

University of Tartu
Faculty of Social Sciences
Institute of Education
Curriculum: Educational Technology

Olga Lutška

DESIGN AND EVALUATION OF A TEACHER TRAINING SERVICE TO DEVELOP
TEACHERS' DIGITAL COMPETENCES

MA thesis

Supervisor: Senior Research Fellow of Educational Technology, Leo Aleksander Siiman, PhD

Tartu, 2019

Abstract

Design and evaluation of a teacher training service to develop teachers' digital competences

The modern system of education requires digitally competent teachers. However, educational institutions still face a problem of teachers' insufficiently developed digital knowledge and skills. To solve the problem and empower teachers to use digital technology meaningfully we should invest in their lifelong learning opportunities, providing advanced training services. The primary objectives of this study were to find out what a well-designed teacher training service, enhancing the teacher digital competence, should be, and what makes such a service useful and productive. The case study demonstrates how a short-term teacher training service can contribute to an educational institution digital plan development. The research reported an improvement in teachers' digital competence and suggests essential components of an effective training service.

Keywords: teacher training service, digital competence, digital plan, ADDIE instructional design model, Technological Pedagogical Content Knowledge

Table of Contents

Title	1
Abstract	2
Table of Contents	3
Introduction	5
Research Problem	5
Evaluation Data Analysis (Digital Mirror, 2017)	7
NKG Teachers' Internal Evaluation in Comparison to NKG Administrative Staff's Digital Mirror External Evaluation of the School Digital Development	8
Internal Evaluation Data Analysis	9
The Level of NKG Digital Development in Comparison with Other Estonian Schools	11
The Digital Solution	12
Research Questions	12
Theoretical Background	12
The Importance of Teacher Digital Competence in the Digital Age	13
The European Commission Policies Supporting the Teacher Digital Competence	13
A Teacher Training Service as a Way to a Digitally Competent Teacher	15
A Framework for Teacher Knowledge	15
Methodology	16
Qualitative Research	16
Design and Development Research	17
Case Study	17
Sampling	18
The Sampling Strategy to be Used	18
The access to the sample	18
Data collection methods	19

Questionnaires	19
Observation	20
Methodology for a Teacher Training Service	21
ADDIE Instructional Design Model for an Advanced Instructional Service	21
The Teacher Training Service Design and Methodological Approaches to Be Used	22
The Teacher Training Service Curriculum	22
The Teacher Training Service Development	23
The teacher training service implementation	23
Results and discussion	23
Observed teacher behaviour during training	24
Teachers' evaluation of the training service	25
Pre- and Post-Questionnaires	28
Limitations and Future Research	31
Acknowledgments	32
Author's declaration	32
References	33

Appendix 1. Questionnaire. Evaluation of the service content and its delivery to be completed by teachers

Appendix 2. Observational Protocol

Appendix 3. ADDIE instructional design model for a teacher training service aimed at NKG teacher digital competence development

Appendix 4. The teacher training service curriculum

Appendix 5. The teacher training service syllabus

Introduction

Research Problem

The digital era we live in, as well as unlimited access to technological advances, have increasingly questioned traditional teacher-student modes in education in recent years, and the role of teachers and educators has evolved to a great extent. The digital revolution we witness today requires an educational paradigm shift, i.e. more digitally competent teachers, systematically and effectively implementing innovative approaches to their instruction methods to meet the real needs of the contemporary learner. “The age of teaching from the front of the room, like drawing on rock with charcoal, or writing on blackboard with chalk, or scribing on an interactive whiteboard, are over.” (Burns, 2016). However, teachers still lack sufficiently developed digital skills and knowledge to responsibly deliver them to the learner as well as readiness and motivation to change their professional mind-sets obsessed with age-old methods. According to Cruz and Diaz (2016) teachers lack “confidence and inadequate competence in the field of ICTs from both a technological and a pedagogical perspective.”

The current thesis aims to tackle the problem of low digital competence among teachers at Narva Kesklinna Gymnasium (NKG), in Estonia. To start with, Estonian schools’ digital development have been measured and assessed using the Digital Mirror, school evaluation dashboard (Digital Mirror), developed by the University of Tallinn (School of Digital Technologies) whose framework model is based on the three dimensions of digital development: 1) Learning Paradigm, 2) Directing Changes and 3) Digital Infrastructure. The reports are submitted by administrative staffs, including principals, Head Teachers, and IT managers of schools. This evaluation platform also suggests a digital development plan devised following a school digital development level, whose aims have to be reached, and whose realisation is tracked and controlled by the Information Technology Foundation for Education in Estonia. Concerning the Learning Paradigm dimension, it is essential to point out that it is based on the Organisation for Economic Co-operation and Development (OECD) report (OECD, 2015), which in turn was a baseline for this dimension five-level criteria designed by the University of Tallinn (School of Digital Technologies). This five-level scale was also based on the European Schoolnet iTEC (*Innovative Technologies for Engaging Classrooms*) project (2014), which distinguishes the following digital development levels:

1. Level A - episodic use: digital devices are used in individual isolated cases in the context of traditional learning.
2. Level B - in-school coordination: new approaches and learning methods are tested using digital tools through the exchange of experiences between teachers.
3. Level C - learning process change: systematic changes in the organisation of learning at a school level, based on the involvement of students as authors/creators/ designers.
4. Level D - the whole - digital school culture: integrated technologies become an unobtrusive and widespread part of work, and the student is the developer and manager of his / her learning environment.
5. Level E - school leadership in innovation: the school's digital learning activities extend beyond the school, students take responsibility for designing their learning path and partly for teaching others.

Figure 1 shows the Digital Mirror school report for the case of NKG. The current research is focused only on this first dimension, the Learning Paradigm, as it directly concerns the teacher professional competence area as a basis for further improvement. It includes the following subtopics: 1.1. Methods of the digital age – changes in pedagogical tools, 1.2 Development of digital skills, 1.3 The role of the teacher, 1.4 The role of the student, 1.5 Study arrangement. Next, the results of the NKG report will be explained and interpreted.

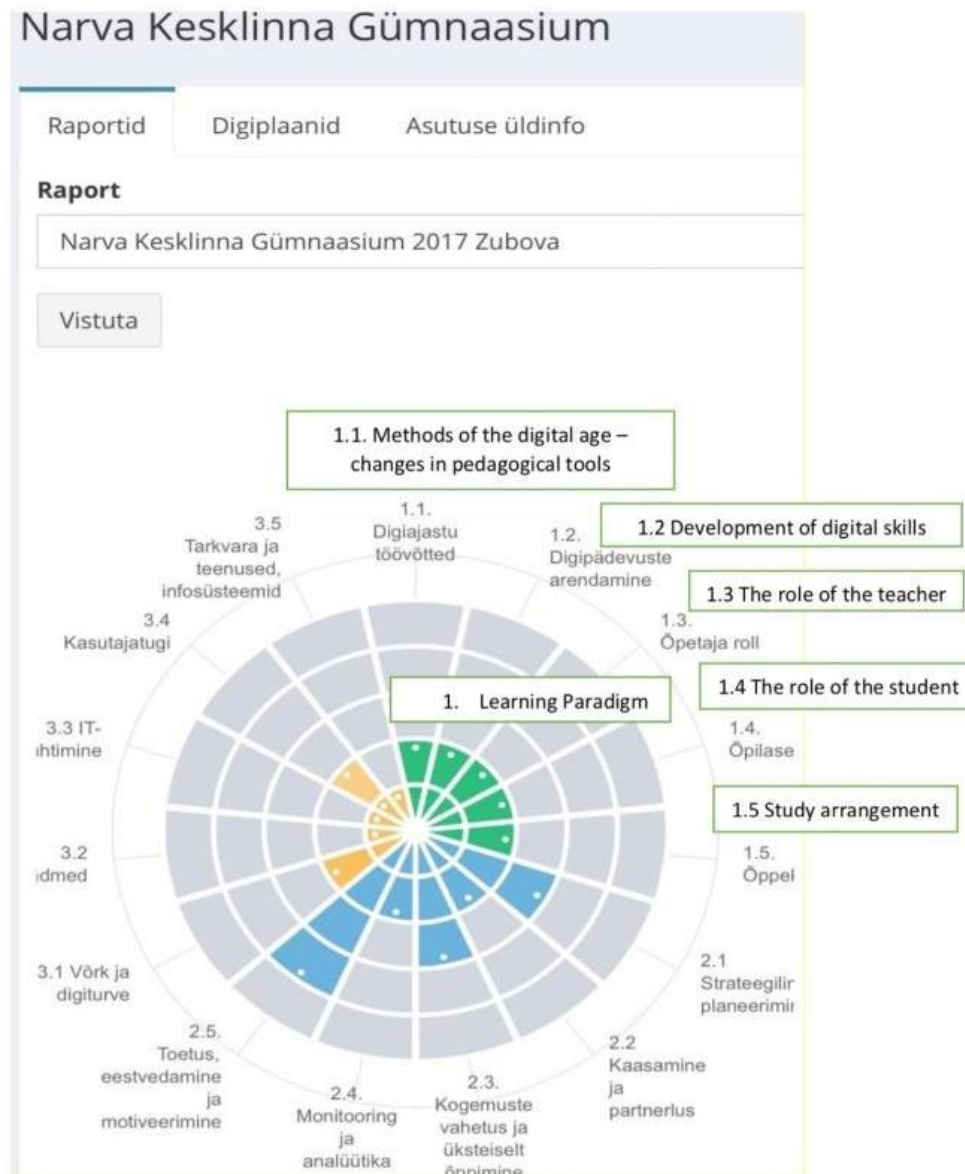


Figure 1. NKG 2017 Digital Mirror evaluation report.

Evaluation Data Analysis (Digital Mirror, 2017)

The report (see Figure 1) demonstrates the fact that NKG is at the B level in terms of the Learning Paradigm in its digital development, which, according to Digital Mirror, implies the following:

1.1. Methods of the digital age – changes in pedagogical tools - at least a quarter of NKG teachers have changed their goals and learning outcomes based on the revised concepts of

modern education, and involve educational technologies as well as use innovative teaching methods (research-based instruction, projects, etc.) in their work.

1.2 Development of digital skills - at least a quarter of NKG teaching staff has a digital competence developed at a sufficient level, and digital technologies are used in class to create digital literacy of students in different subjects. There are also teachers who only have a blackboard and chalk in their classroom, so do not use ICT tools at all.

1.3 The role of the teacher - at least a quarter of NKG teachers participate in collaborative projects involving other colleagues. Collaborative projects are usually short-term and relate to teachers who teach students of the same age group or in the same field of study. Collaboration mostly takes place in the eTwinning environment and Erasmus + projects coordinated only by some teachers of foreign languages.

1.4 The role of the student - at least a quarter of NKG teachers experiment with innovative learning scenarios and methodologies in which students learn actively, creatively, entrepreneurially, and collaboratively. Pupils are allowed to contribute to the planning of their learning based on their interests and abilities.

1.5 Study arrangement - at least one-quarter of NKG teachers take the initiative and change the design of the learning process, including syllabuses, lesson plans, a class arrangement following the innovative approaches. At least a quarter of the teachers sometimes use digital teaching materials and web-based tools in their classes.

NKG Teachers' Internal Evaluation in Comparison to NKG Administrative Staff's Digital Mirror External Evaluation of the School Digital Development

To get a more in-depth overview, an internal evaluation was carried out among a sample group of 17 teachers from different subject areas and of different ages. Collecting and analysing teachers' judgments were also applied only to the first dimension (1. Learning Paradigm) since it directly concerns their professional competence area (1.1. Methods of the digital age – changes in pedagogical tools, 1.2 Development of digital skills, 1.3 The role of the teacher, 1.4 The role of the student, 1.5 Study arrangement).

Internal Evaluation Data Analysis

1.1 Methods of the digital age – the majority of 17 respondents (64,7 %) agree with the fact that at least a quarter of teachers have changed their goals and learning outcomes based on the revised concepts of modern education and involve educational technologies as well as use innovative teaching methods (research-based instruction, projects, etc.) in the work.

1.2 Development of digital skills - the majority of 17 respondents (64,7 %) agree with the fact that at least one-quarter of the teaching staff has a digital competence developed at a sufficient level and digital technologies are used in class to develop digital literacy of students in different subjects.

1.3 The role of the teacher – 13 out of 17 teachers in question disagree entirely with the fact that at least a quarter of teachers participate in collaborative projects involving other colleagues. They consider this number to be significantly less than presented in Digital Mirror research.

1.4 The role of the student – 16 out of 17 teachers agree that at least a quarter of them experiment with innovative learning scenarios and methodologies in which students learn actively, creatively, entrepreneurially and collaboratively, and students are allowed to contribute to the planning of their learning based on their interests and abilities.

1.5 Study arrangement – almost half of the respondents (52,9 %) agree that at least one-quarter of teachers take the initiative and change the design of the learning process including syllabuses, lesson plans, a class arrangement following innovative approaches. Answering the last concluding question on the necessity for a modern teacher to change goals, methods and learning outcomes in terms of the development of educational technologies, 15 out of 17 respondents gave an affirmative answer.

To sum up, the two approaches, on the whole, complement one another since the administrative staff's vision of the problematic situation in the use of educational technology in school aligns with the teachers' judgments with respect to 1.1 Methods of the digital age, 1.2 Development of digital skills, 1.4 The role of the student as well as 1.5 Study arrangement. However, on the subtopic of 1.3 The role of the teacher, their opinions are in great contradiction with each other. This fact demonstrates the administrative staff unawareness of the teachers' role in collaboration and interaction with each other in sharing

their digital learning experience. In the Digital Mirror report, the principal mentions eTwinning and Erasmus+ opportunities but these European educational platforms are familiar only to a restricted number of teachers of foreign languages. The majority of teachers of NKG assess themselves as those lacking this critical experience for their digital competence development, which is relevant only to A level according to the Digital Mirror model. So, considering everything, the main aim of the digital strategic development plan (Figure 2) will be to upgrade the B level of methods of the digital age, development of digital skills, the role of the student and study arrangement to the C/D level with a particular emphasis on the role of the teacher. The teachers also admit the need for making changes in goals and methods of instruction concerning technological advances in education, which may demonstrate their readiness for further continuous improvements of their digital competence.

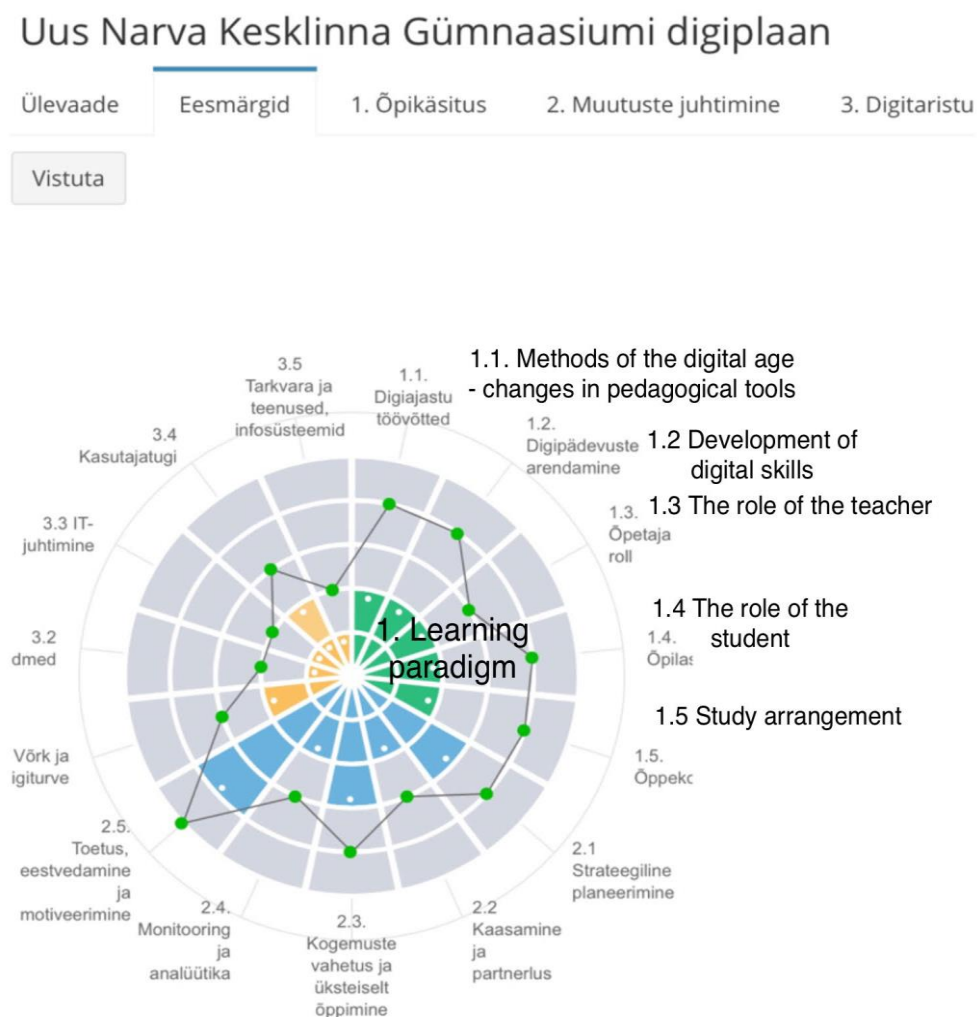


Figure 2. NKG (Narva Kesklinna gümnaasium) Digital Plan. Digital Mirror (2017)

The Level of NKG Digital Development in Comparison with Other Estonian Schools

Digital Mirror provides schools also with an opportunity to compare their digital development to other schools in Estonia. In these terms, the report (Figure 3) demonstrates the fact that NKG B level is identical to the same level of other Estonian schools concerning the dimension in question, 1. Learning Paradigm (in green), in the areas of 1.1 Methods of the digital age – changes in pedagogical tools, 1.3 The role of the teacher, 1.4 The role of the student, 1.5 Study arrangement. However, the area 1.2 Development of digital skills, is less developed in NKG than in other educational institutions and, therefore, requires more attention to be improved and expanded.

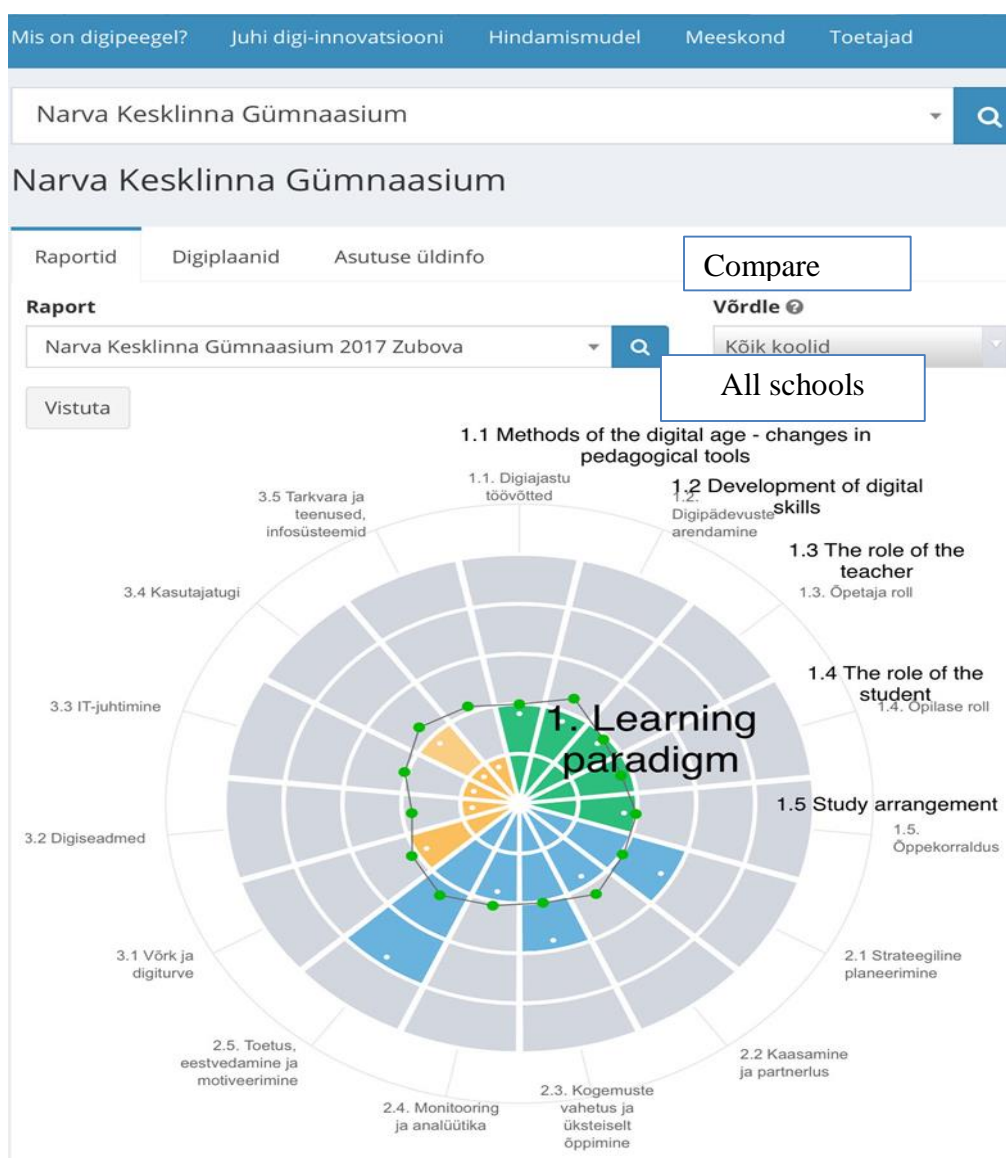


Figure 3. Comparative Report. Digital Mirror (2017)

The Digital Solution

The way to tackle the issue and empower teachers to use digital technology meaningfully is to invest in their lifelong learning opportunities. To reach this objective, a great variety of teacher training services, workshops, seminars, etc. are provided where teachers are equipped with specific skills to be able to use this or that software or hardware tool such as Learning Apps, 3D Design and 3D Printing, photo editing, interactive presentation tools, etc.

According to Mishra and Koehler (2006), "This standard approach suggests that teachers need to be trained to use technology. Underlying this approach is a view of technology that sees it as being a universally applicable skill; unlocking the power and potential of technology can be achieved by acquiring basic competency with hardware and software packages. /.../ The leap of faith, however, is that by demonstrating their proficiency with current software and hardware, teachers will be able to incorporate technology into their classrooms successfully." (Mishra & Koehler, 2006)

Research Questions

Consequently, the research questions are the following: (1) What should a well-designed teacher training service, enhancing the teacher digital competence, be, and how should it be appropriately delivered? (2) What are the teachers' opinions about the usefulness and effectiveness of the implemented teacher training service concerning their digital competence development?

Theoretical Background

The current literature research is based on information-gathering from different studies that have examined the theses relevant topics concerning the importance of the teacher digital competence development in the digital age, and a quality teacher training service design as a way to a digitally competent teacher. The data collection, in turn, is analysed and interpreted to reach a deeper meaning and understanding of the issues raised in this paper. It also helps to find the answer to the research question (What a well-designed teacher training service, enhancing the teacher digital competence, should be, and how it ought to be appropriately delivered?), hence, to generate new knowledge to be applied in the empirical part.

The Importance of Teacher Digital Competence in the Digital Age

Lately, there has been a rapid increase in using digital technologies in all life areas. The topic of the demand for a change in approaches to the learning process is hotly debated today and divides opinion. However, without a doubt, it should be admitted that a 21st-century student requires an entirely new mode of instruction due to technological changes and globalisation. An educator can make a difference only if he or she is open to new things, independent, daring, and ready to learn continually. According to Erstad (2010) problems the digital generation faces are closely related to questions about how we develop an education system that can face the challenges of the 21st century. As far as the digital generation is concerned, M. Prensky (2001) defines its representatives as Digital Natives, "who think and process information fundamentally differently from their predecessors. These differences go far further and deeper than most educators suspect or realize. / ... / Digital Natives are used to receiving information fast. They like to parallel process and multi-task. They prefer their graphics before their text rather than the opposite. They prefer random access (like hypertext). They function best when networked. They thrive on instant gratification and frequent rewards. They prefer games to "serious" work."

As for teachers, Prensky (2001: *ibid*) considers them to be Digital immigrants who believe learners to be the same "and that the same methods that worked for the teachers when they were students will work for their students now. But that assumption is no longer valid. Today's learners are different".

It means that if we want our school leavers and graduates to be well-educated, digitally-minded, hence, successful citizens on the modern job market, it is of prior importance for us to exchange traditional modes of instruction for innovative, inclusive, interactive and collaborative approaches equipped with a variety of digital tools and environments used in a meaningful way.

The European Commission Policies Supporting the Teacher Digital Competence

European teachers in terms of their digital professional development have a lot of scaffolding provided by the European Commission, whose one of the main priorities is the EU citizens' digital development, and which has supported educational institutions with a wide choice of

policies, actions and initiatives to promote and foster digital skills among various target groups in an educational setting. For example, according to *Digital Competence Framework for Educators* (EU SCIENCE HUB, DigCompEdu) teaching professions face a lot of challenges today, which require a more complicated set of competences. This framework describes in depth what it means to be digitally competent and aims to support all teachers in Europe in their professional development in this sphere. A contemporary educator should consider six main areas of the digital competence which include (1) the professional environment, (2) sourcing, creating and sharing digital resources, (3) managing the use of digital tools in teaching and learning, (4) digital tools and strategies to enhance assessment, (5) the use of digital tools to empower learners, (6) facilitating learners' digital competence. Areas 2 to 5 are focused on pedagogy. Hence, they are the key competences educators need to acquire to provide practical and innovative learning strategies, using digital tools.

There is another framework proposed by the International Society for Technology in Education (ISTE) called ISTE Standards, which includes standards for educators and students to rethink education and create innovative learning environments.

If to compare these two frameworks, it could be concluded that both of them aim to capture a contemporary educator-specific digital competence, including competence areas. They have mostly the same meaning and content with the same objectives under almost the same headings. However, there are some differences. Firstly, ISTE Standard for Educators is featured with one more competence area – Citizen, which emphasises the educator's role as a citizen who aims "to inspire students to contribute to positively and responsibly participate in the digital world, create experiences for learners to make positive, socially responsible contributions and exhibit empathetic behaviour online that build relationships and community." This competence is of great importance for a learner as a future citizen being capable of successful digital communication at national and international levels. Secondly, ISTE Standard for Educators draws special educator's attention to co-learning with students while discovering and using new digital resources, diagnosing, and troubleshooting technology issues, which means that teachers not only create environments for students' collaboration with each other but also become active learners and participants in the process of skills and knowledge acquisition. Finally, the European Framework for the Digital Competence of Educators, unlike ISTE Standard for Educators emphasises the learners with

special needs who especially require accessibility to learning resources and activities to avoid exclusion in the digital society.

Another European Commission document that deserves any contemporary teacher's attention is DigComp into Action: Get inspired, make it happen (Cluzer et al., 2018). It is a user guide to the European Digital Competence Framework, which provides 38 existing inspiring practices of DigComp implementations, case studies, and tools, and can be used by both teachers and educational institutions to start their digital professional development.

These assumptions about the importance of teacher professional digital development and the necessity of readiness for urgent changes in teaching Digital Natives (Prensky, 2001) as well as reference to European frameworks for educators' digital competence is a basis for further study and will be used in the empirical part – design, development and implementation of a quality teacher training service.

A Teacher Training Service as a Way to a Digitally Competent Teacher

A Framework for Teacher Knowledge

The way to tackle the issue of a gap in teacher digital development and empower the teacher to use digital technology meaningfully is to invest in his or her lifelong learning opportunities. To reach this objective, a great variety of teacher training services, workshops, seminars, etc. are provided worldwide where teachers are equipped with certain skills to be able to use software or hardware tools. It implies that traditional instructional products and services whose aim is to provide a student teacher with some knowledge and skills are focused only on the practical use of technology, and do not enable "learners to practise authentic tasks, by simulating realistic contexts." (Verstegen, et al., 2008) However, such tasks are useful and valuable aspects for everyday work based on teachers' practical experiences and have a link with the teacher theoretical knowledge. (Leijen et al., 2013)

That is why recent studies in the area of educational technology are featured with a lack of theoretical baseline. According to Leijen (2013), "teacher education programs in Europe and beyond have been criticized in the past for leaving a "gap" between theory (i.e., research-generated knowledge) and practice." It could be concluded that present teacher – training instructional services should aim to support teachers' new digital knowledge and skills in correlation with their theoretical, pedagogical knowledge. Concerning this, it is relevant to

refer to Mishra and Koehler (2006) who strongly believe that "thoughtful pedagogical uses of technology require the development of a complex, situated form of knowledge / ... / - Technological Pedagogical Content Knowledge (TPCK)". In other words, this model of technology integration in teaching and learning proves "that developing good content requires a thoughtful interweaving of all three key sources of knowledge: technology, pedagogy, and content." (Mishra and Koehler, 2006) They also argue that no single technological solution applies for every teacher, every course, or every view of teaching; however, appropriate, context-specific strategies and representations should be developed.

It means that teachers' new knowledge should consist of three components (content, pedagogy, and technology), which allows educators to use methodology equipped with an appropriate digital tool to teach new content and reach learning objectives aligning with a curriculum.

All the facts discussed above lead to the following conclusions:

- the teacher should deliver a progressive modern way of instruction focused on the needs of the new generation of Digital Natives (Prensky, 2001),
- in order to enhance his or her digital competence the teacher should be provided with advanced teacher training services which will be in tune with the European Commission policies (DigCompEdu, ISTE Standards), and where their new digital knowledge and skills will be correlated with their theoretical, pedagogical knowledge, following the Technological Pedagogical Content Knowledge model. (Mishra and Koehler, 2006)

Methodology

Qualitative Research

Qualitative research applies to the study as it explores complex issues and interactions between people, reasons for outcomes, and it aims to understand and interpret specific social interactions. In light of this, the research purpose is to explore what an advanced teaching - training service aimed at enhancing teachers' digital competence is, how it should be implemented to nurture the teachers' needs with respect to their digital development as well

as to analyse and interpret collected data in order to draw conclusions to be applied for further improvement or in similar situations.

Design and Development Research

The model of design and development research (DDR) on products and tools is used to the current study as well. It is characterised as "a type of inquiry unique to the instructional design and technology field dedicated to the creation of new knowledge and the validation of existing practice." (Spector et al., 2014) In other words, it is about the creation of an empirical basis for an instructional product or tool. In this paper design and development of a teacher training service as a tool is performed with its further implementation and evaluation. DDR also "deals with real-life projects, rather than with simulated or contrived projects, / ... / leads to knowledge production, a more complete understanding of the field" (Spector, et al, 2014) which is applicable to this study, taking place in a real-life educational setting (Narva Kesklinna gümnaasium) facing a real-life complex educational problem (a gap in teachers' digital competence), requiring a solution (a teacher training service).

Case Study

A case study as a research method is appropriate for the theses as it implies a systematic investigation of a group of people (a group of teachers) as well as an examination of a complex phenomenon (design, development, and implementation of a teacher training service) in the natural setting (Narva Kesklinna gümnaasium). The case study is aimed at the analysis of the phenomenon rather than at numerical data (Cohen et al., 2007) leading to conclusions and generalisations which can help in the research of other similar problems, cases, and phenomena. Hence, the analysis of a quality teacher training service based on the researcher's observations and data collection from teachers is a baseline for generalisations about an advanced instructional product.

As far as the role of the researcher is concerned, being in the role of a mentor, she is an active participant of the case whose purpose is to assist, direct, support and encourage her colleague - teachers in the development of their digital competence, suggesting them a quality teacher training course. The importance of the role of the researcher in the case study is emphasised by Hitchcock and Hughes (1995). They claim that the researcher should be

"integrally involved in the case" to provide an in-depth description of events relevant to the situation.

Sampling

The quality of the research is also provided by the suitability of the sampling strategy that is used by the researcher. It must be based on the population on which the study is concentrated. (Cohen et al., 2007) So, the sample included eleven teachers of Narva Kesklinna gümnaasium (a small number of targeted participants features the qualitative research), which is an educational institution facing a problem of its staff's insufficient digital competence development and requiring measures to improve the situation.

The Sampling Strategy to be Used

A non-probability sample method was used to choose teachers in question, which is suitable for the case in small-scale research within one school. The researcher targeted a particular group, which represents itself. (Cohen et al., 2007)

A convenience sampling also takes place in the research. It is also called opportunity sampling and "involves choosing the nearest individuals to serve as respondents and continuing that process until the required sample size has been obtained or those who happen to be available and accessible at the time." (Cohen et al., 2007) The main reason for this kind of sampling is teachers' time management, which implies a lack of time or participation in other teacher training services. The researcher chose the sample from the teachers to whom she had easy access.

However, to give more value to the service and make it cross-curricular, eleven teachers were chosen from different subject areas (primary school teachers, teachers of Nature Studies, Handicrafts, English and Estonian, Social Studies).

The access to the sample

Access to the sample is a critical issue in any research and can be difficult and problematic. In terms of this study, because of the teachers' common problem of time management, which the researcher could not afford to neglect, by popular request, it was decided to have eight thirty - minute sessions once a week in a school computer lab.

Data collection methods

In this paper, data collection activities are aimed to study a process of a quality teacher training service design as well as to assess and analyse its implementation in a real-life setting. The case study data collection is focused on extensive forms of information such as a questionnaire and observation. The information is recorded employing an observational protocol. As far as storing data is concerned, it is stored in computer files.

Questionnaires

To collect data, a questionnaire (Appendix 1) was designed to be carried out at the end of the training service to obtain the teachers' opinions and feedback on the service content and its delivery concerning their digital competence development. The teachers were asked to express their point of view on the importance of theoretical and pedagogical background in the training service, a combination of face-to-face meetings with online platforms, collaboration with colleagues as well as content specific authentic learning environment. The teachers also provided answers to open-ended questions about what they liked or disliked in the training activities, and were asked to give recommendations for further similar teacher-training services. Also, it provided the answer to the first research question: What should a well- designed teacher training service, enhancing the teacher digital competence, be, and how should it be appropriately delivered?)

Also, pre- and post- questionnaires (Table 1) were designed basing on NKG digital plan, including the five areas of the dimension The Learning Paradigm: 1.1. Methods of the digital age – changes in pedagogical tools, 1.2 Development of digital skills, 1.3 The role of the teacher, 1.4 The role of the student, 1.5 Study arrangement. (Digital Mirror) They were provided to determine the initial level of teachers' in question digital competence and compare it with the one after the teacher training service implementation. Hence, they helped to assess the usefulness and effectiveness of the service and answer the second research question: What are the teachers' opinions about the value and effectiveness of the implemented teacher training service concerning their digital competence development?)

Observation

The method of observation is implemented in the research as it provides an investigator with the possibility to collect 'live' information within a real-life social situation. (Cohen et al., 2007) Cohen (ibid) refers to Moyles (2002) who argues that observational data demonstrates "strong ecological validity" including personal knowledge, which assists researchers to get a more in-depth insight into the context of programmes that can be not to be paid proper attention to in other types of data collection. It also contributes to the answer to the first research question.

Cohen (ibid) takes a reference to Le Compte and Preissle (1993: 93–4) concerning the role of the researcher in an observation process. As for this study, the researcher takes the role of the 'participant - as - observer' who "is part of the social life of participants and documents and records what is happening for research purposes." Cohen (ibid)

The observation protocol (Appendix 2) in this research paper includes the following checklist of the content: (1) meanings and goals - how participants explain the purposes of the course, and what goals they are trying to achieve, (2) the number of sessions attended by the teachers during the course, (3) participation and activities (what the participants did, how active, motivated and self-regulated they were) (Cohen (ibid)) as well as (4) metaphors of learning (the teachers' preferable modes of gaining new knowledge and skills in their digital competence development). (Simons et al., 2008) The latter one is of great importance as it provides the researcher with possibilities to organize learning in various ways considering the teachers' preferable ways of acquiring new knowledge and skills. In these terms, Simons (ibid) suggests a system of five metaphors of learning, which was used in the observation process:

1. Apperception metaphor. The teacher learns well under pressure and "in a hectic, relatively unpredictable and constantly changing work environment. They look for situations that will teach them something".
2. Participation metaphor. The teacher prefers to learn socially with and from others, arriving at a collective meaning. She needs a mentor who guides the process.
3. Acquisition metaphor. The teacher learns well when goals are set, and learning outcomes are tangible. She feels comfortable and secure if taught by an "expert", who knows the subject matter. She believes that mistakes should be avoided.

4. Exercising metaphor. The teacher believes that what is learned should be applied in practice, and learns well when situations are related to everyday practice as closely as possible. She continually asks questions and prefers mistakes to be discussed. The teacher needs to have a mentor who can simplify situations and point things out.
5. Discovery metaphor. Life and learning are synonymous for the teacher. She does not need to be supervised. Creative drive and urge to discover and try new things are her characteristic features. The teacher learns well when she has a significant degree of freedom and prefers to go her own way. Knowledge is what she constructs. She does not need detailed instructions. She is an independent and self - regulated learner.

Methodology for a Teacher Training Service

ADDIE Instructional Design Model for an Advanced Instructional Service

ADDIE has been known as an instructional design model for more than 30 years and has been successfully used in the designing and learning process due to its ability to fit any educational needs. This model framework consisting of Analysis, Design, Development, Implementation, and Evaluation has added value and efficiency to this research in terms of designing an advanced teacher training service where new digital knowledge and skills are correlated with theoretical, pedagogical knowledge, following the Technological Pedagogical Content Knowledge model (Mishra and Koehler, 2006), in order to reach the service learning goals and objectives.

The table (Appendix 2) demonstrates how ADDIE instructional design model has been implemented in the research, being modified for the specific purpose of designing a quality teacher training service aimed at NKG teacher digital competence development. Campbell (2014), in the article *Modifying ADDIE: Incorporating New Technologies in Library Instruction*, refers to Bell and Shank (2007) who provide the definitions of each ADDIE principle.

The Teacher Training Service Design and Methodological Approaches to Be Used

According to the European Training Foundation (ETF) publication (2009), "E-Learning for Teacher Training: from Design to Implementation. Handbook for Practitioners", to be advanced and quality "the service should provide a valuable and robust methodological approach" to the adoption of educational technologies, e.g., to empower teachers' present "knowledge and skills with the most up - to - date information."

In light of this, the service is focused on Technological Pedagogical Content Knowledge (Mishra and Koehler, 2006) to let the teachers develop their digital competence in their everyday work through real-life practical experience.

A blended learning approach is used to combine face-to-face classroom meetings with online platforms to contribute to the convenience, mobility, autonomy, and interactivity of the service content presentation. Also, a constructivist approach is implemented according to which the teachers - participants acquire new knowledge productively as well as are responsible for the results of learning. Finally, the collaborative learning approach is adapted to the training service, which means that participants reach learning goals and objectives employing interaction and cooperation.

The creation of a context-specific authentic learning environment related to real - life situations and solving real-world problems where teachers could use their pedagogical knowledge and reach learning objectives through digital tools and environments is also applicable in the teacher training service design.

All these approaches contribute to the service effectiveness and make it a comprehensive learning process when new knowledge and skills in the area of educational technologies are acquired in a supportive shared environment.

The Teacher Training Service Curriculum

The service design stage includes planning its curriculum based on the outcomes of the analysis of the problem NKG teachers face (external (Digital Mirror) and internal (NKG teachers' opinions) evaluation analysis) and considering the European Commission policies (DigCompEdu, ISTE Standards).

The service curriculum consists of two modules: **(1) Introductory Module** - to provide the teachers with theoretical, pedagogical knowledge, **(2) Core Module** - to offer them access to digital tools and environments (Appendix 4).

The Teacher Training Service Development

The service development stage includes creating a service syllabus that is based on the curriculum. It is descriptive and summarises the topics covered in the service curriculum. (Appendix 5)

The teacher training service implementation

At the implementation stage the role of a tutor is of a great importance. In this study, the learning-focused approach to teaching (Postareff, 2008) is applicable to the role of the tutor as a facilitator. It implies that she supports the teachers with tutoring actions. She encourages students to be active, being positive towards learning, and having an equal and casual relationship with the service participants who learn from the tutor and vice versa.

The tutor's responsibilities also include accommodating the teachers' needs: sending email messages to those who miss sessions or to remind of a task, to assist those who stayed with some activity for a long time, to enter e-platforms to track online activity.

For successful delivery of the training service, hardware and software were considered. For the convenience of access, a school computer lab was used with a sufficient number of personal computers, an overhead projector, and an Internet connection. The school technology specialist was also at hand to fix hardware-related problems. As for the software, Google Classroom service, belonging to the school domain, was chosen to be the service e-learning platform due to its flexibility, simplicity in use, adaptability to any content, as well as its ability to provide space for collaboration and self-regulated learning.

Results and discussion

This study aimed to answer the following research questions: (1) What should a well – designed teacher training service, enhancing the teacher digital competence, be, and how

should it be appropriately delivered? (2) What are the teachers' opinions about the usefulness and effectiveness of the implemented teacher training service concerning their digital competence development?

The following section presents the results of the observational protocol, the teachers' evaluation of the service content and delivery as well as the pre- and post- questionnaires concerning the teachers' digital competence development. The results are accompanied by discussion, all of which help to answer the research questions.

Observed teacher behaviour during training

The purpose of the observational protocol was to control the teacher training service implementation concerning the teachers' performance in its activities. That is why it was based on the researcher's records made during the service implementation stage, tracking the teachers' number of sessions attended, activities participated in, and their learning metaphors to understand under what learning conditions they acquire new digital skills productively.

As far as the number of attended sessions is concerned, none of the teachers attended all eight planned meetings. The maximum number of visits was six, and the minimum was four. The reason for this was a lack of time and participation in other work-related activities.

As for five activities (digital tools implementation) the teachers had to participate in, the protocol shows that their average number is four, which can be considered a positive result, taking into account that nobody was able to partake in all sessions. It can be explained by the fact that a blended learning approach was used in the service content delivery, i.e., face-to-face communication with the tutor was combined with an online platform (Google Class). There the service participants were introduced to each session objectives, activities to take part in as well as relevant tutorials for digital tools to be applied to reach the service objectives. Moreover, the convenience of access to the tutor as a colleague-teacher, working in the same educational institution, also contributed to active participation in all service activities.

The researcher observed the teachers' ways they acquire new digital knowledge and skills as well. The protocol demonstrates that the service participants have different metaphors of

learning, however, exercising and participation metaphors are the most favourable modes of new digital skills acquisition, which implies that the teachers learn well when what they learn is applied and reflected in their everyday work, when mistakes are discussed, and the mentor is always at hand to ask questions. Furthermore, the teachers create new knowledge more efficiently, providing that they learn collaboratively, learning with and from each other and reaching a common goal. On the other hand, the apperception metaphor, which implies an unpredictable and continually changing educational setting, is not suitable for any service participant.

Teachers' evaluation of the training service

The aim of the teachers' evaluation of the service (Appendix 1) was to identify the level of the service participants' satisfaction with the service content and its delivery as well as to ask them to give recommendations for its improvement in the future.

The questionnaire demonstrates that all respondents are satisfied with this teacher training service since all of them agreed that the service improved their digital competence. (Question 1)

Answering questions 1 - 5, 100% of teachers gave affirmative answers.

They admitted the importance of Technological Pedagogical Content Knowledge in the process of digital skills acquisition, i.e., they agreed that new digital knowledge and skills should be developed in correlation with theoretical, pedagogical knowledge. The reason for this could be the fact that the researcher provided the teachers not only with access to specific digital tools and environments but also with a theoretical, pedagogical baseline, including constructivist and collaborative learning approaches, authentic and project-based learning. (Question 2)

According to all teachers' opinions, the combination of face-to-face sessions with an online platform (Google Class) made the service content delivery flexible and convenient for them. All teachers gave an affirmative answer as this blended learning approach helped them to solve their time management issues and reach the service objectives. (Question 3)

The creation of a context-specific authentic learning environment related to a real-life situation and solving a real-world problem was also crucial for all participants in their digital competence development in an efficient way. It can be explained by the fact that the researcher opted for an authentic online eTwinning platform of European schools where the teachers with their students could develop their digital competence in a real-life situation (Earth Day 2019), solving real-world problems (ecological issues). (Question 4)

All teachers in question agree completely that the atmosphere of collaboration with colleagues where they could share their experience and positive practices helped them to develop their digital competence efficiently. It can be demonstrated by the fact that in the frames of the teacher training service, the teachers shared with their colleagues how they succeeded to implement digital tools, used in the project and to reach learning objectives in a different context. All these inspired other teachers to follow their colleagues' examples. (Question 5)

Answering the open-ended question (Question 6) about what they liked best in the teacher training service, the respondents answered as follows:

- *practical tasks to be completed with digital tools,*
- *collaborative work with students,*
- *participation in the international e-project for the first time,*
- *the possibility to apply acquired knowledge and skills in everyday work,*
- *sharing experience and positive practices online at school and European levels,*
- *the professionalism of the tutor,*
- *combination of theoretical and pedagogical backgrounds with digital skills.*

However, the teachers pointed out some negative points of the service (Question 7):

- *unexpected obstacles arose while applying digital tools in practice,*
- *a lack of time to get acquainted with new online platforms in detail,*
- *a lack of time for a proper application of digital tools in class,*
- *some digital tools were familiar, which makes the learning process a little less exciting.*

Giving recommendations for future improvement of a similar teaching training service, the respondents suggested the following:

- *longer terms for digital tools implementation,*
- *to create a common database with a list of all digital tools and environments with clear instructions on how to use them,*
- *to make learning meetings longer than half an hour,*
- *to conduct similar courses longer,*
- *to conduct the same sessions on holidays.*

To sum up the data above, it could be said that the monitoring the learning progress of participants by means of the observational protocol (Appendix 2) and the teachers' evaluation of the service (Appendix 1) was significant for the researcher in order to understand how the teachers were progressing during the training activities implementation stage, and what corrective measures should be taken.

The results and discussion of the observational protocol and the teachers' evaluation of the service suggest the answer to the first research question: What should a well-designed teacher training service, enhancing the teacher digital competence, be, and how should it be appropriately delivered? Now it can be concluded that the following factors should be considered:

- (1) Teachers' time management issues should not be neglected. For this purpose, a flexible blended learning approach ought to be used to combine face-to-face classroom meetings with online platforms to contribute to the convenience, mobility, and autonomy of the service content delivery.
- (2) The role of the tutor as a facilitator in a quality teacher training service is to support teachers with tutoring actions, encourage them to be active regularly, being always at hand to solve teachers' problems that arise while utilising new digital tools in practice.
- (3) Metaphors of learning, i.e., teachers' preferable modes of acquiring new knowledge and skills in their digital competence development should be taken into consideration since they provide a facilitator with possibilities to organise learning in various ways nurturing learners' needs. In light of this, a great tutor's attention should be drawn to exercising and participation metaphors as teachers' most favourable modes of new digital skills acquisition.

- (4) Teachers' new digital knowledge and skills should be correlated with their theoretical, pedagogical knowledge, following the Technological Pedagogical Content Knowledge model (Mishra and Koehler, 2006), to reach curriculum learning goals and objectives.
- (5) The creation of a context-specific authentic learning environment related to real - life situations and solving real-world problems where teachers could use their pedagogical knowledge and reach learning objectives through digital tools and environments is also of great importance.
- (6) A facilitator ought to create collaborative environments that improve teachers' professional development outcomes and where they share their emotions and positive practices while applying new digital skills to their everyday learning context. It should be done both at local and international levels, using online platforms.
- (7) A quality teacher training service should be long-term and regular so that participants could have enough time for an in-depth analysis of digital tools and environments and their successful and meaningful application in different learning contexts.
- (8) While delivering a teacher training service, a tutor ought to consider different levels (from elementary to advanced) of participants' digital competence development and suggest a variety of digital solutions to be used to achieve the same learning objectives. It will keep all of them interested and actively engaged in new digital knowledge and skills acquisition. A shared database with these digital tools and their tutorials should be created to provide convenient access to all of them any time.

Pre- and Post-Questionnaires

Pre- and post-questionnaires (Table 1) were designed based on the five areas of NKG digital plan first dimension called The Learning Paradigm. They were used to determine the usefulness and effectiveness of the service in terms of the teachers' digital competence development. Both questionnaires are identical and have eight questions. All teachers completed the pre-questionnaire at the beginning of the course, and the post-questionnaire - at the end of the course.

The results (mean, standard deviation and independent samples T-test) (Table 1) show changes in average scores which demonstrate that the digital competence has been enhanced for the whole group of teachers in question in all five areas of the dimension "The Learning Paradigm" (NKG digital plan). (Figure 2) The further results analysis and their discussion provide the answer to the second research question: What are the teachers' opinions about the usefulness and effectiveness of the implemented teacher training service concerning their digital competence development?

All items except Question 1 and Question 2, showed a statistically significant increase between pre- and posttest. It can be explained by the fact that a single short - term teaching training service cannot contribute to the systematic use of innovative teaching methods, including digital environments and tools approved at the school level. (Q1) Similarly there is only a slight rise in terms of the use of a personal digital work environment which may be explained by the fact that all participants have only started to use one (Google Classroom), but for such a short period of time they were not able to get acquainted with this platform advantages in detail. (Q2)

Further the results reveal that a little higher increase can be seen in Question 3 (from 2.82 (.75) to 3.55 (.52)), Question 7 (from 2.45 (.69) to 3.27 (.65)) and Question 8 (from 2.73 (.47) to 4.34 (.69)). A plausible reason for this is that the tutor created a learning setting where the respondents with their students and colleagues could experiment with new digital tools, but it could not be assumed that it was done regularly, bearing in mind only eight sessions of the course. (Q3) The results also show that the teachers have started to make attempts to create a multifunctional physical learning environment at lessons, supporting students' collaboration using digital tools. It may be a result of the service planned activities where the teachers acquired new digital tools and then applied them in the context of their classroom activities, engaging students into collaboration with each other in the frames of an online international project. (Q7) The increase in the development of digital learning resources, which partially or completely replace traditional paper-based ones, by the teachers, can also be observed since digital content presentation tools were introduced to them to be implemented in a real-life learning context. (Q8)

Table 1. Pre- and post-questionnaire descriptive statistics and T-test results. The items were rated on a 4-point Likert scale: 1 - Completely disagree, 2 - Mostly disagree, 3 - Mostly agree, and 4 - Completely agree.

Questionnaire Item	Pre-questionnaire <i>M</i> (SD)	Post-questionnaire <i>M</i> (SD)	<i>p</i> -value
Methods of the digital age – changes in pedagogical tools			
Q1. I use systematically innovative teaching methods, including digital environments and tools approved at the school level.	3.09 (.54)	3.55(.52)	0.058
Development of digital skills			
Q2. I use a personal digital work environment.	2.91 (.83)	3.36 (.67)	0.174
Q3. I experiment with your students and colleagues with new digital tools and alternative web environments regularly and integrate them with the school information platform.	2.82 (.75)	3.55 (.52)	0.016
The role of the teacher			
Q4. I collaborate with my colleagues at the school level (for example, in weekly training meetings with teachers of various subjects and age groups, participating in long-term joint projects).	2.18 (.75)	3.45 (.69)	< 0.001
The role of the student			
Q5. My teaching is closely related to solving real-life problems meaningful for my students.	2.64 (.67)	3.82 (.4)	< 0.001
Q6. My students accustomed to working in diverse teams (of different age, nationality, culture), participating in research and projects using digital technologies.	2. (.45)	3. (.63)	< 0.001
Study arrangement			
Q7. The physical learning environment at my lessons is multi-functional and supports student collaboration with digital learning.	2.45 (.69)	3.27 (.65)	0.009
Q8. I develop digital learning resources to support innovative approaches to learning, which partially or entirely replace traditional paper-based learning resources.	2.73 (.47)	4.34 (.69)	0.009

Interestingly the highest intervention effect was found in the areas The role of the teacher (which was considered the most problematic) and The role of the student in Question 4 (from 2.18 (.75) to 3.45 (.69)), Question 5 (from 2.64 (.67) to 3.82 (.4)) and Question 6 (from 2.45 to 3. (.63)). A possible reason for this is that the teachers did collaborate with their colleagues at the school level at weekly training sessions, participating in a joint online international project. (Q4)

Furthermore, the teachers solved real-life problems (ecological problems) in a real-life event (Earth Day 2019). (Q5) Finally, the study also has reported that the teachers agree that their students work in diverse teams of different ages, nationalities, and cultures, partaking in projects, and using digital technologies. It can be explained by the fact that the online eTwinning platform of European schools, introduced by the tutor, was an ideal e-learning community for international collaboration and digital skills development.

Limitations and Future Research

The current research was focused only on the first dimension of NKG digital plan, the Learning Paradigm (Figure 1), as it directly concerns the teacher professional competence improvement. However, the development of two other dimensions, Directing Changes and Digital Infrastructure, is a responsibility of the administrative staff.

The findings, based on the teachers' opinions, presented above, are encouraging as they demonstrate a slight but positive impact on the teachers' in question digital competence development. That is why the teaching training service can be considered useful and effective for them.

However, in the future, to get more significant results and achieve the goals of NKG digital plan to a greater extent in the area of teachers' digital competence development similar teacher training practices should take place on a regular basis, providing teachers with learning settings where they could systematically utilise innovative teaching methods, including digital tools and environments.

The study represents a methodological example of a teacher training service aimed at teachers' digital competence development, including its curriculum, syllabus, observational protocol, content and delivery evaluation form as well as pre- and post- questionnaires to

check the impact of the service in terms of its usefulness and effectiveness. It can be adopted by all educators to reach similar objectives in any educational setting.

Acknowledgments

I would first like to thank my thesis advisor Senior Research Fellow of Educational Technology, Leo Aleksander Siiman (Ph.D.), of the Faculty of Social Sciences, Institute of Education, at the University of Tartu. He provided the right amount of guidance, support, and independence to ensure the writing and research process was a smooth one. I would also like to thank all lectures and administrators of the EduTech Masters programme for the fruitful discussions we had on and off-line and the support they offered throughout the process.

Author's declaration

I hereby declare that I have written this thesis independently and that all contributions of other authors and supporters have been referenced. The thesis has been written in accordance with the requirements for graduation theses of the Institute of Education of the University of Tartu and is in compliance with good academic practices.

Signature:

Date:

References

- Bell, S. J., and Shank, J. D. (2007). Academic librarianship by design: A blended librarian's guide to the tools and techniques. Chicago, IL: American Library Association.
- Burns, M. (2016). The Flipped Classroom – A Paradigm Shift. Retrieved from <https://educationtechnologysolutions.com/2016/04/the-flipped-classroom-a-paradigm-shift/>
- Campbell, P. C. (2014). Modifying ADDIE: Incorporating New Technologies in Library Instruction. *Public Services Quarterly*, 10:138–149, 2014 Published with license by Taylor & Francis.
- Cluzer, S. (2018). DigComp into Action: Get inspired, make it happen. Retrieved from <https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/digcomp-action-get-inspired-make-it-happen-user-guide-european-digital-competence-framework>
- Cohen, L., Manio, L., Morrison, K. (2007). Research Methods in Education. (sixth edition) the Taylor & Francis e-Library.
- Cruz, F. and Diaz, M. (2016). Generation Z's Teachers and their Digital Skills. *Comunicar Journal 46: The internet of the Future* (Vol. 24 - 2016). Retrieved from <https://www.revistacomunicar.com/indice-en/articulo.php?numero=46-2016-10>
- Digital Mirror. Retrieved from <https://digipegel.ee/>
- European Training Foundation (ETF). (2009). E-Learning for Teacher Training: from Design to Implementation Handbook for Practitioners. Retrieved from <https://www.etf.europa.eu/en/publications-and-resources/publications/e-learning-teacher-training-design-implementation-handbook>
- EU SCIENCE HUB, Learning and Skills for the Digital Era. Retrieved from <https://ec.europa.eu/jrc/en/research-topic/learning-and-skills>
- EU SCIENCE HUB, DigCompEdu. Retrieved from <https://ec.europa.eu/jrc/en/digcompedu>
- Erstad, O. (2010). Educating the Digital Generation. Retrieved from <https://www.idunn.no/dk/2010/01/art05>

ISTE Standards. Retrieved from <https://www.iste.org/standards/for-educators>

Moyles, J. (2002). Observation as a research tool. In M. Coleman and A. J. Briggs (eds) *Research Methods in Educational Leadership*. London: Paul Chapman, 172–91.

Mishra, P., Koehler, M. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record* Volume 108, Number 6, June 2006, pp. 1017–1054.

OECD. (2015). Education at a Glance. Retrieved from https://read.oecd-ilibrary.org/education/education-at-a-glance-2015/estonia_eag-2015-53-en#page1

Postareff, L and Lindblom-Ylänne, S. (2008). Variation in teachers' descriptions of teaching: Broadening the understanding of teaching in higher education. *Learning and Instruction* 18 (2008) 109 - 120. Retrieved from <https://www.journals.elsevier.com/learning-and-instruction>, accessed April 26, 2019

Prensky, M. (2001). *Digital Natives, Digital Immigrants* By From On the Horizon. (MCB University Press, Vol. 9 No. 5, October 2001)

Simons, P.R-J., Manon C.P. Ruijters. (2006). Varieties of work-related learning. *International Journal of Educational Research* 47 (2008) 241–251

Verstegen, D.M.L., Barnard, Y.F. (2009). Pilot Designing needs statements in a systematic, iterative way. *Computers & Education* 52 324–332. Retrieved from www.elsevier.com/locate/compedu

Leijena, Ä., Allasa, R., Toomb, A., Husuc, J., Mena Marcos, J., Meijere, P., Knezice, D., Pedastea, M., Krulla, E. (2014). Guided reflection for supporting the development of student teachers' practical knowledge. *International Conference on Education & Educational Psychology 2013 (ICEEPSY 2013)* Published by Elsevier Ltd, *Procedia - Social and Behavioral Sciences* 112 (2014) 314 – 322. Retrieved from www.sciencedirect.com

Appendices

Appendix 1. Questionnaire. Evaluation of the service content and its delivery to be completed by teachers

Scale for multiple - choice questions: Yes/No
Multiple - choice questions:
1. Have you improved your digital competence?
2. Was the theoretical and pedagogical background in the content of the service essential for you?
3. Do you agree that the combination of face - to - face sessions with an online platform (Google Class) makes the service content delivery flexible and convenient for you?
4. Do you agree that the creation of a context-specific authentic learning environment related to a real-life situation and solving a real-world problem by the tutor has helped to develop your digital competence efficiently?
5. Do you agree that the atmosphere of collaboration with colleagues where you could share your experience and positive practices has helped to develop your digital competence efficiently?
Open-ended questions:
6. What did you like most about the teacher training course?
7. What did you like least about the teacher training course?
8. What are your recommendations for a teacher training service aimed at the teacher's digital competence development in the future?

Appendix 2. Observational Protocol

Observational Protocol
The role of the researcher: to observe the teacher training service participants considering oral, visual and digital data received during the service as well as to actively partake in the learning process, instructing and encouraging teachers
The role of the participants: to participate in all teacher training service sessions and activities aimed at digital competence development
The number of participants: 11 teachers
Who they are: teachers of different subjects from Narva Kesklinna Gymnasium (NKG)
The time of the observation: 4/3/2019 - 8/5/2019
The chronology of the events: Session 1 - 6/3/2019, Session 2 - 13/3/2019, Session 3 - 20/3/2019, Session 4 - 27/3/2019, Session 5 - 3/4/2019, Session 6 - 10/2/2019, Session 7 - 2/5/2019, Session 8 - 8/5/2019
The service activities to participate in: (1) Google Drive (planning eTwinning project activities in collaboration with other school teachers), (2) international collaboration in Twin Space, (3) Thing Link (an interactive picture creation), (4) Canva (a digital poster creation), (5) Book Creator (online collaboration and an e-book creation)
Goals set by teachers: <ul style="list-style-type: none">- to learn how to use digital tools and environments effectively,- to create projects and participate in them through cooperation with other subject teachers,- to create conditions for students where they would take the initiative and be interested in the learning process, and the teacher would play the role of assistant and instructor,- to teach students to link their digital skills with situations in their everyday life,- to create conditions in which children learn from each other utilising digital tools and environments.

Teacher	Number of Sessions	Number of Activities	Metaphors of Learning
1	6	4	Acquisition metaphor:
2	5	4	Participation metaphor
3	6	4	Exercising metaphor
4	5	4	Acquisition metaphor Exercising metaphor
5	5	4	Discovery metaphor
6	4	5	Participation metaphor
7	4	4	Acquisition metaphor
8	6	5	Participation metaphor
9	5	5	Participation metaphor
10	5	5	Exercising metaphor
11	4	4	Exercising metaphor

Appendix 3. ADDIE instructional design model for a teacher training service aimed at NKG teacher digital competence development

Analysis: <i>the process of defining what is to be learned.</i>	Design: <i>the process of specifying how it is to be learned.</i>	Development: <i>the process of authoring and producing learning materials.</i>	Implementation: <i>the process of installing the instruction product in a real-world context.</i>	Evaluation: <i>the process of determining the impact of the instruction.</i>
<ul style="list-style-type: none"> - analyse the level of digital competence of NKG teachers in terms of Learning Paradigm (Figure 1), using the data in Digital Mirror, school evaluation dashboard (external evaluation), and NKG teachers' opinions (internal evaluation) - identify the teachers' digital competence gap through a pre-questionnaire 	<ul style="list-style-type: none"> - process for finding and discovering a tool to fill the desired gap, e.g., an instructional service, - identify the characteristics of an advanced and quality teacher training service aimed at NKG teacher digital competence development in correlation with the European Commission policies (DigCompEdu, ISTE Standards) -design a curriculum of the training activities 	<ul style="list-style-type: none"> - create a teacher training service syllabus aimed at NKG teacher digital competence development: - set learning objectives - devise the service content - define core skills and knowledge to be developed (Technological Pedagogical Content Knowledge) - define teaching methods to be used (authentic learning, constructivism, collaborative learning, autonomy, project-based learning) - select software (digital tools and environments) to be meaningfully applied to reach the learning objectives 	<ul style="list-style-type: none"> - install the quality training service in the educational setting of NKG: - plan the schedule of learning sessions, -find an appropriate physical place -find a digital environment for the teacher training service implementation 	<ul style="list-style-type: none"> - determine the effectiveness of the teacher training service aimed at NKG teacher digital competence development: - analyse the pre- and post-questionnaires and observational protocol, - the teachers' opinions and feedback on the teacher training service content and its delivery (questionnaire) - draw conclusions and generalisations for further steps and improvement as well as for similar educational settings

Appendix 4. The teacher training service curriculum

Modules	Content	Goals	DigCompEdu Areas/ ISTE standards to be Developed	Number of Sessions
I. Introductory Module	<ul style="list-style-type: none"> - Introduction to the problem. The level of school digital development (Digital Mirror). - A school digital development plan (Digital Mirror). - The importance of Technological Pedagogical Content Knowledge 	<ul style="list-style-type: none"> - to introduce teachers to the problem of their school digital development based on the data provided by - to present teachers their school digital development plan (Digital Mirror) - to develop teachers' digital competence concerning the importance of Technological Pedagogical Content Knowledge 	<i>Area 1: Professional Engagement</i> (Teachers use Digital Mirror platform as a starting point for their digital competence development)	2

II. Core Module	<p>- An e – environment as an authentic platform for professional digital development</p> <p>- From an idea to a cross-curricular digital project realisation</p>	<p>- to create a context-specific authentic learning environment related to real - life situations and solving real-world problems where teachers could use their pedagogical knowledge and reach learning objectives using digital tools and environments,</p> <p>- to encourage teachers to use new approaches in education (collaborative learning, constructivist approach, autonomy in new skills and knowledge acquisition) using digital tools and environments</p>	<p><i>Area 1: Professional Engagement</i> (Teachers use digital technologies for communication and collaboration in a context-specific authentic learning environment)</p> <p><i>Area 2: Digital Resources</i> (Teachers create and share digital resources)</p> <p><i>Area 3: Teaching and Learning</i> (Teachers manage the use of digital technologies in teaching and learning.)</p> <p><i>Area 4: Assessment</i> (Teachers use digital technologies and strategies to enhance assessment.)</p> <p><i>Area 5: Empowering Learners</i> (Teachers use digital technologies to enhance inclusion and learners’ active engagement.)</p> <p><i>Area 6: Facilitating Learners’ Digital Competence</i> (Teachers enable learners to creatively and responsibly use digital technologies for information, communication, content creation, wellbeing, and problem-solving.)</p> <p><i>Citizen ISTE standard</i> (Teachers create experiences for learners to make positive, socially responsible contributions and exhibit empathetic behavior online that builds relationships and community.)</p>	<p>6</p>
------------------------	---	--	---	----------

Appendix 5. The teacher training service syllabus

Modules/Sessions	Topic/ Learning content	Learning objectives/ Activities	Methodology to be used	Digital tools and environments
I. Introductory Module				
Session 1 6/3/2019	<ul style="list-style-type: none"> - The problem in Narva Kesklinna Gümnaasium (NKG) digital development (Digital Mirror) - NKG digital development plan (Digital Mirror) 	<p>The teachers:</p> <ul style="list-style-type: none"> - are aware of their school digital development problem and digital development plan based on the data from the Digital Mirror platform, - create accounts in the service collaborative e-learning platform Google Classroom belonging to the school domain. 	<p>Collaborative learning Authentic learning</p>	<p>Google Classroom (Narva Kesklinna gümnaasium school domain)</p>
Session 2 13/3/2019	<ul style="list-style-type: none"> - The importance of Technological Pedagogical Content Knowledge - Setting service goals 	<p>The teachers:</p> <ul style="list-style-type: none"> - analyse their digital competence concerning NKG digital development plan participating in a pre-questionnaire, - set their own service goals in cooperation with each other in Google Drive e-environment, - are aware of new approaches in education (constructivist approach, collaborative learning, autonomy), - know about the importance of theoretical background in the integration of educational technologies. 	<p>Collaborative learning Constructivist approach Authentic learning</p>	<p>Google Classroom Google Drive shared environment</p>
II. Core Module				

<p>Session 3 20/3/2019</p>	<p>- eTwinning e – environment as an authentic platform for professional digital development</p>	<p>The teachers:</p> <ul style="list-style-type: none"> - are introduced to possibilities of European schools eTwinning environment as a platform for digital professional development, - create an eTwinning account and join the community of European schools - explore eTwinning possibilities (Twin Space, Partner Forum) - generate a future cross - curriculum eTwinning project idea in cooperation with each other. 	<p>Project-based learning Collaborative learning Constructivist approach Authentic learning</p>	<p>Google Class eTwinning environment Twin Space Partner Forum https://www.etwinning.net/en/public/index.htm</p>
<p>Session 4 27/3/2019</p>	<p>The planning of the short - term eTwinning project “Let’s Celebrate Earth day Together!” 1/04 - 3/05/19</p>	<p>The teachers:</p> <ul style="list-style-type: none"> - work in groups and plan the eTwinning project activities in a shared e-environment, completing a table of project stages (international project partners also complete the table) - get their students involved in the project activity and encourage them to plan activities devoted to Earth day 2019 - complete the table "Ideas Bank" with the ideas generated by students (international project partners also complete the table). 	<p>Project-based learning Collaborative learning Constructivist approach Authentic learning</p>	<p>Google Class Twin Space of the project https://twinspace.etwinning.net/87097/home Google Drive The project plan: https://lingid.ee/3kfEV Ideas Bank https://lingid.ee/Xp2Jl</p>

Session 5 3/4/2019	The project realisation according to the plan (1)	<p>The teachers:</p> <ul style="list-style-type: none"> - can create an interactive photo in cooperation with their students using a digital tool (ThingLink) to introduce themselves at the first stage of the project and publish them in Twin Space (online project environment), - can create environmental e - posters promoting the project eco - friendly ideas in collaboration with students, - participate in an exhibition of the digital posters in an e - environment (Padlet) 	Project-based learning Collaborative learning Constructivist approach Authentic learning	<p>Google Class Twin Space of the project https://twinspace.etwinning.net/87097/home Interactive photos of project participants (available in the project Twin Space) www.thinglink.com The exhibition of e - posters https://ru.padlet.com/olga_lutska/tuiuq48p78qe</p>
Session 6 10/2/2019	The project realisation according to the plan (2)	<p>The teachers:</p> <ul style="list-style-type: none"> - can collaborate online with their students and participate in the creation of the project final product - Green Book - where project partner countries share their positive eco - friendly practices devoted to Earth Day 2019, using a digital tool (Book Creator), - can get their students involved in giving their feedback on the project results using a digital tool (Mentimeter), creating an online word cloud of project-related ideas together with international project partners. 	Project-based learning Collaborative learning Constructivist approach Authentic learning	<p>Google Class Twin Space of the project https://twinspace.etwinning.net/87097/home The final project product - Green Book https://read.bookcreator.com/BWFphysfDBNfg39blGxnuX0shwi2/ACTt4yHZROKGFgGxYrHsLw The project feedback - word cloud of the project - related ideas https://www.mentimeter.com/s/efedf83d8ff7cbcb848911ef88fa37a8/a8daf585ac66</p>

Session 7 2/5/2019	Summing - up of the project results		Collaborative learning Constructivist approach	Twin Space of the project https://twinspace.etwinning.net/87097/home The final project product - Green Book https://read.bookcreator.com/BWFphysfDBNfg39blGxnuX0shwi2/ACTt4yHZROKGFgGxYrHsLw
Session 8 8/5/2019	Summing - up to the service activities.	The teachers: - give their feedback on what and how they have learnt, and what to do next to enhance their digital competence, - analyse their digital competence concerning NKG digital development plan participating in a post- questionnaire	Collaborative learning Constructivist approach	Google Classroom Google Drive

Non-exclusive licence to reproduce thesis and make thesis public

I, Olga Lutška (date of birth: November 6, 1974),

1. herewith grant the University of Tartu a free permit (non-exclusive licence) to:

1.1. reproduce, for the purpose of preservation and making available to the public, including for addition to the DSpace digital archives until expiry of the term of validity of the copyright, and

1.2. make available to the public via the web environment of the University of Tartu, including via the DSpace digital archives until expiry of the term of validity of the copyright, 'Design and evaluation of a teacher training service to develop teachers' digital competences', supervised by Leo Aleksander Siiman (PhD).

2. I am aware of the fact that the author retains these rights.

3. I certify that granting the non-exclusive licence does not infringe the intellectual property rights or rights arising from the Personal Data Protection Act.

Tartu, 27.05.2019