoral level degrees in various academic fields. University TE programmes consist of studies in academic disciplines, pedagogical studies (60 ECTS), including teaching practice, communication and ICT, and research studies for bachelor's and master's theses (Niemi et al. 2018; FNAE 2018). Universities of applied sciences also offer pedagogical studies (60 ECTS) mainly for vocational schools and adult education teachers. These TE students have completed academic subject studies in their earlier BA and MA studies at universities or at applied universities of applied sciences or in some cases have a tertiary-level degree of three or 3 years of relevant studies from their field. In addition, in most cases they must have at least three years of work experience before applying to TE, which is not expected from university student teachers. This means that university student teachers are often younger. Teaching practice at both types of universities comprises several phases, which broaden and deepen student teachers' competencies and are supervised by qualified teacher educators. The 60-credits pedagogical studies of both types of universities have the same objectives that support student teachers to become autonomous and responsible professionals. However, universities focus more on research and new knowledge creation, whereas universities of applied sciences concern more practical projects with regional partners.

Research questions

This study aimed to investigate how Finnish student teachers assessed their learning of 21st-century competencies and how well they applied these competencies to their teaching, and using the following research questions:

(1) What are the student teachers' perceptions of their 21st-century competencies acquisition in TE and what differences exist between student teachers regarding gender and types of university?
(2) What are the student teachers' perceptions of how well they applied their 21st-century competencies to practice and what differences exist between student teachers regarding gender and types of university?
(3) What relationships exist among competencies in TE and in teaching practice, and between competencies acquired in TE and applied in practice?
(4) What are the student teachers' opinions regarding best practices and major obstacles, and suggestions for supporting their learning of 21st-century competencies?

Methodology

Data collection and participants

This study used a mixed method approach. Data were collected voluntarily online between December 2017 and June 2018 from student teachers at two Finnish universities and three universities of applied sciences. Confidentiality and autonomy were explained to participants at the beginning of data collection. The total number of respondents was 227, of which 55% were from the two participating universities and 45% from the three

participating universities of applied sciences; 24% were male and 76% female student teachers. Of the student teachers, 12% were studying to become kindergarten teachers, 14% class teachers, 21% subject teachers, 8% special education teachers, 30% vocational education teachers, and 15% other teachers, mainly higher education teachers [*].

The research instruments

Previous studies (Hixson, Ravitz, and Whisman 2012; Ravitz 2014) had validated the questionnaire using scales from 1 to 5. This study's questionnaire was translated from English into Finnish, the translation being checked by three experienced researchers whose native language is Finnish and who have expertise in English. The number and definition of competencies and item questions remained the same. The scale for student teachers' self-assessment of their competencies is also from 1 to 5 as with previous studies. However, the main questions were modified to suit student teachers, as the original instrument was intended for schoolteachers, and background information questions were added. Ravitz granted permission to use the questionnaire for this research. The questionnaire instructions were as follows:

> Part A: How well did the TE programme studies (including both pedagogical studies and subject matter studies) help you to achieve the following competencies?

Example: Critical thinking competency, Part A with six items, one item example is: 'Has helped to compare information from different sources when completing tasks or assignments.'
    Part B: Please evaluate your competencies based on your own teaching experience (e.g. from teaching practice or other teaching situations).

Example: Critical thinking competency, Part B with three items, one item example is: 'I can apply methods that support my students' critical thinking skills.'
    Part B includes the option: 'I do not have any teaching experience yet.'
    Qualitative data collection used open-ended questions regarding best practices and major obstacles to acquiring 21st-century competencies, along with suggestions for supporting student teachers' learning of 21st-century competencies in TE. All questions concerned both subject matter studies and pedagogical studies with teaching practice as part of them:

Question1: Please share your stories of your best or most important experience in learning 21st-century competencies.

Question 2: Please share any major barriers or obstacles you experienced in learning these competencies.

Question 3: In what ways can your university or teacher educators help and support you in developing those competencies?

    Examining our study's reliability analysis with Cronbach's Alpha [*] showed that the reliability scores concerning teacher education varied between .886 and .926, and the

scores concerning teaching in practice varied between .828 and .912. The detailed item reliability analysis for each competency was also calculated [*]. The questionnaire was pre-tested and checked with five student teachers before data collection. After several language checks, the questionnaire was uploaded to the online system.

Analysis methods

This study used the mixed method approach. Quantitative data analysis used descriptive statistics and correlations. Descriptive statistics inform the mean value and standard deviation of the student teachers' perception of how well they acquired their competencies. The t-test was used to compare gender differences among student teachers and differences between student teachers from universities and universities of applied sciences. Relationships between the student teachers' competencies learning in TE and their teaching in practice were described by correlations.

The qualitative data analysis used content inductive analysis to identify the key information from qualitative data; such analysis complements quantitative data by providing a deeper understanding of students' quantitative assessments (Mischler 1986;). Two experienced researchers analysed the qualitative data using content analysis and discussed the data analysis to achieve a synthesis in the data interpretation [*]. Inductive content analysis revealed the major aspects contributing to the student teachers' learning of 21st-century competencies, such as courses, teacher educators, teaching method/learning settings, and learning strategies. We strove to identify how these aspects contributed to the student teachers' learning of 21st-century competencies. Additionally, we intended to identify the major obstacles in their learning.

Findings

Competencies acquired in TE and demographic differences

The first research question focused on student teachers' perceptions of their 21st-century competencies achieved during their TE and teaching practice. Based on descriptive statistics analysis [*] of the eight competencies, six had a mean value that varied between 3.20 (SD = .84) and 3.73 (SD = .78). The best-achieved competencies were 'Collaboration' (M = 3.73, SD = .78), and 'Critical thinking' (M = 3.50, SD = .71). The least well achieved competencies were 'Global connections' (M = 2.58, SD = .94) and 'Local Connections' (M = 3.01, SD = .92).

For finding gender and institution differences, the means and standard deviations were used with the t-test [*]. Mean values were slightly higher for male than female student teachers; however, no significant gender differences existed in any of the eight competencies. A comparison of the student teachers from both types of university revealed significant differences in five competencies: collaboration ($p = .04*$), communication ($p = .02*$), creativity & innovation ($p = .02*$), self-direction ($p = .00**$), using technology as a tool for learning ($p = .02*$). The perceptions of competencies of student teachers from universities of applied sciences were generally higher than the perceptions of competencies of student teachers from universities [*].

Competencies applied in teaching practice and demographic differences

For the second research question, we found that student teachers successfully applied almost all of their 21st-century competencies when teaching pupils in a classroom [*]. Of the eight competencies, seven had mean values that varied between 3.24 (SD = .78) and 3.78 (SD = .65). The best-applied competencies were 'Collaboration' (M = 3.78, SD = .65) and 'Using technology as a tool in learning' (M = 3.6, SD = .78). As earlier, the least applied competencies in practice were 'Global connections' (M = 2.9, SD = .95). Regarding the application of competencies, all mean values were slightly higher than the student teachers' perceptions of what they had learned in their TE.

To determine differences in gender and institution, we compared the means and standard deviations of competencies with the t-test [*]. Mean values were slightly higher for male than female student teachers. However, no significant differences existed in gender in most of the eight competencies, except self-direction (p = .01**) and using technology as a tool for learning (p = .04*). A comparison of student teachers from both type of university revealed significant differences in five competencies: Critical thinking (p = .01**), communication (p = .02*), self-direction (p = .00**), global connections (p = .02*), local connections (p = .00*). The reason for the differences in perceptions may be that student teachers in universities of applied sciences are required to have at least three years working experience, which facilitates familiarity with certain competencies in their workplaces.

Relationships of acquired competencies in TE and applied in practice

The third research question focuses on relationships among competencies in TE and in teaching practice, and relationships between competencies acquired in TE and applied in practice. High interconnections were found [*] both among the eight competencies acquired in TE (varying .41** – .74**) and applied in practice (varying .31** – .58**). Statistically significant correlations (varying .34** – .42**) were found to exist between the eight competencies acquired in TE studies and between the eight competencies applied in practice [*]. Consequently, student teachers' learning of 21st-century competencies in TE are highly correlated with their application in teaching. The highest competency correlation between competency acquired in TE and applied in practice occurred in the domain of global connections (r = .42, p < 0.01).

Best practices in 21st-century competencies development

Our analysis of best practices resulted in the following categories (U-ST represents student teachers from universities, and UAS-ST represents student teachers from universities of applied sciences in Finland).

Collaborative learning – learning with and from each other through group work

Of the total 183 responses, 82 claimed that the best way to develop their 21st-century competencies was collaborative learning, including group work, teamwork, peer learning, co-teaching, learning communities, networking, and sharing. Students learned best through interactions; learning both from each other and with each other. As two student teachers from comprehensive universities (U-ST) commented:

'teamwork is most rewarding.' (U-ST1)

"teamwork is most rewarding . . . [you] exchange ideas and hear advice from other students and teachers . . . " (U-ST2)

Another comment echoed this:

"[the best experience] is studying in different groups. There is a tremendous sense of community. We support each other and share with each other. This kind of learning experience had a great deal of significance for me." (U-ST3)

Several student teachers from universities of applied sciences (UAS-ST) confirmed the same finding.

For many years, Finish teacher education has emphasised the importance of cooperation and shared learning, which seems especially important when learning 21st-century competencies.

Deepening the competencies in practice

Several student teachers (n = 79) said that teaching practice is the best practice for learning 21st-century competencies. A student teacher commented:

"the best practice is during the training period [teaching practice time)]! There you can try things out and get practical advice [from a supervising teacher]." (U-ST4)

Another student teacher's comment:

"learned the basics [of those competencies] from courses, then deepened [them] in teaching practice." (U-ST5)

Certain courses are important

Many students (n = 76) praised the quality of courses on offer. Applying technology applications, media, online, animations, and coding courses were considered important.
One student teacher stated:

"in one pedagogical course, we used many different technology tools. The animation was interesting, fun and inspiring." (U-ST6)

Learning to use digital tools opened up new ways of teaching:

"ICT skills have been this kind of 'aha' experience that I still enjoy and remember." (U-ST7)

Many students considered that learning about digital tools was 'the most useful thing I have experienced during my studies' (UAS-ST1).

Student teachers mentioned that the teaching methods and contents of certain courses were useful in developing their 21st-century competencies, such as courses in didactic, educational psychology, history, art and handicraft. Course descriptions included comments on teaching methods and reinforced the importance of collaboration, that is intensive conversations and sharing, such as via group chat. Student teachers' experiences emphasised the importance of learning communities. The opportunities to engage and integrate knowledge and practice resulted in student teachers' appreciation of active learning processes such as making videos, audio essays, analysing old teaching cases, and project- and problem-based learning.

Major obstacles to student teachers' 21st-century competencies development

We also analysed the major obstacles to the student teachers' learning of those competencies. Of the 272 respondents, 188 student teachers described their experiences, of which 8.5% (16 out of 188) claimed no barriers existed. The three main identified challenges are described below.

Insufficient time, practice and resources

The most often mentioned barrier was insufficient time (25 of 188 respondents). Also mentioned were insufficient practice and insufficient resources, such as computers, cameras, 3D printing, software licences, different applications, digital skills, lacking resources

'Lack of time or lack of resources.' (UAS-ST2, UAS-ST3)

'Things taught are not practised.' (U-ST8)

Insufficient support and inadequate ability of some educators

Also listed were barriers to learning, which related to teacher-educator's skills such as weak competency or low motivation, old-fashioned ways of teaching, and mass lectures. Student teachers would have needed more support from teacher educators, particularly concerning student teachers' individual needs or differences. Problems identified in some courses included: too many things happening at once, too much course content, too little instruction, unclear information, and little integration of skills into the course. Students also mentioned poorly organised group work, such as overly large groups, insufficiently clear instructions for group work, constantly changing study groups, too much time spent on scheduling group meetings, and giving feedback in a big group.

Some students were argued that 21st-century competencies were poorly taught.

" . . . these skills are not systematically, consistently, thoroughly taught, but they are taught through learning other things . . . and skills are also not evaluated adequately . . . " (UAS-ST9)

Fear, attitude, lacking confidence and motivation

One interesting finding concerns student teachers' self-reflective comments on their own development: 7 participants lacked motivation, 5 participants lacked courage or initiative, 2 participants lacked self-confidence in learning or were uncertain about their own competencies.

"the biggest obstacle is my own courage to try out [those skills] in a new situation." (UAS-ST8)

"probably your own perceived attitude is often the biggest obstacle [in learning 21st-century competencies]." (UAS-ST9)

Suggestions for developing 21st-century competencies

The student teachers were asked for suggestions regarding supporting their learning of 21st-century competencies in TE. Of the 272 respondents, 191 answers received fall into the following categories, confirming our earlier realisations.

More collaborative teaching and learning

The suggestions dovetailed with previous identifications of best practices: more collaboration with colleagues/peers, co-teaching opportunities, and opportunities to share experiences with other student teachers.

> "21st-century competencies in learning and teaching can be practiced in small groups." (U-ST9)

'more structured collaboration with peers.' (UAS-ST4)
> 'Sharing experiences is very important.' (UAS-ST5)

Specific courses and teaching methods

The student teachers wished for more courses in the following areas: courses which consist of 21st-century competencies, psychological aspects of learning, using various technology/ICT/digital tools in different teaching situations, online learning and teaching, dealing with challenging situations at school (e.g. bullying at school, interaction with parents) and interaction skills, along with more teaching practice.

> "More specific, systematic or comprehensive learning and teaching of those competencies." (UAS-ST6)

> "how to teach those competencies integrated with a specific subject/field." (U-ST10)

> "some teaching at the universities is old-fashioned, it needs to be adapted to the 21st century." (U-ST11)

> "a good way to learn those competencies could be learning by teaching them, this can be tried out in small groups." (U-ST12)

Integrating theory and practice

Many student teachers wanted better methods to integrate theory and practice:

> "I hope that we will have more concrete tools and methods in developing those competencies . . . the important aspects are not only why and what, we also need to know how . . . we know the theory, but we do not learn how to apply it in practice for teaching in class."

> "exams do not help in learning the competencies, it should be based on true-life situations." (U-ST13)

> "those competencies should be integrated into teaching methods and exercises so that the student teachers are able to practice them in teaching later on." (U-ST14)

'More practical methods and ways to apply the theory.' (U-ST15)

Learning continuously

Student teachers highlighted the need for continuous learning and development: further training, more specific competencies courses, more practice, and going deeper into the competencies.

> "learning those competencies takes time, it is a continuous process. I would love to go deeper into learning and teaching those competencies." (U-ST16)

'More training is still needed after graduation from university.' (UAS-ST13)

"The TE programme taught me that I can never learn too much or enough, there is always something new to learn." (U-ST17)

"In all competencies, you can always evolve and never be so-called ready! I am keen to learn new things and to develop things that I have already been learning." (U-ST18)

Discussion

The student teachers' self-assessment revealed that TE trained them very well in 21st-century competencies. Many factors may have contributed to this positive result, such as the strong focus of the Finnish education system on 21st-century competencies in the latest national core curriculum (FNAE 2014) and teacher education programmes (FNAE 2018). Another possible factor concerns the quality of teaching practice, which has many phases and is connected to theoretical studies. A third possible factor concerns Finnish TE's long history of promoting the development of competencies and social-emotional skills, as the teaching profession involves everyday interaction with people (Niemi 2002). A fourth possible factor concerns the high quality of candidates admitted to TE in Finland (FNAE 2018; Niemi 2015). However, the competencies of 'Local connections' and 'Global connections' remain lower than other competencies both at a theoretical and teaching practice level. Further development in these two competencies is needed in the future.

This study demonstrated the importance of student teachers' competency learning by integrating the learning in TE and in teaching practice. Ball (2000) highlights the importance of integrating knowledge with action. Several other researchers (Pantic and Wubbels 2010; Struyven and De Meyst 2010; Westera 2001) also discuss the importance of integrating knowledge and skills in professional tasks and situations. This came out very clearly in the student teachers' responses. Combing theoretical learning and applying it in practice is the best way to learn and develop the competencies. Both the quantitative and qualitative data suggest the most effective way of learning is combining theoretical learning and applying 21st-century competencies. This is a continuous process. Revealed were high correlations among competencies achieved in TE studies and in practice. This demands the whole TE systems and their culture to foster these competencies extensively (see e.g. Binkley et al. 2012; Griffin et al. 2012; Lee and Tan 2018).

Based on the qualitative data, we discovered that student teachers learn both from and with each other through group work, teamwork, peer learning, collaborative learning, co-teaching, learning communities, networking, and sharing. This finding fits well with the social-cultural theory (Vygotsky 1978), according to which learning is a socially and culturally related process that occurs when interactions exist between learners.

Both quantitative data and qualitative data, based on student teachers' self-assessment, demonstrated that the competency of collaboration was assessed with the highest scores among the eight competencies in this study. This confirms earlier studies on Finnish student teachers' learning of 21st-century competencies (Valtonen et al. 2017; Häkkinen et al. 2017).

Student teachers described many positive elements of TE, especially the group work supported the students' learning of 21st-century competencies. Some improvements are still needed to maximise the benefits, such as smaller group sizes, clearer instructions for group work, and finding suitable time slots for group work. Additional suggestions for

improvements were: (1) more integration of theory and practice, (2) more courses which consists of 21st-century competencies, and (3) courses which have teaching methods that involve students in active roles and collaboration. Student teachers also need more time to develop their competencies. Student teachers learned both from their courses and teacher educators; however, insufficient support from teacher educators was one obstacle to their learning.

In conclusion, based on self-assessment, the Finnish student teachers successfully achieved their 21st-century competencies both in TE and in teaching practice. No difference existed between female and male student teachers' perceptions. Regarding the different types of universities, the perceptions of student teachers from universities of applied sciences were slightly higher for almost all competencies, and significantly higher for certain competencies than student teachers' perceptions from universities. In addition, student teachers felt that they best learn 21st-century competencies from group work by learning both from and with each other; from certain courses and teacher educators; and from teaching practice. The major obstacles were too little time, deficient resources, insufficient support from teacher educators and inadequate teaching methods in some courses.

Conclusions and practice implications

The following implications and suggestions for teacher educators may support the development of student teachers' 21st-century competencies: paying more attention to competencies of Local and Global connections, facilitating effective group learning opportunities; improving teacher educators' own competencies; integrating theoretical learning and practice; making competency development more visible by defining them in learning outcomes and offering more specific courses for those competencies; ensuring sufficient time for learning, practice and discussion; and developing student teacher's confidence, positive attitude and mindset for continuous growth. This study shows that teacher education programmes are crucial for student teachers 21st-century competencies development. Teacher educators play a vital role in facilitating the student teachers' acquiring competencies and enabling them as active learners through group work and teaching practices in interactive and collaborative learning environments.

Although this study was carried out in Finland, these ideas can also be used elsewhere to support student teachers' 21st-century competencies, such as students learning both from and with each other through group work, integrating knowledge and action by practicing the competencies in teaching. Also important is student teachers becoming aware of competency learning; creating positive attitudes to continuous learning; and building the learning to learn skills so that the student teachers can always start learning a competency whenever needed.

Limitations and future research

The findings of this study are based solely on self-assessments. External observation and other parties' assessments would help to verify the results. The voluntary and online responses may be biased as possibly only the most active student teachers responded. Further studies could also follow up student teachers' development, for example after graduation when they are

teaching in schools. Similar studies could be replicated in other countries to gain a broader understanding of the development of 21st-century competencies.

Note:

The Tables and further details indicated [*] in the text are also available at: https://tuhat.helsinki.fi/ws/portalfiles/portal/167032845/20210730_Tables_in_the_article_of_Finnish_student_teachers_21st_century_competencies.pdf

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