Law Pui Ying

TEACHER PROFESSIONAL DEVELOPMENT
OF DIGITAL COMPETENCE

Faculty of Education and Culture
Master Thesis
April 2021
The increasingly digitally mediated learning environment has heightened the need for teacher professional development of digital competence. Ubiquitous digital surroundings have transformed how young people access information, communication, and learn. In response to that, digital competence-related content has been introduced in school curricula all over the world. Teachers need to develop the capacity for teaching new content and integrate digital competence in different subjects and their daily practices in schools.

The purpose of the study was to understand how digital competence was integrated in teacher professional development, from the perspectives of educational experts and teachers. This study may suggest potential lessons to be learnt from the Finnish context, and may anticipate different stakeholders to create more favourable conditions that facilitate teachers for professional development of digital competence.

This study was derived from a research project from the European Union's Horizon 2020 Research and Innovation Framework Programme called ySKILLS (youth skills). It implemented the constructivist grounded theory approach as the framework for data collection and analysis, underscoring the collaboration of empirical data, rigorous coding, and conceptualization in a qualitative study. Empirical data included eight semi-structured interviews with local educational experts and upper secondary school teachers. The data were transcribed and analyzed with the facilitation of qualitative research analysis software atlas.ti.

The findings indicated both educational expert and teacher respondents shared the understanding that digital competence is versatile and multifaceted, teachers need to continuously adapt to the changes by professionally develop themselves. The findings also reflected the lack of common understanding of digital competence in the curriculum by policy makers, school leaders and teachers. Besides, although teachers in Finland possess extensive professional autonomy, it was affirmed in the findings that teacher professional development of digital competence was not only an individual issue of teachers’ personal motivation, but it could also be positively or negatively influenced by various external factors, such as educational leadership and policy and resources. The study also highlights proliferation of self-initiated learning and community of practice as effective ways for teacher professional development of digital competence.

The findings implied the need for teacher professional development of digital competence to move beyond activities. Instead, it is important to design conditions that support teachers’ continuous learning on digital competence. The following four aspects could be considered. First, promoting ongoing deliberation for common understanding on digital competence in the curriculum. Second, designing conditions for practical use of digital competence that have genuine connection with school reality. Third, nurturing positive sharing culture to facilitate professional knowledge exchange. Last, designing a policy that recognizes and supports the increasing online happenings of self-initiated learning and community of practice for teachers’ professional development of digital competence.

**Keywords:** Digital competence, Teacher professional development, Finnish National Core Curriculum, Community of practice, Grounded theory

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1 INTRODUCTION

The increasingly digitaly mediated learning environment has heightened the need for teacher professional development of digital competence. Ubiquitous digital surroundings have transformed how young people access information, communicate, and learn (Smahel et al., 2020). In response to the transformation, digital competence related content has been introduced in school curricular all over the world (Mannila, Nordén, & Pears, 2018; Ottestad, Kelentrić, & Guðmundsdóttir, 2014; Søby, 2015). One of the most important concerns to successfully shift the paradigm in pedagogy with digital technology integration is teachers’ preparation for their professional digital competence (Viberg, Olof Bälter, Khalil, & Mavroudi, 2020). Teachers need to develop the capacity for teaching the new content and integrate digital competence in different subjects, as well as in their daily practices in schools. Also, teachers are not only seen as reference model who is able to demonstrate their creative and critical use of digital technologies, but also as the foremost learning facilitators for the young people to develop the competence that enables them to be fully and actively participating in a digital society (Plaza-de-la-Hoz, García-Gutiérrez, & Moreno-Mediavilla, 2015; Redecker, 2017). To enable teachers to take up these roles in this digital era, teacher professional development of digital competence is of paramount importance.

As a result, research on the professional digital competence of teachers is gaining momentum in recent years (Mcgarr & Mcdonagh, 2019). Four main areas of research concerning this topic have been identified. Firstly, since digital competence in the educational profession is distinguished from other professions and general digital technology users, there has been extensive research attempting to pin down the conceptual frameworks of digital competence in the educational profession, to consolidate what is needed to strengthen teachers’ professional development (For example Caena & Redecker, 2019; Falloon, 2020; Howell, 2012; Mcgarr & Mcdonagh, 2019; Redecker, 2017). For example, Howell (2012) defines pedagogical digital competence in terms of using digital technologies to teach. Osttestad et al. (2014) propose the three dimensions of teacher digital competence including generic, didactic, and professional-oriented dimensions. Redecker (2017) and Caena and Redecker (2019) develop the European framework for digital competence of educators that encompasses 22 educator-specific digital competence in 6 areas. Mcgarr and Mcdonaugh (2019) suggest the PEAT
model with four parts that include pedagogical skills, cyber-ethics and attitudes, and technical skills. Falloon (2020)’s teacher digital competence (TDC) framework attempts to expand the conceptualization of teachers’ digital competence from technical and literacies aspects to a more holistic view that includes personal ethical and personal professional aspects. The permutations of the conceptualization of digital competence although differ in meaning, depth, and breath, corroborate the complexity and multidimensions of the notion.

Secondly, there have been studies focusing on teachers’ pedagogical practices with the integration of digital technology. It is widely agreed among researchers that teachers are the foremost player to implement the curriculum and key players in the educational uptake and use of digital technologies (Sipilä, 2014; Ward & Parr, 2010; Wastiau et al., 2013). Ward and Parr (2010) suggest that teachers’ confidence in their ability to facilitate students learning with technology, along with the provision of strong pedagogical motivation for teachers to integrate digital technology are keys to successful technological integration in pedagogical practices in classrooms. Wastiau et al. (2013) find that students use digital technologies to a greater extent when they are taught by teachers with high digital competence, even those they may have limited access to digital technologies in the classroom, compare to those who have free access to technologies but taught by teachers with low digital competence. Similarly, Sipilä (2014) also concludes that competent and confident teachers are needed for students to make the best use of the digital learning environment. It is thus affirmed that teachers bear influential roles in digital competence education.

Thirdly, integrating digital competence in teacher education is a prevalent theme of research in this topic (Instefjord, 2014; Mcgarr & Mcdonagh, 2019; Røkenes & Krumsvik, 2016). For instance, Instefjord (2014) finds that student teachers are not confident and experienced enough in effectively using digital technology in pedagogical practices, she suggests that technology should be integrated as a pedagogical tool for teaching and learning in all subjects in teacher education programs to create opportunities for the appropriation of digital competence for pre-service teachers. Røkenes & Krumsvik (2016)’s case study of Norwegian teacher education identifies the multiple factors and modes of learning experience that affect the mastery of pedagogical digital competence of student teachers. Whereas Mcgarr and Mcdonagh (2019), aiming to support student teachers’ development of professional digital competence, suggest the multifaceted nature of teacher professional digital competence needs to be addressed by a more holistic framework that helps to scaffold the complex process of developing the competence.
Lastly, there is also research on the importance of different forms of teacher professional development of digital competence (Mannila et al., 2018; Mannila, 2018; Wastiau et al., 2013). For example, Mannila (2018) acknowledges the need for ongoing teacher training for digital competence to address the complexity in educational settings brought about by rapid technological development. She emphasizes self-efficacy is the key factor in this ongoing process of development for teachers to explore and learn independently and continuously. Wastiau et al. (2013) claim that professional development activities, such as informal learning settings and professional online learning communities, that are closely integrated into teachers’ daily practices are important means for teachers’ continuous professional development of digital competence. Besides, Mannila et al. (2018) identify a list of prerequisites that helps school leaders to drive the digital transformation at their schools as a learning community. This research acknowledges that teachers’ professional development of digital competence is not only an isolated individual’s competence but is highly influenced by contextual factors such as leadership, infrastructure, and culture of the educational setting.

Despite the growing trend of research on the above four areas in teacher professional development of digital competence, the research has tended to focus on pre-service teacher training, comparatively rather little attention has been paid to in-service teacher training on professional digital competence. However, the development needs of pre-service teachers and in-service teachers are different (Davis, Petish, & Smithey, 2006), research focuses on pre-service teachers is not entirely applicable to in-service teachers. Also, previous research on teachers’ use of and beliefs about using digital technology for educational purposes are predominantly subject-specific and technical skills oriented (Olofsson, Lindberg, Fransson, & Hauge, 2011), further study is needed to provide a more holistic picture for teachers from different specialties to professionally develop digital competence and see it as a transversal competence across subjects as stated in various educational framework and curricular. Therefore, further study is needed to gain a better understanding of in-service teacher professional development of digital competence.

In this research it is important to learn, in the Finnish context, how teachers integrate digital competence in their professional development. Finnish teachers have been having a reputation around the world as highly qualified professionals since 2010 when the country ranked the first in PISA (Dervin, 2016; Lavonen, 2018; Li, Y. & Dervin, 2018), and have become a positive reference society in global education (Waldow, 2017). The eagerness to learn from Finland’s education and their highly regarded and qualified teachers have been enormously growing globally. “Educational pilgrimage”
to Finland remains a global trend in the hope of replicating the secret of its success (Li, Y. & Dervin, 2018; Søby, 2015). However, research finds that the majority of Finnish teachers consider themselves both unqualified and unprepared to use ICT that would add value to teaching and learning (Kaarakainen & Kaarakainen, 2017; Sipilä, 2014). Digital competence gap is also observed—male and younger teachers tend to have higher digital competence than the female and older ones (Kaarakainen & Kaarakainen, 2017; Sipilä, 2014), while Finland has 72% female teachers and 37% of teachers were 50 or more years old (Eurostat, 2019). According to the Finnish Ministry of Education and the teacher union OAJ, the majority of teachers who felt their digital skills were weak have received just a few hours of in-service training to adopt digitalization in educational context during the past five years (Hietikko, Ilves, & Salo, 2016). This contrast gives a clue that Finnish teachers are not in an education paradise as portrayed in media accentuation (Itkonen, Dervin, & Talib, 2017; Takayama, Waldow, & Sung, 2013), they do share similar struggles with teachers in the other parts of the world. Whereas in Finland’s most recent national core curriculum reform in 2014, digital competence is emphasized as one of the main focuses (Vahtivuori-Hänninen, Halinen, Niemi, Lavonen, & Lipponen, 2014), the need for teachers to professionally develop their digital competence is getting more immense. These backgrounds also prompt the interest to gain perspectives from local experts and teachers. This research thus aims to understand how digital competence is integrated in teacher professional development, from the perspectives of local educational experts and teachers.

This research is derived from ySKILLS (Youth Skills) research project, Work Package 3 Digital Skills: Actors and Factors. ySKILLS is a four-year project running under the European Union’s Horizon 2020 Research and Innovation Framework Programme as a so-called “Research and Innovation Action” (RIA). The ySKILLS project seeks to enhance the positive impacts of the digital environment on young people, while Work Package 3 aims to contribute knowledge on the factors and actors in the formal and non-formal educational setting that affects young people’s acquisition of digital competence (Donoso et al., 2020). In Work Package 3, interviews with experts from the educational sector and the labour market were carried out in six European countries, Finland was one of them. The researcher of this research participated in the interviews with the educational experts in Finland during April and May 2020. A report of the ySKILLS Work Package 3 has been published with the synthesis of data of all the six participating countries. Based on the research interest and the richness of the data collected, the researcher decided to focus on the data obtained from Finland to derive this research, focusing on teachers who are one of the crucial actors of digital skills education in the formal education sector. A more detailed explanation regarding the adaptation of ySKILLS project in this research will be discussed in Chapter 3 Methodology.
This thesis is divided into seven chapters. Followed by this introduction chapter, chapter 2 introduces the contextual background and conceptual framework of this research. Chapter 3 outlines the research methodology and methods for data collection and analysis. Chapter 4 presents the findings whereas Chapter 5 contributes to the discussion of the findings. Chapter 6 discusses the evaluation of this research and followed by a conclusion in Chapter 7.
2 DIGITAL COMPETENCE IN EDUCATION PROFESSION

This chapter presents the contextual background and conceptual framework of this research. It first problematizes the context of this study which focuses on the decentralization of the Finnish education system, the role of the Finnish national core curriculum in digital competence education, and a brief account of teacher professional development in Finland. Followed by unpacking the notion of digital competence and the concept of teacher professional development. Finally, the mapping of this research that intersects digital competence with teacher professional development is introduced.

2.1 Finnish context in a nutshell

A brief history of FNCC: decentralization and teacher autonomy

Approximately every decade in the past 50 years, a novel Finnish national core curriculum (FNCC) is designed to address the political and societal changes. Though it has a rather short history, it serves as a steering wheel of education in Finland, not only as an administrative document, but also as a guide for teachers to develop their pedagogical practices (Vitikka, Krokfors, & Hurmerinta, 2012).

In the four reforms during the past 50 years, the Finnish education system has been undergoing a decentralization process. The first FNCC, which was introduced in 1970, aimed to provide basic education for all children, had a strong centralization approach, for example, textbook control and school inspection system (Vainikainen, 2014). It was then reformed in 1985, introducing the direction of decentralization that municipalities and teachers were given higher autonomy for decision making on for example textbooks and assessments, and the school inspection system was terminated (Niemi, 2012; Vainikainen, 2014). Later in 1994, further decentralization continued, the FNCC reform gave municipalities an even larger degree of autonomy to organize schools, education process, and funding (Vitikka et al., 2012). Since then, school-based decision-making has become a key part of the formulation of curriculum (Lankinen, 2010; Vitikka et al., 2012), local municipalities, schools, and teachers as education providers and organizers have substantiated autonomy and flexibility to
interpret, design, implement and evaluate their local curricula based on the FNCC (Vahtivuori-Hänninen et al., 2014; Vainikainen et al., 2017; Vitiikka et al., 2012).

One of the main ideas behind the decentralization approach is teachers’ professional role which is said to be the Finnish way to define the professionalism of teachers (Lavonen, 2018) and one of the keys to the success of Finnish education (Niemi, 2012). Since 1979, the basic qualification for secondary and elementary schools has been defined as a master degree (Niemi, 2012), the research-based initial teacher training empowers teachers to be educational leaders and “autonomous executives” (Vahtivuori-Hänninen et al., 2014) who are able to make professional educational decisions (Niemi, 2012; Vainikainen et al., 2017). Teachers are trusted as the valued expert who develops school-based curriculum and has extensive autonomy to be responsible for both curriculum and assessment policies and that they have the final decision in the versatile educational environment for pedagogical practices (Vahtivuori-Hänninen et al., 2014). Niemi (2012)’s study on the societal factors that contribute to education in Finland affirms that high-quality teacher education in Finland supports teachers’ role to work as high-quality professionals. While discussing the professionalism of Finnish teachers, Lavonen (2018) on the other hand also argues that the decentralization poses challenges for efforts to improve educational practices and the professional development of teachers as teachers always have the autonomy to decide on their professional development.

As of 2020, there are 310 municipalities, approximately 48,800 teachers in comprehensive schools, and 7700 teachers in upper secondary school in Finland, the diversity of interpretation and implementation of educational policy with the extensive autonomy from municipalities, schools, and teachers could be considerable. Some might argue for its inclusiveness and its tailor-made strategies to meet the local needs, while some might find it problematic to maintain equity and equality (Li, Y. & Dervin, 2018). This controversy contributes to problematize the understanding of teacher autonomy in this research.

**FNCC 2014 and digital competence**

The most recent Finnish national core curriculum reform in 2014 (FNCC 2014) is said to be one of the most radical education reform ever undertaken by a country, that catches the attention of global educators and policy makers (Søby, 2015) and becomes a classic example of cross-country attraction for policy borrowing (Chung, 2010). The FNCC 2014 has been implemented since 2016, the most essential reform in FNCC 2014 is that it moves from subject-based to competence-based curriculum (Palsa & Mertala, 2019; Søby, 2015; Uljens & Rajakaltio, 2017). A common misconception on this
reform arises followed by some media coverage saying that Finland is going to scrap the school subjects (Søby, 2015). Instead of abandoning subjects, a competency-based curriculum advocates developing transversal competence across subjects. FNCC 2014 introduces seven transversal competence areas which are described as an entity of knowledge, skills, values, attitudes, and will, that should be taught and integrated into each subject (Finnish Board of Education, 2014). Vahtivuori-Hänninen (2014) points out that one of the most important trends that shapes FNCC 2014 is the increasingly predominant role of ICT and media in education as in everywhere else. Since the seven competence areas are frequently interconnected (Finnish Board of Education, 2014), it is also described that digital literacy is embedded into all competence areas, but most explicitly into the area of multiliteracy and ICT competence.

In FNCC 2014, multiliteracy is defined as the competence to interpret, produce and evaluate various kinds and forms of texts, including audio-visual and digital forms (Finnish Board of Education, 2014). And ICT competence is developed in four main areas including ICT operating principles, safe and responsible use of ICT, using ICT to create, and using ICT to interact (Finnish Board of Education, 2014). These two transversal competence areas associate with the understanding of digital competence and guide digital competence education in the formal educational setting. While teachers in Finland have the extensive professional autonomy to interpret the curriculum and develop their pedagogical capacity with reference to the guidance of FNCC, how teachers understand digital competence in the curriculum and its importance would be influential to how they make the autonomous decision on their professional development of digital competence, of which this research is interested in studying.

**Teacher professional development in Finland**

Research on teacher professional development in Finland is scarce, according to Li and Dervin (2018), in terms of international scientific publication, there seem to be only four articles regarding this topic in the Finnish context available, and none of these is related to teachers’ digital competence. This session attempts to give a brief account based on the limited accessible resources, to provide a glimpse of the contextual background of teachers in Finland concerning their professional development.

Teacher professional development in Finland takes many different forms and faces some critiques. Guiden and Brennan (2017) identify three forms of such including compulsory training, voluntary training, and informal training. The compulsory ones are free for full-time teachers to participate and supported by the local education providers whereas the voluntary ones usually associate with a charge.
and the teachers might fund themselves or seek partial or entire financial support from their employers. According to the Finnish Ministry of Education, in 2005, 70% of teachers financed their professional development activities to some degree that probably reflects the initiatives of teachers in Finland in participating in professional development activities (Guiden & Brennan, 2017). On top of financial issue, focusing on formal in-service teacher training, Li and Dervin (2018) strongly criticize that teacher professional development in Finland is problematic, scattered, inconsistent and lack of systematic organization, teachers are facing various challenges that hinder the motivation to participate in professional development, such as geographical constraints, relevance, practicality, and continuity of the training (Li, Y. & Dervin, 2018). Moreover, in the three-year research project on in-service training of Swedish language teachers in Finland, Huhtala and Vesalainen (2017) find that teachers hesitate and are passive to explore new pedagogy and not always willing to cooperate with each other. In addition, according to the Teaching and Learning International Survey (TALIS) by OECD (2013) Finnish teachers have less in-service training than those in other countries, which can be considered as contradictory to their highly qualified and professional global image (Li, Y. & Dervin, 2018). These critiques reflect the problematic context of teacher professional development in Finland.

However, Niemi (2015) suggests that the TALIS results may be due to the nature of some in-service teacher training in Finland is not purely traditional models of structured activities but more of school-based development projects, which are usually responsible by local education providers, for example, municipalities or schools. According to Niemi (2015), officially, there are three mandatory in-service training days for every teacher each year (also known as VESO days, referring to Public Service Collective Agreement), yet these can be used in quite different ways depending on local decisions. The local providers are responsible for the quality of education, they have the autonomy to decide on the funding, the direction, and the models of teacher training, thus, there lies an incentive to integrate teacher professional development activities with school development projects. Besides, Geeraerts et al. (2015) find that peer-group mentoring is the new model for supporting teacher professional development in Finland and suggest an alternative conceptualization of teacher professional development that includes social dimension in a work community. Niemi (2015) points out the strong movement of teacher professional development from individual in-service training days towards more long-lasting development projects and programs that are supposed to generate more sustainable effects. This movement that is intended to be more local-based and takes the contextual needs of teachers and schools into account is said to be beneficial for the school and teacher communities to cope with the increasingly agile and complex situations in the educational environment (Niemi, 2015).
The localness of the teacher professional development trend could be one of the reasons that this area is not easily accessible for studying by international researchers. Li and Dervin (2018) also explain that due to language barriers, there is a lack of direct dialogue and engagement with relevant stakeholders in this area. Thus, this research is interested in engaging in first-hand discussion with local experts and teachers who are involved in activities for the professional development of digital competence, attempting to contribute to this considerable gap.

2.2 Unpacking digital competence

The fuzziness of digital competence is widely agreed among researchers that digital competence does not have a static and standardized conceptualization and framework, it is an evolving concept that comes with the advancement and rapid development of digital technology as well as societal and political changes (Brox, 2017; Ilomäki, Paavola, Lakkala, & Kantosalo, 2016; Tømte, 2013). Tømte (2013, p.76) describes the notion as a “moving target”; Aesaert, Vanderlinde, Tondeur, & van Braak (2013, p.143) refer it to “a tangled ball of concept”; Buckingham (2019) criticized that there are too many overlapping frameworks serving similar purposes. Ilomäki et al. (2016, p.655) describe it more positively as “a loosely defined boundary concept” in which its fuzziness and imprecision are important nature that gives versatility for adaptation and cross-discipline collaboration. There are different terms associated with the concept of digital competence, such as digital literacy, ICT competence, ICT literacy, information literacy, multiliteracy, media literacy, digital and media literacy, new literacy, etc. Not only different terms are used, each of their definitions and frameworks, although overlapping, consist of some different focuses that ranging from basic ICT skills to problem-solving, critical thinking skills, and ethics. According to Ilomäki et al. (2016), at least 34 terms are found in their article research that describe digital technology related skills and competence between 2005 and 2013, the most used term was digital literacy, followed by new literacies, media literacy, multiliteracies, and digital competence comes the fifth. Echoing with the results of Spante, Hashemi, Lundin & Algeras (2018), the research shows that digital competence is a rather new term compare to others.

Evolution of the terms with technological advancement

Mcgarr & Mcdonagh (2019) observe that the evolution of these terms is determined by the dominant technologies of that era and skills associated with them, which is roughly identified here as four periods: pre-internet, Web 1.0, Web 2.0, and Web 3.0. During the pre-internet period, for instance,
“computer literacy” is simply referred to the standalone nature of early computing technologies. Bawden (2001) mentions that early “computer literacy” was mainly pragmatic skills-based, which implies the abilities to use a personal computer for some computer applications, e.g. word processing, and some general IT skills such as printing. In the period of Web 1.0, when computer use was more common but users were mostly “read-only” consumers, Gilster (1997) defines digital literacy as “the ability to understand and use information in multiple formats from a wide variety of sources when it is presented via computers.” Whereas later on when Web 2.0 that highlights user-generated content becomes a norm, technological expansion to information and communication dimension, brought the need to the rise of some new term such as information literacy, digital and media literacy, etc. (Mcgarr & Mcdonagh, 2019). While Web 3.0 is setting in place, artificial intelligence, algorithm, and big data are having a breakthrough, critical and ethical dimensions of digital competence emerge significantly and are reflected in the related notions, for instance, critical literacy, critical media literacy, and in the reconceptualization of digital literacy and digital competence. Buckingham (2015) advocates digital and media literacy as critical use and evaluation of information and technology. On the other hand, Mihailidis & Thevenin (2013) and Hobbs (2017) stress the participatory competence and creativity in media and digital literacy for active citizenship engagement. When Baron (2019) reflects on the conceptual development of the term digital literacy, he notes that the earlier conceptions of digital literacy always focus on the novelty of computer as communication media and that internet was seen as a separate entity apart from users’ daily lives, while since Web 2.0, digital devices and internet has been so seamlessly woven into the everyday life of most people, the notions of being digital literate require new conceptualization too. Markauskaite (2006) points out that there is a need for inventing and reinventing the concepts related to digital competence to effectively tackle the social, cultural, and economic transformations that are brought about by the rapidly changing digital landscape. All in all, the development of the related terms encompasses broader dimensions from technical skills to higher-order thinking capacity. While Web 4.0 is said to be in progress (Choudhury, 2014), it is, therefore, foreseeable that the connotations of these terms will keep evolving by the same token. It is recommended that approaches to the terms should be dynamic and regularly revised (Ilomäki et al., 2016).

Diversity of its background domains

Another reason for the terms to be fuzzy is that digital competence is a concept that encompasses notions from different domains. Markausakaite (2006) says that not only there is no clearly agreed definition, the confusion between ICT competence, media literacy, and information literacy with digital competence is still huge. According to Ilomäki et al (2016), who describe digital competence
as a boundary concept explain the confusion by pointing out that literacy studies, media studies, library studies, and technology studies are the background domains of digital competence that all bring some elements to the notion. This explanation also provides a clue for the origin of some terms which are deriving from these domains. In literacy studies, “literacy” is defined as the ability to read and write and to use numeracy. With the rise of digital and audio-visual media, the notions in traditional literacies are broadened, terms such as new literacies, multiple literacies, or multiliteracies as in FNCC 2014 are often used to refer to the ability to understand, to use, and to create multimodal texts (Halinen, Harmanen, & Mattila, 2015). Also, digital competence has a strong connection with the media studies domain. For example, Palsa & Ruikamo (2015) explain that the concept of multiliteracies in FNCC 2014 is closely related to media literacy although they argue that the two terms are different and FNCC 2014 defines multiliteracies different from literature. Kupiainen (2019) also points out that in FNCC, media literacy belongs under the umbrella term multiliteracy and it is overlapping with concepts of digital literacy and information literacy. While the library studies domain contributes to the information skills elements, the technology studies domain mostly refers to the terms like ICT skills/competence, digital skills, etc. However, it is found that there has been diminishing interest in the purely technical aspect of the notion (Ilomäki et al., 2016). Furthermore, Al-Mutka (2011), when mapping digital competence together with other main concepts, concludes that there are obvious overlaps in various areas including ICT literacy, internet literacy, information literacy, media literacy, and digital literacy.

The concept of digital competence emerges across various domains that all have their traditions and focuses in different contexts, there is hardly one single definition or framework to be agreed on, thus, taking into considerations its connections with different background disciplines while using the term would help to broaden the understanding (Ilomäki et al., 2016).

**Digital literacy and digital competence**

Despite the fuzziness of the terms, there has been research attempting to distinguish between digital literacy and digital competence. Lea (2013) criticizes that the connotation of the term literacy connecting to the ability to read and write is not aligned with the competence-based agendas for transferrable skills in the digital society. Spante et al. (2018) point out digital literacy has been used for a longer time, and is more linked to many different research agendas and perspectives, while digital competence is a more novel term, very often appears in policy papers which starts to gain legitimacy. In the same research, Spante et al. (2018) also found that digital literacy is more commonly used in English-speaking countries whereas digital competence in European countries,
such as the Nordic countries. Furthermore, Falloon (2020) suggests abandoning the present skill-focused digital literacy, “in favour of broader digital competency models that recognize the more diverse knowledge, capabilities, and dispositions.”

Furthermore, it is found that Nordic countries’ curricula show different preferences on the use of the terminology. Godhe (2019)’s research examines the conceptualization of digital literacy and digital competence in compulsory education in four Nordic countries. It is interesting to note that according to Godhe (2019), Finland’s curriculum is the only one that specifically refers to literacy, yet, it refers to multiliteracies instead of digital literacy, while Sweden is the only one being consistent in using the term digital competence, Denmark’s curriculum uses IT and media whereas that of Norway’s uses digital skills.

In addition, Krumsvik (2008) argues that although digital literacy is internationally more frequently used, digital competence is most commonly used in the Scandinavian countries in educational contexts. He explains that the term “competence” has a more holistic meaning in Scandinavian English than in traditional English that it embeds a more complex and holistic proficiency in the use of digital technologies.

Interpretation problems in formal education

Regarding the dissemination of these fuzzy terms across nations in education policies and curriculum, Aesaert et al (2013) criticize that these different terms result in educators from the national level, school level to teacher level’s different interpretation on the complex landscape of the evolving concepts. As a result, implementation in the educational setting, learning outcomes, and evaluation could vary a lot. While these terms have been permissively and interchangeably used in different circumstances, Markauskaite (2007) commented that the notion has been poorly understood in formal education that affects the synergy effect in educational policy implementation among different levels. It is worth critically look into what one means when using specific terms, otherwise, according to Mcgarr &Mcdonagh (2019), simply surface-level changes in language are not effective in creating fundamental changes in understanding. Therefore, there is a need to identify the interpretation of relevant concepts among different levels of educators, in order to align classroom-level practices with the policy goals.
The European frameworks of digital competence

There have been attempts to pin down the definition and framework of the fuzzy concept to provide a more common understanding and language to discuss, thus reducing the disparity in implementation of relevant policy and practices (For example Calvani, Fini, & Ranieri, 2009; Ilomäki et al., 2016; Janssen et al., 2013). Although the frameworks may differ in meaning, depth, and breadth and varies among authors (Spante et al., 2018), illustrating the complexity and multifaceted nature of the concept, it is obvious that digital competence encompasses far more than just knowledge and skills, but also attitudes and values dimensions.

The term digital competence is said to have first appeared in European policy documents related to future skills needed in the 21st century to be a competent citizen with active participation in society and the economy (Ala-Mutka, 2011; Falloon, 2020; Plaza-de-la-Hoz et al., 2015). The concept has caught attention since 2006 when the European Union defined digital competence as one of the eight key competencies for lifelong learning (Spante et al., 2018). Thereafter, followed by further development on DIGCOMP projects which provide frameworks for implementation and acquisition of the competence.

Developing digital competence has then become a priority in European Commission in recent policies (Søby, 2013). In 2011-12, the European Commission commenced the project DIGCOMP that conceptualize digital competence (Ala-Mutka, 2011), and was later on developed into a European level framework DIGCOMP (Ferrari, 2012; Ferrari, 2013), DIGCOMP 2.0 (Vuorikari, Punie, Gomez, & Van Den Brande, 2016) and DIGCOMP 2.1 (Carretero, Vuorikari, & Punie, 2017). According to Vuorikari et al. (2016), the DigComp frameworks provide a common language on how to identify and describe the key areas of digital competence and thus offer a common reference at the European level. In 2017, the DigComp framework was updated to DigComp 2.1, to include 8 proficiency levels for each of the 21 competencies. It consists of an update of the conceptual framework with a revision of the vocabulary and more streamlined descriptors (Carretero et al., 2017).

This research uses the DIGCOMP 2.1 framework with reference to the ySKILLS project. This framework was integrated into the interview protocol in the ySKILLS research project, as well as in this research, to offer a common ground for the researchers and the participants to discuss the understanding of digital competence. A summary of the DigComp 2.1 framework is shown in the skill cards in the interview guidelines in Appendix 2.
Digital competence of education profession

The digital competence of the education profession is distinguished from other professions and digital technology users in which they need to focus on pedagogical purposes and developing the digital competence of young people. Much effort has been put into conceptualizing educators’ digital competence in the last decade, to consolidate what is needed to strengthen their professional development (Brox, 2017). For example, Krumsvik (2008) emphasizes the double dimensions of teachers’ digital competence that not only teachers themselves should possess digital competence that all citizens need to participate in the digital society so that they can serve as a role model for young people on critical and creative use of digital tools and information, but teachers also need the capacity to make professional pedagogical decisions on what, how and why digital technologies are used for pedagogical purposes that enhance effective learning and strength students’ digital competence.

For pedagogical digital competence, according to Falloon (2020), the technological-pedagogical-content knowledge (TPACK) model by Mishra & Koehler (2006) is a conceptual framework that is frequently used and well-supported by empirical research. TPACK framework is derived based on the earlier work of Shulman (1986) by introducing technology knowledge to the pedagogical content knowledge (PCK) framework, conceptualizing effective use of technology in pedagogical practices and how technology knowledge interacts with pedagogical content knowledge. Falloon (2020) commented that the TPACK framework provides a more holistic model that integrates conceptual knowledge (CK) with the use of technology (TCK) through constructive pedagogies (TPACK) to enhance learning.

Furthermore, based on the European framework DigComp and DigComp 2.0, DigCompEdu (Redecker, 2017) is published in 2017, aiming to provide a common framework, language, and logic to European countries in response to the growing need to conceptualize the specific digital competence needed by educators in the ubiquitous digitally mediated 21st century. DigCompEdu aims to provide a framework of 6 areas with 22 competencies that can guide policy across all levels and is directed towards educators at all levels, from early childhood to higher and adult education, including general and vocational training, special needs education, and non-formal learning contexts. The comprehensive framework also proposes a progression model with 6 proficiency levels that an educator’s digital competence typically develops. Educators are able to identify their current proficiency and decide on the specific steps to take for strengthening their competence.
Conceptualizing the digital competence of the education profession provides support and guidance to teachers’ practices as well as their continuous professional development. These conceptualizations serve as pragmatic understanding of digital competence needed by teachers in this research when discussing teachers’ professional development for digital competence.

2.3 *Teacher professional development*

*Ways and phases of teacher professional development*

Teacher professional development can be defined in many different ways in various contexts (Li, Y. & Dervin, 2018; Niemi, 2015). In a broad sense, OECD Teaching and Learning International Survey (TALIS) defines teacher professional development as “activities that develop an individual’s skills, knowledge, expertise and other characteristics as a teacher (Peña-López, 2009, p.49)”. This broad definition covers formal and informal ways of teacher professional development, ranging from structured activities (e.g. courses, workshops, conferences, seminars, etc.), to semi-structured activities (e.g. peer observation, coaching, collaborative projects, etc.), and informal activities (e.g. conversations and engagement with other teachers, etc.). More precisely, Kennedy (2005) categorizes nine teacher professional development models into three categories: transmission, transitional and transformative, which suggests increasing capacity for teacher autonomy to move from the transmission, through transitional to transformative categories. She suggests that each of them serves different purposes of development regarding different forms of knowledge. It is important to determine the purpose of the professional development and the nature of knowledge before pinning down which model to adopt (Kennedy, 2005). With reference to these categorizations of professional development activities, this research is interested in studying the models that teachers have experienced and found effective regarding their professional development of digital competence.

In addition to the categories of models, there are different phases of teacher professional development. The European Commission (2010) emphasizes the lifelong learning approach towards teacher professional development that consists of three phases: initial teacher training, induction, and in-service teacher training. According to Niemi (2015), the induction phase is almost non-existent until recent years, which reflects the considerable gap between initial teacher training and in-service teacher training, thus Finland’s teacher professional development is attempting to move towards this life-long learning approach that sees teachers’ development as a continuum. Li and Dervin (2018) also point out this considerable gap between initial teacher training and in-service
teacher training and that the focus of international research is often on how the initial teacher training prepares highly qualified and professional teachers but rarely how they sustain their profession. This research would like to focus on the third phase, which is supposed to be the longest phase of a teacher’s professional life yet to be sufficiently studied.

**Teacher motivation to learn**

In the Finnish context, where teachers have extensive autonomy to decide for their professional development, factors affecting their motivation to learn and professionally develop themselves could be influential. However, teacher motivation for professional development is a scarcely studied area because of its complexity, motivation component of teachers’ learning is almost absent from the current literature (Appova & Arbaugh, 2018). Osman & Warner (2020) also mention that one of the main reasons for the complexity is that motivation for professional development must take the context and individual characteristics into account, the idiosyncrasy of the internal and external factors is an obstruction for studying. Nevertheless, Appova and Arbaugh (2018)’s study conceptualizes teacher motivation to learn at the intersection of four research fields, including policy and accountability, educational psychology, andragogy and adult learning, and teacher education and professional development. Appova and Arbaugh (2018) suggest that these four aspects have significant influences on teacher motivation to professionally develop themselves. The policy and accountability aspect refers to the emphasis on reward systems concerning teacher accountability, reform adoption, and teacher evaluations, etc., that could affect teachers’ job satisfaction, efficacy, and attitudes towards professional learning. The educational psychology aspect refers to teachers’ efficacy and their intrinsic and extrinsic motivation to continuously adapt to the changes in the educational contexts (i.e., self-determining theory). Andragogy and adult learning aspect refers to two main principles: self-directed learning and transformative learning, which emphasize teachers’ internal motivation and responsibility to initiate learning and application of new knowledge to their roles. The teacher education and professional development aspect refers to the growth of a teacher’s professional career to improve students’ learning, as well as the demands and constraints that teachers face in their school communities, cultures, and policies that drive teachers to learn.

Motivation is seen as an important and essential condition for teachers’ professional development to be effective and successful in bringing transformations to teachers’ pedagogical practices (Karabenick & Conley, 2011; Timperley, Wilson, Barrar, & Fung, 2007). Therefore, it is believed that understanding the factors affecting the motivation would provide pathways to teachers’ participation in professional development (Heystek & Terhoven, 2015). Taking into account
Appova and Arbaugh (2018)’s conceptualization of teacher motivation to learn, this research is also interested in studying the factors that affect the teachers in Finland to participate in professional development regarding digital competence.

2.4 Mapping and research question

Based on the multifaceted conceptual frameworks of digital competence (Carretero et al., 2017; Vuorikari et al., 2016) and pedagogical digital competence (Krumsvik, 2008; Mishra & Koehler, 2006; Redecker, 2017), the ways of teacher professional development (Kennedy, 2005; Peña-López, 2009), and the four aspects that influence teacher motivation to learn (Appova & Arbaugh, 2018), this research is interested in understanding how digital competence is integrated in teacher professional development from the following three aspects: the understanding of digital competence, the factors that affect the process and the forms of professional development of digital competence. The mapping shown in Figure 1 illustrates the three aspects of this study that conceptualize how digital competence is integrated in teacher professional development.

**FIGURE 1.** Mapping of this study on the integration of digital competence in teacher professional development
The research question for this study is:
How is digital competence integrated in teacher professional development?

And the following sub-questions will guide the research to approach the main research question:

1.1 How is digital competence understood among educational experts and teachers?
1.2 How is motivation shown for teacher professional development of digital competence among educational experts and teachers?
1.3 How is professional development of digital competence shown among educational experts and teachers?

Based on the research questions, similarities and differences between the views of educational experts and teachers are discussed in Chapter 5.
3 METHODOLOGY

This chapter introduces the research methodology for this qualitative research which implemented a constructivist grounded theory approach as the framework for data collection and analysis, aiming to understand how digital competence is integrated in teachers’ professional development in Finland. The justification of the qualitative approach and constructivist grounded theory approach are discussed in detail in this chapter, followed by the research plan including an adaptation from the ySKILLS research project, procedures of using semi-structured interview for data collection, sampling of participants, and data analysis methods.

3.1 The research paradigm and methodology: Constructivist qualitative research

This study aimed to gain an understanding of the integration of digital competence in teachers’ professional development in Finland. The research methods design aims to answer the following research question: How is digital competence integrated in teachers’ professional development in Finland?

A strong research design is rooted in a research paradigm that is congruent with the researchers’ belief about the nature of reality (Levers, 2013). Paradigm refers to a system of ideas, or world views, used by the researchers to generate knowledge. The paradigm and the research questions would determine the research methodology and how data is collected and analyzed. This research was situated within the constructivist paradigm which encompasses the intention of understanding the world of human experience and suggests that the reality is socially constructed (Mackenzie & Knipe, 2006) by people active in the research process (Mertens, 2014). This paradigm assumes that the meaning of experience and events are constructed by individuals, that is, people construct the realities that they participate in (Charmaz, 2014). Therefore, researchers should attempt to understand the complex world of lived experience from the point of view of those who live it (Mertens, 2014). Moreover, constructivist acknowledges the subjectivity and the researchers’ involvement in the construction and interpretation of data, that is, recognizes the impact on the research of the researchers’ background and experiences
(Charmaz, 2014). It emphasizes that research is a product of the values of the researchers and cannot be independent of them (Mertens, 2014). Furthermore, rather than beginning with a theory, the constructivist approach inductively generates a theory or pattern of meanings throughout the research process (Mackenzie & Knipe, 2006). Thus, it is suggested that the constructivist paradigm operates predominantly with qualitative methods for data collection and analysis (Mackenzie & Knipe, 2006; Thanh & Thanh, 2015).

This research aligned with the nature of the constructivist approach explained above. The notion of digital competence is dynamic, complex, and multifaceted, it varies according to the social contexts, such as technological development and individual contexts, such as different professional backgrounds, it aligns with the constructivist approach that reality is subjective and allows multiple interpretations under different social constructions. Also, this research was interested in understanding teachers’ experience in a specific social context through the construction of meanings and realities from the teachers’ point of view, interpretations by the participants and researcher were both taken into account. Furthermore, teachers’ professional development for digital competence has been an under-researched area, theory to discuss and explain the phenomenon is scarce, the constructivist approach allowed the inductive process to look for a pattern of meanings in the context and to generate systematic understanding grounded from data.

Based on the constructivist paradigm and the research question, a qualitative approach was chosen instead of quantitative. According to Stake (2010), qualitative methods rely primarily on human perception and understanding, in which “personal experience, intuition, and skepticism work alongside to each other to help refine the theories” (p. 11). Qualitative methods are interpretive, experiential, situational, and personalistic, they tend to emphasize microcosms over macrocosms (Stake, 2010). While quantitative methods rely heavily on linear attributes, measurements, and statistical analysis (Stake, 2010), seek to understand the relationship among variables through numerical data in a positivist and deductive approach (Muijs, 2010). Muijs (2010) points out that quantitative methods will fail if we want to explore a complex problem in-depth. While quantitative methods are best for looking at causality and explain things in a broader sense, they are best for looking at the meaning of particular circumstances. Therefore, qualitative methods aligned better with the aim of this research.
3.2 Constructivist grounded theory approach

This qualitative study was conducted using the framework of grounded theory methodology, which is an important method that underscores the collaboration of empirical data, rigorous coding, and conceptualization in a qualitative study. It is inductive as the theories emerged from, rather than exist before the data (Cohen, Manion, & Morrison, 2013). Glaser and Strauss, the founders of grounded theory first defined grounded theory as “the discovery of theory from data” (Glaser Barney & Strauss Anselm, 1967, p.1). Since then, grounded theory has been widely applied in research and different permutations of the methodology evolve (Mills, Bonner, & Francis, 2006). For example, according to Strauss and Corbin (1994), grounded theory is “a general methodology for developing theory that is grounded in data systematically gathered and analyzed” (p.273). Charmaz (2014) in her explanation of constructivist grounded theory as “methods consist of systematic, yet flexible guidelines for collecting and analyzing qualitative data to construct theories from the data themselves” (p. 2). She emphasizes that grounded theory begins with inductive data, invokes iterative strategies of going back and forth between data and analysis, using comparative methods, keeps the researcher interacting and involved with the data and emerging analysis. Although some of the permutations appeared to be partly contradictory with each other or even dispute each other, they share some basic principles in common (Timonen, Foley, & Conlon, 2018). Timonen et al. (2018) pragmatically summarize four common core principles from all variations of grounded theory: (1) taking the word “grounded” seriously, (2) capturing and explaining context-related social processes, (3) pursuing theory through engagement with data, that is constant comparison, and (4) pursuing theory through theoretical sampling. Although this research did not aim to pursue a theory out of the relatively limited data, it sought to align with these common core principles, in order to apply the framework of the grounded theory method to approach the best findings in the soundest way.

This research was conducted with a constructive grounded theory approach. According to Charmaz (2014), the constructive approach of grounded theory arose as an alternative to objectivist forms of grounded theory, it places priority to see both data and analysis as social constructions than objective realities. Instead of seeking decontextualized generalization, the constructivist grounded theory emphasizes contextualization to addresses the complexity of realities. Constructive grounded theory conceptualizes the studied phenomenon in abstract terms, articulates theoretical claims, acknowledges subjectivity, and offers an imaginative interpretation (Charmaz, 2014). Based on these principles, this research sought to conceptualize the research participants’ views and experiences in
their specific context, to understand in abstract terms resulted from the constant comparison of data and finally reached systematic understanding based on the interpretation of the data.

*Constructing grounded theory* by Kathy Charmaz (2014) establishes the foundation for this research, it provides the framework and procedures for grounded theory methodology to be carried out, except for the outcome—instead of a theory, systematic understanding on the topic is grounded from the data, due to limitation of time, sample size and the novice researcher, a broader understanding on the issue cannot be generalized from the data. Below is a flow chart of the research process.

![Diagram of research process with grounded theory approach](image)

**FIGURE 2.** Summary of the research process of this research with grounded theory approach

### 3.3 Data collection: Sampling methods and semi-structured online interview

#### 3.3.1 Sampling methods

The appropriateness of the sampling strategy would determine the quality of the research (Cohen et al., 2013). Maintaining transparency of the sampling strategy and process has impacts on the trustworthiness of the research (Higginbottom, 2004). This research started with purposive sampling
to obtain initial data that stimulates the subsequence theoretical sampling. In the research process, snowball sampling was also employed to reach more participants during the theoretical sampling stage. The following sections explain the appropriateness of the sampling strategies and discuss in detail the procedures to maintain transparency.

**Purposive sampling**

Quoting Crookes and Davis (1998), purposive sampling is defined as “judgmental sampling that involves the conscious selection by the researcher of certain subjects or elements to include in the study” (Higginbottom, 2004). It is often that the participants are selected based on their in-depth knowledge or experience of relevance and interest to the research (Cohen et al., 2013). Purposive sampling does not seek to represent a wider population, it is deliberately selective and biased (Cohen et al., 2013). While concurrent data collection and constant comparison are central to grounded theory, initial purposive sampling provides data for the researcher to analyze. Codes and categories induced from the first data set provide clues for the researcher to follow and progress in the iterative process of the research (Chun Tie, Birks, & Francis, 2019).

In the initial purposive sampling of this research, a selection was made in relation to the participants’ professional backgrounds in the education sector in Finland with reference to the ySKILLS research project (Donoso et al., 2020). ySKILLS research project work package 3 was interested to understand the actors and factors that influence the effectiveness of digital skills education. Three educational experts with different expertise, referred by two ySKILLS national project leaders in Finland, were invited for the interview. According to the purposive sampling principle of the ySKILLS project, educational experts are essential to provide overarching points of views and insightful knowledge as a result of their professional experience and closeness to the field, who are able to observe tendencies and phenomena which otherwise might not always become evident in scientific research (Donoso et al., 2020).

All the three educational experts interviewed are currently working in the educational sector, knowledgeable and experienced in their expertise. Here are their profiles:

**Educational expert 1 (E1)**

He is a scholar of ICT in education, has been working as a teacher educator in university for more than 10 years, and has been participating in international projects of ICT in education. He is also an e-book writer. This expert has plenty of knowledge about the use of digital technologies in schools. He is also an expert in training teachers on the use of ICT in education.
Educational expert 2 (E2)
She is a media literacy and education specialist working for a Finnish governmental agency for over 10 years to promote media literacy, active citizenship, and a better media environment for all. She has been collaborating with academic operators in the field of Finnish media literacy. She also provides and facilitates media literacy training for education professionals. She has profound knowledge and experience of media education policy in Finland.

Educational expert 3 (E3)
He is a representative of an organization for the expertise of digital youth work in Finland. He has been working there for about 4 years. He is mostly specialized in practical technology education and international youth work. He develops programs, training, and educational materials for young people and youth workers around topics related to digital skills, media literacy, online safety, coding, etc.

Based on the initial analysis of data collected from these three educational experts, theoretical sampling was introduced and explained as follows.

Theoretical sampling and snowball sampling
Theoretical sampling is one of the main features of grounded theory. This research applied theoretical sampling based on the following two principles.

First, Charmaz (2014) defines theoretical sampling as “seeking and collecting pertinent data to elaborate and refine categories in your emerging theory” (p. 193). Theoretical sampling brings explicit systematic checks and refinements into the analysis and prevents getting stuck in unfocused analysis. After making an initial comparison between data, some tentative categories and incomplete ideas emerge. The researcher will then select some focused codes or categories and collect more data on their properties to enrich the tentative categories and proceed with further analysis (Charmaz, 2014).

Second, according to Cohen et al. (2013), the sample size in grounded theory research is “relatively immaterial” (p. 116), since the researcher does not know in advance how much data would be sufficient to reach theoretical saturation. The researcher should proceed to gather more data until no additional data would bring modification to the theory developed. Also, quoting Glaser and Strauss (1967, p. 49), it is suggested that the selection should be based on theoretical relevance, in other words,
selected participants are able to facilitate the generation of as many properties and categories as possible (Cohen et al., 2013).

The theoretical sampling in this research was done based on the emerging idea from the data and theoretical relevance. After initial coding of the data collected from the three educational experts, the code “teacher autonomy” emerged as the second most prevalent code, with a total of 16 occurrences, while the most prevalent code was “versatility of digital competence” with 17 occurrences. Nevertheless, the limitation to analyze based on the absolute number of code occurrence was that it did not reflect accurately the importance of the emerging code or theme as the same participant can express the same idea in many of his or her responses that result in a high number of code occurrences. It is suggested that the “number of individuals independently expressing the same idea is an even better indicator of overall thematic importance than the absolute number of times a theme is expressed and coded” (Namey, Guest, Thairu, & Johnson, 2008, p. 143). To look for a better indicator, the researcher also discovered that “teacher autonomy” was a common code among all three educational experts. The data indicated the prevalence of the code in both occurrence in total and across participants, therefore, the researcher was drawn to look more details into the data of this code. The initial understanding of the data suggested that all the experts agreed teacher autonomy was both the strength and weakness to implement digital skills education in Finland as getting teachers to develop their digital competence very much rely on their own decision. To refine the analysis and to enrich this predominant tentative theme, the researcher was intrigued to study further what teachers experienced in their pursuit for professional development on digital competence. Subsequently, the researcher aimed to invite local upper secondary school teachers with diverse backgrounds to participate in the interview.

There were three reasons to focus on upper secondary school teachers. Firstly, the researcher, who is an upper secondary school teacher outside Finland, has immense interest to study and reflect on the experience of Finnish teachers who have a similar background and have gained a global reputation for their professional qualifications. Second, the matriculation examination after finishing upper secondary high school has been undergoing digitalization since 2016. Teachers in these levels are obliged to practice and integrate relevant digital skills in their daily teaching in order to help students prepare for taking the examinations digitally. Their experience and opinions on the development of their professional digital competence are valuable to study. Lastly, the experience of teachers teaching different levels could vary a lot, with limited time, this research focused on upper secondary school teachers to reduce the variations to be studied.
There were 5 teacher interviewees, who were referred by the ySKILLS national project leader, recruited through snowball sampling and personal connection. 5 invitations were sent based on the referral by the project leader, 3 of them responded and agreed to be interviewed, while there was no response received from 2 of them. In order to reach more participants to increase the richness of data, snowball sampling was introduced. Snowball sampling is a purposeful sampling method in a qualitative study that relies on initial participants’ referral to recruit new participants who possess similar characteristics and relevant knowledge (Ghaljaie, Naderifar, & Goli, 2017). Subsequently, the sample size grows as the study continues. One advantage of this method is that, with a previous participant vouching for the research interview, the potential participants would feel more comfortable participating in the research (Johnson, 2014). One participant was referred through snowball sampling. Moreover, one participant was recruited through personal connection, nevertheless, the researcher did not know the interviewee before the interview and there was no personal interest involved. As a result, 5 teachers who are currently serving in upper secondary schools in Finland were interviewed. The diverse background of the interviewees, with different subject expertise, duration of teaching experience, and include both males and females, facilitated the emergence of as many codes and categories as possible (Cohen et al., 2013). The profiles of the teacher interviewees are as follow in Table 1:

<table>
<thead>
<tr>
<th>Interviewees</th>
<th>Subject expertise</th>
<th>Teaching experience</th>
<th>Serving school level</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>English and German languages</td>
<td>12 years</td>
<td>High school</td>
<td>Female</td>
</tr>
<tr>
<td>T2</td>
<td>Media studies</td>
<td>5 years</td>
<td>High school</td>
<td>Female</td>
</tr>
<tr>
<td>T3</td>
<td>Mathematics and Physics</td>
<td>&gt; 10 years</td>
<td>High school</td>
<td>Male</td>
</tr>
<tr>
<td>T4</td>
<td>Mathematics</td>
<td>&gt; 10 years</td>
<td>High school</td>
<td>Male</td>
</tr>
<tr>
<td>T5</td>
<td>Music</td>
<td>5 years</td>
<td>High school</td>
<td>Male</td>
</tr>
</tbody>
</table>

**TABLE 1. Profiles of the teacher interviewees**

3.3.2 Semi-structured interview

The semi-structured interview method was used for data collection in this research. A qualitative semi-structured interview is a flexible method to obtain data while allowing the researcher to explore subjective views and peoples’ experience in-depth, and to discover the complexity in their perception and interpretations (Choak, 2011). It also allows respondents to answer in their own words and to discuss issues that emerge in the process (Choak, 2011). A semi-structured interview consists of series
of questions with some defined themes in the interview guidelines, which facilitate the directions of data collection. It also allows flexibility for the researcher to change or choose to pose follow-up questions in response to the emerging themes during the interview. This allows the research to be continuously adapting to emerging themes (Evans & Lewis, 2018). According to Choak (2011), a semi-structured interview resembles a “flowing conversation” between the interviewer and the respondents, that facilitates the exploration of the constructed realities and their interpretations.

**Interview guidelines**

**Educational experts interview guidelines**

The interview guidelines for the educational experts were provided by the ySKILLS consortium since this research was derived from the ySKILLS research project work package 3, which aimed to study the actors (e.g., teachers, parents, policy makers, etc.) and factors (e.g., the curriculum, resources, etc.) that influence digital skills education (Donoso et al., 2020). The aims that these guidelines originally served were different from this research, nevertheless, the broadness and richness of the data collected with the guidelines provided possibilities for further analysis that focused on Finland’s context. Besides, given that the ySKILLS consortium and the interviewees consented that the acquired data could be used in projects investigating similar topics to advance knowledge in the area (Donoso et al., 2020)(see Appendix 1 for the consent letter), the data collected using the ySKILLS interview guidelines for educational experts was adopted and analyzed in this research.

The ySKILLS interview guidelines consist of open-ended questions on five main overarching themes: (1) Conceptualizing digital skills, (2) Core skills needed in the digital age, (3) The development of digital skills, (4) The importance of digital skills compared to non-digital skills, and (5) The strengths, weaknesses, opportunities, and threats related to digital skills education in Finland. Based on these themes, a set of questions for each theme was formulated (see Appendix 2 for the interview guidelines). For example, in theme 1, the questions started by asking the experts what they think would make a person digitally skilled. Then, followed by an interactive exercise that the interviewees were provided with 21 cards, each of them specifying a digital competence which was taken from the European Commission’s Digital Competence Framework for Citizens (DigComp 2.1) in its revised 2017 version (Carretero et al., 2017). The interviewees were asked to select the five most important digital competence that they think should be taught in schools and rank them in order of importance. It was also possible for them to add additional competence that was not included in the Digcomp 2.1 framework. Afterward, they were asked to comment on their choices. This set of questions in theme
was used as a source of inspiration for the interviewees to express their understanding and views on digital competence in more detail and concrete ways.

The interviews were designed in a semi-structured way to allow space for individual, detailed responses and to allow the emergence of unanticipated themes. Therefore, the researcher was free to inquire into any issue relevant to the research aim raised by the interviewees. Subsequently, the length of the interview ranged from 1 hour 17 minutes to 1 hour 37 minutes. Here is an example of a follow-up question that the researcher inquired further after the interviewees mentioned some unanticipated yet relevant issues.

**E3:** “I think there should be a wider dialogue between the formal and non-formal sectors in the sense, like where are we going with technology education and why you need it….because I think….between these fields there is no real dialogue at the moment.” (5:24)

**Interviewer:** “What means a real dialogue for you?”

**Upper secondary school teachers interview guidelines**

After the educational expert interviews and the initial coding, a tentative theme “teacher autonomy” emerged that intrigued the researcher to study further the teachers’ opinions and experience on their professional development on digital competence. The following two themes were added to the above guidelines that helped to focus on the scope of teachers’ point of view and their experience: (6) Teachers’ experience on professional development on digital competence, (7) Teachers’ motivation on professional development on digital competence (See Appendix 2 section 3-6). This modification helped to collect data that did not exist in the first data set of expert interviews, to refine and enrich the tentative themes that emerged (Ligita, Harvey, Wicking, Nurjannah, & Francis, 2019).

**Interview procedures**

The three educational experts were invited for the interview in April 2020 through e-mail. Information about the research project and a consent letter were included to help them understand the aims of the research and the reasons they were invited. Informed consent was obtained from them before the interview with their signatures on the consent letter (See Appendix 1). Interview guideline was sent one week before the interview to keep them engaged and to help them get prepared and familiarized with the upcoming interview. The interviewees were well-prepared for the length of the interview and the variety of questions that would be discussed. The guidelines were also helpful during the interviews that the interviewees had the files opened in front of them and could easily refer to the
plenty of examples listed in the guidelines for brainstorming and to follow the progress of the interview.

Due to the COVID 19 pandemic situation, the interviews were conducted and recorded online in May 2020 on Microsoft Teams video conferencing platform, which was a platform that the university had a data processing agreement (PDA) in place. Except in one case, due to a technical issue with the network, half of the interview with E3 was carried out via Whatsapp audio call and recorded with an iPhone voice memo. Online interview not only offers flexibility for time and space with cost-effectiveness (Silverman, 2016), in this unprecedented time of the pandemic, it also helped to maintain social distancing to reduce health risks.

For the teacher interviews, after obtaining official approval to conduct research in local schools from the city council in Finland in Nov 2020, interview invitations were sent to the teachers in Dec 2020 and Jan 2021, following the same procedures as interviewing educational experts stated above. The teacher interviews were conducted in Jan 2021 online via the Microsoft Teams video conferencing platform. A total of 10 hours 54 minutes of recording was obtained from the eight interviews.

3.4 Data analysis in grounded theory

3.4.1 Constant comparison and memo writing

One of the core principles of grounded theory is to pursue the theory through engagement with data. Constant comparison and memo writing are highly iterative processes to assist the researcher’s engagement with the data and eventually develop the theory that emerged from the data (Charmaz, 2014). The constant comparison refers to the analytical process of comparing new data with existing data, in order to identify similarities and differences between them. Constant comparison helps to explore and refine research focus by constantly advancing codes, categories, and concepts that emerged in the data collection and analytical process (Timonen et al., 2018).

Memo writing is considered a crucial process to ensure the quality of grounded theory (Birks & Mills, 2015). The purpose of memo writing is to document ideas generated through interacting with data that aims for the discovery and development of theory, it is a private conversation between the researcher and the data (Charmaz, 2014). Thus, different from formal writing, the central principle of memo writing is to do it expansively, freely, and unconstrained, it can be fragmented phrases, weird
diagrams, incomplete sentences (Charmaz, 2014), as long as it allows the researcher to think through the emerging ideas and to search the linkage between categories and concepts.

Memo writing is a reflective practice that builds a trace of conceptual development in the research process as the memo would provide detailed records of the researchers’ thoughts, feelings, and intuitive contemplations that foster the analytical process and the emerging theory. (Birks & Mills, 2015; Chun Tie et al., 2019).

The researcher followed the practices of constant comparison and memo writing throughout the research process, for example, after the interviews, during different stages of coding. The memos served as guiding posts to make further inquiries and facilitates making follow-up questions during the upcoming interviews for in-depth exploration with the interviewees. Some examples of memos are shown in Table 6 in section 3.5.3.

3.4.2 Transcriptions

All the 8 interviews, including 3 educational experts and 5 upper secondary school teachers in Finland, a total of 10 hours 54 minutes, were transcribed with an online application amberscript and were manually revised for accuracy. To ensure capturing the important ideas emerging from the data, transcription was done almost word by word, except for repetition, filler words, or incomplete utterance. All the transcripts were browsed through 2-3 times before coding, memos of the overall impression were written. The transcripts were then read through in more detail, line by line for initial coding.

3.4.3 Initial coding

According to Charmaz (2014), coding is the pivotal link between collecting data and developing an emergent theory to explain these data, it forms the bones of the analysis. The terminology surrounding coding differs among variations of grounded theory (Timonen et al., 2018). This research is based on constructivist grounded theory, the three iterative stages of coding are named initial coding, focused coding, and theoretical coding.

Initial coding is mining early data for analysis that leads to pursuing further data collection and analysis. It is important to remain open to all possible theoretical directions to avoid prematurely
forcing data to fit into a particular framework (Charmaz, 2014; Cohen et al., 2013; Timonen et al., 2018). Initial coding attributes meaning to the data (Chun Tie et al., 2019), which enables the researcher to explore the similarities and differences among different sets of data and to refine the codes and categories in the ongoing iterative process of data analysis. Charmaz (2014) suggests that initial codes should be kept “short, simple, spontaneous and analytic, and the rest will fall in place” (p.161).

In this research, qualitative research analysis software atlas.ti was used to facilitate the extensive and vigorous coding process through tracking records of the analysis and introducing various analytical tools. The user license of this offline software was offered by the university. Phrases, sentences, and sections were initially coded based on their repetitive appearance, relevance to the conceptual framework of the study, or emergence as important ideas that need further study. All interviews were conducted in English, having considered that English was not the native language of both the interviewees and interviewer, the data was coded by identifying the thematic occurrence instead of a particular word or phrase count because the use of a specific word or phrase as a marker for an idea was less certain in this situation (Namey et al., 2008).

Three educational experts were interviewed in the purposive sampling stage in May 2020. Initial coding was done for these interviews in the first cycle of the coding process. 70 codes emerged, examples are shown in Table 6. Constant comparison was applied simultaneously to critically evaluate the similarities and differences among the data sets. Some questions were constantly asked during the coding process to facilitate coding and comparison, for example, how is this view related to the research? Does the data reveal something else outside the research theme or does it reveal some new perspectives? How does code A similar to code B? Could this data be a new code or an existing code? etc. Since this is initial coding, the codes remain instinctive, simple, and descriptive to give openness for further analysis. Memo writing was also used to dialogue with the data, which also facilitates the emergent of codes and themes and the development of critical understanding towards the data. A total of 12 memos were written in this stage.

After initial coding of the expert group data, focused coding, theoretical sampling, initial coding for teacher group data were simultaneously and iteratively employed to refine and enrich the codes and seek additional data for further advancement to look for patterns and themes. After teacher group data was processed with initial coding based on the existing codes and themes, accumulatively, 73 codes
and 24 memos were generated. Below in Table 6 are some examples of initial coding, some early memos, and example of multiple codes in one paragraph.

<table>
<thead>
<tr>
<th>Initial codes</th>
<th>Transcription quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Versatility of digital competence</td>
<td>E3: “If you have good digital skills now, but in 5 years, then those skills will be hopelessly outdated at that time.” (5:1)</td>
</tr>
<tr>
<td></td>
<td>T2: “…technologies are developing every day. But I think the most important skill you have to learn how to find out how new technologies work and how to learn... programs are changing and ways of using technology are changing, you have to adapt to the new technology...learning to learn—that's the most important thing.” (8:22)</td>
</tr>
</tbody>
</table>

Memo

#3 All experts agree that DigComp is versatile. This links to the literature review of the ever-changing conceptual framework of DigComp. This also links to the need for in-service prof dev of teachers. How do teachers think about this need?

<table>
<thead>
<tr>
<th>Transcription quotes</th>
<th>Initial codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>E2: “…when it comes to schools, I think it's also important that children learn those basic of devices and programs that are used in studying in their own schools. Sometimes this is not self-evident, since some teachers may have false beliefs about children as digital natives, who would master all digital issues without teaching, and I hope that no child would get poor grades from school because they are not properly taught to operate digital environments, but I am afraid it may happen in some occasions.” (4.11-12)</td>
<td>Digcomp: technical and operational skills</td>
</tr>
<tr>
<td></td>
<td>Digital savvy myth</td>
</tr>
<tr>
<td></td>
<td>Educational equity</td>
</tr>
</tbody>
</table>

| TABLE 2. Examples of initial coding and some early memos and multiple codes in one paragraph |

3.4.4 Focused coding

Focused coding is built on initial coding. Initial coding produces tentative codes and categories, focused coding identifies core categories that indicate analytic significance (Charmaz, 2014), and work alongside new data from theoretical sampling by constant comparison and memo writing, transforming the initial codes to more abstract concepts. The researcher separates, sorts, and synthesizes data to review concepts, identify and refine their properties (Charmaz, 2014; Chun Tie et al., 2019). Instead of axial coding proposed by Strauss and Corbin (1994), Charmaz (2014) advocates keeping codes simple, direct, analytic, and emergent. The focused coding phase is a significant step to organize data and emerging analysis. It helps to move to the theoretical coding phase when
theoretical saturation is reached, that is no additional data would bring any further modifications to
the existing categories and codes.

In this research, after extensive coding in the previous stage, codes were merged, revised and
categorized, until each code and theme became precise and distinct. Questions were frequently asked
to revise and categorize the codes, for example, are the codes mutually exclusive to each other? Can
some codes merge together? Should some codes be dropped out? Can the codes create a new theme?
Does this code belong to more than one theme? Is the code list comprehensive and exhaustive? etc.
Constant comparison and memo writing were simultaneously applied to continue dialogue with the
data.

Additional literature was also reviewed when new concepts emerged, or enrichment of existing
concepts was needed. For example, the literature of the emerging theme “Community of practice”
was reviewed to gain a deeper understanding, which helped to build a stronger theoretical foundation
for this research. Also, the theme “Versatility of digital competence” had 29 codes at the beginning
of this stage, some of the codes were found overlapping and intertwined with each other, after
reviewing the relevant literature, some codes were merged under new codes for distinctiveness and
preciseness. For example, the three codes “Digcomp: communication skills”, “Digcomp: interacting
through digital tools”, “Digcomp: netiquette” were merged into the code “Digcomp: communication
and interaction” as this is the term that was mentioned in the literature. As a result, 14 codes remained
in this theme.

After refining all the codes, 39 codes remained. The researcher began to identify and consolidate the
emerging themes from the codes. The comparisons of frequency of codes and occurrence of themes
were employed as a starting point to give an idea of the prevalence of thematic responses across
participants (Namey et al., 2008). For example, the code “Educational equity” not only had a
comparatively high frequency with 21 occurrences in total, but it also occurred in the responses across
7 participants. This discovery indicated that this could be an important theme to be analyzed. As a
result, the researcher decided to make it a theme and further looked for the relationship of this theme
with the other emerging themes in the next stage of coding.

During this process, the researcher also needed to delineate the boundaries of the analysis by
extracting data that was relevant to the research question (Namey et al., 2008). That means, some
irrelevant data or less relevant data, for example, with low occurrence both in the whole data set and
across participants, needed to be set aside. According to Namey et al. (2008), these analytical decisions could help to sharpen the data and give focus to the analysis that is relevant to the research question and could facilitate the data to tell a coherent story. This is particularly important for this research for it was adapted from ySKILLS research project that served different objectives. For example, there was a section about home-school collaboration in the ySKILLS interview guidelines which was of relatively low relevance with this research, some codes, for instance, “home-school collaboration” were set aside to bring focus to the analysis. Also, some codes with the lowest occurrence were set aside while looking for the emergence of relevant themes, for example, the code “Too much dependent on digital environment” had only 1 occurrence across the data sets; the code “GDPR as threat” had 2 occurrences from 2 respondents with a thin discussion that were not relevant to the objective of this research; the code “Informal digital education lack of clear goals” had 3 occurrences but all from the same respondent. The analysis suggested that these codes were of insignificant importance to be included in the final analysis, thus, setting them aside allowed the data to tell the story more sharply and coherently.

After an iterative coding process and analytically selecting relevant data, 9 themes emerged. The themes include (1) Versatility of digital competence, (2) Digital competence in education curriculum, (3) Teachers’ self-learning (4) Community of practice, (5) Formal teacher training (6) Teacher autonomy, (7) Teacher motivation to learn (8) Educational leadership (9) Policy and resources. Memos for each emerged theme were written to consolidate the properties and dimensions for further analysis. The finalized codebook is attached in Appendix 3. Below in Table 7 demonstrates an example of focused coding and memo.

<table>
<thead>
<tr>
<th>Theme: Versatility of digital competence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focused codes</strong></td>
</tr>
<tr>
<td>Digcomp as learning to learn</td>
</tr>
</tbody>
</table>

**Memo**

#21

**Theme:** Versatility of digital competence

**Properties:** skills descriptions, attitudes, examples of using the skills

**Dimensions:**

<table>
<thead>
<tr>
<th>Importance: important VS. less important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength: strong VS. weak</td>
</tr>
<tr>
<td>Essentiality: survival VS. non-survival</td>
</tr>
<tr>
<td>Complexity: multifaceted VS. unidimensional</td>
</tr>
<tr>
<td>Adaptability: versatile VS. mechanical</td>
</tr>
</tbody>
</table>
TABLE 3. Example of focused coding and memo

The analytical process of focused coding was iterative until a satisfactory level of saturation was reached, which means, no major modification was needed with the existing data. The most prevalent emerging themes were reviewed for continuous dialogue with the data that facilitated theoretical coding in the next phase of data analysis.

3.4.5 Theoretical coding

Theoretical coding is a sophisticated stage of coding that follows focused coding. It is a form of coding to integrate and solidify the analysis in a theoretical structure (Charmaz, 2014). During theoretical coding, the researchers analyze how themes and codes that emerged from data might relate to each other, and how they can be integrated into a coherent story (Hernandez, 2009). To achieve this integration, researchers need to “inspect, choose, and use theoretical codes as analytical tools to organize and conceptualize their codes and themes with each other to develop a coherent story (Thornberg & Charmaz, 2014)”.

While initial codes and focused codes are built on constant comparison of data, according to Thornberg and Charmaz (2014), theoretical codes consist of ideas and perspectives that are imported from “outside” of the data, from a range of existing theories. These existing theories provide ideas or models that may facilitate the emergence of possible relationships among codes and themes. Therefore, the more and wider range of theories the researcher studies, the stronger the theoretical sensitivity to identify the emergence of the theoretical codes (Thornberg & Charmaz, 2014). Nevertheless, Glaser (1992) emphasizes that theoretical codes must not be preconceived, they have to “earn their way” into the analysis through the engagement with the data.

According to Hernandez (2009), several theoretical codes may emerge during the research process, but eventually, through constant comparison and memoing, one theoretical code is chosen as the theoretical code for the study. Subsequently, a model of how the codes and themes are related to this theoretical code and a coherent story emerges, which quite often uses storylines and diagrams as tools to illustrate (Chun Tie et al., 2019). Birks and Mills (2015) define storyline as the conceptualization of the core category, it is “a strategy for facilitating integration, construction, formulation, and presentation of research findings through the production of a coherent grounded theory” (p. 180).
Birks et al. (2009) affirm that “storyline enhances the development, presentation, and comprehension of the outcomes of grounded theory research” (p. 405). After the storyline is formed, the grounded theory research is finalized with theoretical codes that provide a framework for enhancing the explanatory power of the storyline (Birks & Mills, 2015). In addition, a diagram is also recommended to illustrate the storyline that visually reinforces the final grounded theory (Birks et al., 2009).

To explore the potential relationship among the themes and codes, the researcher looked for the co-occurrence of codes and themes, similarities and differences between the experts’ and the teachers’ data sets, and studied literature related to the emerged themes. Quoting Guest and McLellan (2003), co-occurrence is defined as “the application of two or more codes to a discrete segment of data from a respondent (Namey et al., 2008, p. 145)”. Namey et. al (2008) affirm that code co-occurrence report often provides helpful information in understanding the patterns in the data and the correlation among codes, themes, and respondents. Thus, a code co-occurrence table was produced in atlas.ti for detailed analysis, as shown in Appendix 4. The frequency of the co-occurrence ranged from 0-6. Co-occurrences of 3-4 frequency were highlighted yellow and 5-6 frequency were highlighted red. Each of the highlighted pairs was studied and memos were written during this process to capture the emerging relationships between the codes. After checking for code co-occurrence frequency, the researcher revisited the data to find out if the co-occurrence could be found across participants in order to identify it as an important emergence. For example, the codes “community of practice” and “COVID-19 pandemic as accelerator” had 5 co-occurrences, which were relatively high, while this co-occurrence was also identified across the majority of the participants. Responses from all five teachers and one expert provided a variety of examples of how the COVID-19 pandemic gave rise to the involvement and experience in the community of practice. This analysis hinted at the potential relationship between the codes that probed the researcher to ask questions and look for possible answers from literature and the data. For example, what were the reasons that two other experts didn’t have this co-occurrence? What was the nature of the opportunity brought about by the COVID-19 pandemic in terms of professional development? How did this nature motivate teachers to learn as a community? As a result, literature on professional development and community of practice were reviewed to gain a more concrete understanding. Here are some other examples of high code co-occurrence frequency that facilitated the development of the theoretical coding analysis: “Educational equity” and “Teacher autonomy” (6), “Educational leadership” and “Policy and budget” (6), “Teachers’ self-learning” and “motivated teachers” (4), etc.
After the code co-occurrence was studied, the researcher began to sort the memos, used diagrams to help to visualize the relationship of the emerged codes and themes, and to select a core category. According to Strauss and Corbin (1998), the criteria of core category are (a) a category's centrality in relation to other categories, (b) frequency of a category's occurrence in the data, (c) its inclusiveness and the ease with which it related to other categories, (d) clarity of its implications for a more general theory, (e) its movement toward theoretical power as details of the category were worked out, and (f) its allowance for maximum variation in terms of dimensions, properties, conditions, consequences, and strategies. Eventually, “Community of practice” was chosen as the core theme to answer the research question because this theme appeared to be the most prevalent theme that was able to correlate the other themes, with 18 code occurrences and across all teacher respondents and one expert. Also, literature on the development of the theoretical framework of the concept demonstrated this theme allowed a variety of properties, dimensions, and strategies to be discussed.

Finally, a storyline and diagram were generated to illustrate the systematic understanding grounded from the data. Diagraming was conducted with the facilitation of the Network function in atlas.ti which provided various versions of visualization to stimulate different possibilities of the representation. With reference to Birks et. al (2009)’s principle, the layout of the diagram strived to avoid the use of excessive arrows and lines or labels that might compromise the clarity of the storyline. Evolving from the framework of Corbin and Strauss (2014) and the data analysis in this research, several versions were drafted before finalizing the diagram. The final diagram is shown in Chapter 4 Figure 3. Last but not the least, a coherent story was generated regarding the following four principles proposed by Birks and Mills (2019): (a) Keeping theory foremost, (b) Staying grounded, (c) Embracing variation, and (d) Visually representing the theory, to ensure the storyline is a credible rendering of the findings in this research.

**Theoretical sensitivity**

As stated in Figure 1, theoretical sensitivity is needed in the whole research process. Charmaz (2014) defines theoretical sensitivity as “the ability to understand and define phenomena in abstract terms and to demonstrate abstract relationships between studied phenomena” (p. 161). Therefore, developing theoretical sensitivity enables researchers to increase analytical power in the process of engaging in the codes and constructing theory from data. Theoretical sensitivity can be increased along the way in the research process when the researcher immerses in the data, engages with it, and dances with it (Birks et al., 2009; Birks & Mills, 2015; Charmaz, 2014; Chun Tie et al., 2019). Some
analytical tools are also helpful in developing theoretical sensitivity and were used in this research, for example, reading literature, open coding, category building, memo writing (Chun Tie et al., 2019).

**Conclusion**

This chapter discussed the research methodology and outlined the methods and procedures of the research. The constructivist grounded theory approach was applied to achieve a systematic understanding of teachers’ professional development for digital competence. Data collection and analysis procedures were discussed with respect to purposive, theoretical, and snowball sampling, semi-structured online interviews, and the initial, focused, and theoretical coding in order to pursue systematic understanding from the data. The next chapter aims to demonstrate the research findings after the methodology stated in this chapter was applied.
4 FINDINGS

This chapter presents the findings of this research. In the first section, the storyline and the diagram are presented to illustrate the overview of the systematic understanding of how digital competence was integrated in teachers’ professional development in Finland, by demonstrating the connections of the emerged themes. Followed by a detailed discussion of the content in each emerged theme with supporting data.

4.1 Storyline and diagram representation

The following storyline was generated according to the data analysis in this research:

*The needs for teachers’ professional development on digital competence*

Professional development on digital competence is important for teachers, in response to the rapid development of the digital landscape. Integration of digital competence in educational curriculum requires teachers to be digitally competent to perform their duty. However, being digitally competent is a versatile concept that evolves along with the advancement of digital technologies, and depends on the contexts and needs, one will always develop their skills and never be ready to have them all. As a result, professional development on digital competence is a continuous need during teachers’ service.

*Strategies of teachers’ professional development on digital competence*

The three strategies teachers use to develop their professional digital competence are self-learning, formal training, and community of practice. The implementation of strategies varies in different contexts include teaching experience and subject expertise. Self-learning and community of practice are found to be more effective than formal training for teacher professional development of digital competence.

*Factors affecting teachers’ involvement in professional development of digital competences*

Teachers’ involvement in the strategies is affected by four factors including teacher autonomy, teacher motivation to learn, educational leadership, and policy and resources. When certain conditions
are favorable to facilitate teachers’ involvement in the strategies, collective enhancement of teachers’ professional digital competence is achieved.

The diagram representation of the above storyline is illustrated in Figure 3 below.

**FIGURE 3. The systematic understanding of teachers’ professional development on digital competence**

The themes illustrated in the diagram are explained in detail in the following sessions with supporting data.
4.2 Causal conditions

Two themes emerged from the data as the causal conditions that lead to teachers’ professional development of digital competence.

4.2.1 Versatility of digital competence

The data revealed that for three experts and two teacher interviewees, digital competence should be seen as a versatile construction instead of a static status. E3 pointed out the rapid technological advancement requires a constant update of digital skills:

“Even if you have good digital skills now, but in 5 years, those skills will be hopelessly outdated.” (5:1)

Whereas T5 held the same opinion:

“Technologies change all of the time, I think being digitally skilled means that you have the ability to learn easily new technologies, new programs and new ways of doing things.” (12:2)

Besides, digital competence cannot be easily generalized as it depends on specific contexts and needs, E2 gave some examples to illustrate the idea:

“Some of the digital game skills or photo editing skills can be essential for some kids' social life, even for their future profession, but at the same time, they can be totally useless for others.” (4:7)

These comments seem to provide evidence that digital competence is not a static set of skills, thus, to be digitally competent in different contexts, continuous adaptability is crucial.

In addition, all expert and teacher interviewees tended to prioritize critical thinking and social digital competence over operational and technical skills. Among the top five digital skills that they selected to be taught in school, all of them picked “evaluating data, information and digital content” and seven of them either ranked it the most or the second most important skill. T1 commented:

“So much often people think it is only about how to use computer, but I think it is also whether you understand how to find information, what information is correct.” (7:1)

While T2 said that technical digital competence was a foundation to acquire other skills:

“When learning how to use a camera and how it works, it's also important to learn how to do work together with digital things... that kind of collaboration skills is more than just the technical skills to handle the devices.” (8:11)
Furthermore, from the data, social digital competence was prevalent when discussing what digital competence was and its importance. The code “DC: communication and interaction” had 43 occurrences in total and occurred across all participants, which is the highest among all codes. This code also co-occurred with the code “DC: daily living and survival skills” 5 times. T2 commented on the importance of social digital competence:

“I was thinking about social media, because, almost everyone is there, so it's really important that you know how to survive that kind of environment and how to use it and be part of the community... just communicate with others, you really need it as human.” (8:9)

Both experts and teacher interviewees tend to agree that general operational and technical skills should be learnt as basic skills that facilitate the acquisition of other essential skills, particularly soft skills like collaboration and communication.

Seeing the multifacetedness of digital competence, E2 and E3 expressed their concerns on how young people were taught in schools in terms of digital skills:

“Sometimes I am a bit afraid that when teaching digital skills, it's actually so practical that it might happen that the child learns only to use specific software instead of understanding the broader competence related to the issue” (4:39)

“If we only teach them how to use the current digital tools in very mechanical way, once the technology changes, they are kind of on their own and they are left to figure out where to get new education because it doesn’t apply anymore.” (5:12)

Their worry suggests that the role that formal education plays in nurturing the digital competence of the young people should be concerned that whether stakeholders in the formal educational setting are prepared and supported for the continuous adaptation to the versatile and multifaceted competence.

E1 and T2 related the versatile nature of digital competence to the need for teachers to keep learning. E1, who is a teacher educator, specified the need for continuous professional development:

“Because ICT is changing all the time and new things happen. So we need ongoing in-service teacher training.” (3:50)

While T2 as a teacher emphasized the ability of learning to learn:

“The programs are changing and ways of using technology are changing, you have to adapt the new technology. Learning to learn, that's the most important thing. And I think it's important for teachers to learn to learn new technologies.” (8:22)

Their views are congruent with each other that teachers need to continuously engage in professional development to be constantly adapted to the rapidly changing digital landscape.
4.2.2 Digital competence in educational curriculum

The second causal condition consists of how digital competence is integrated in the educational curriculum that teachers are obliged to implement, the challenges that come with it, and how the implementation of curriculum leads to the need for teachers’ professional development of digital competence.

As discussed in Chapter 2, digital competence is included in the latest Finnish national core curriculum (FNCC14) as transversal competence both implicitly and explicitly across all subjects. T3 gave an example to explain how he implemented digital competence in his subject regarding the curriculum:

“Digital skills are quite explicitly in, at least high school level curriculum. For example, here in physics, curriculum has all these core skills that are needed from the physics point of view. For example, we are now learning thermodynamics, and I think there are these notes [in the curriculum] that students are supposed to learn how to do digital crafts in this course. I think there are quite extensive notes there.” (9:24)

According to the data, interviewees had quite diverse opinions on digital competence as transversal competence in FNCC14. Integrating digital competence in the curriculum as transversal competence was described as “a nice and beautiful idea” (5:20) by E3, and “a definitely good thing” (10:17) by T4, however, there was criticism emerged from the data that there was lack of common understanding on the notion by various stakeholders in the formal educational setting. E1 opinioned that the curriculum needed more detail and concrete guidance:

“We have it in our curriculum, but ... what to teach? How to teach? What is the goal?... There should be more exact text about ICT in our curriculum...We don't have exact measurements or evaluation criteria for using our digital competencies or digital skills.” (3:26, 30-31)

E2 also pointed out the lack of shared understanding and clear framework for evaluation:

“We haven't had any shared understanding of what are the actual skills that children are supposed to gain in their basic education in relation to digital skills.” (4:52)

This view was also evidenced among teacher respondents. Some teacher respondents expressed their vague understanding of the curriculum regarding digital competence, for example, T1 said:

“I don't actually know how it is stated in the curriculum, if there is an actual sentence that says that this must be taught, but it is kind of within the curriculum.” (7:19)
T4 also expressed that it wasn’t clear to him:

“I think even in the new curriculum, it's not very explicitly stated. What kind of digital skills are needed then? What kind of digital skills should be taught?” (10:53)

In addition, upper secondary school teachers, in particular, tend to focus on their own subjects without knowing how other subject teachers are integrating digital competence into their profession, as T2 mentioned:

“There are different things in every subject, but I really don't know so well on other subjects on my own, because in Finland, in high school, teachers really focus on their own [subject].” (8:31)

This focus may imply teachers are likely to lack a clear overview of students’ holistic development of digital competence, which may result in some skills being repeatedly taught in various subjects, while some skills are not covered at all.

Digital competence as transversal competence as stated in the education curriculum requires teachers across subjects to be digitally competent. This brings the collective needs for teachers to develop their professional digital competence, teachers are the foremost player to implement the curriculum and key players in the educational uptake and use of digital technologies (Olofsson et al., 2011; Sipilä, 2014; Ward & Parr, 2010), their professional development on digital competence should be well-supported to bring the best educational outcome.

4.3 Central phenomenon: Teachers’ needs for professional development of digital competence

The two causal conditions, the versatility of digital competence and digital competence in education curriculum, resulted in the need for teachers’ professional development of digital competence as shown in Figure 3.

It is a prevalent theme among all the teacher interviewees that they expressed their needs for training and support. T3 is an experienced teacher whose initial teacher training did not prepare him for pedagogical digital competence. He shared his doubts and fear:

“I think the fears came to many points. But one of them was for sure that are teachers themselves able to teach these things? Are they skilled enough themselves? And it was seen as a huge leap in the skill sets that you need to just do this. For example, like the math programs that are now used in every lesson. I've never seen
them in my life, for example. And now very soon, I'm supposed to be teaching them to kids.” (9:15)

Whereas T2, a young teacher who showed confidence in her digital competence observed it could be a challenge for older teachers:

“Teacher should be trained digital things because like I said already, the older teachers when they're done with their own studies in teaching, there were no computers, there was no digital world at all. So it's really impossible for them sometimes to teach something that they don't know themselves.” (8:35)

T1 also expressed her worry that older teachers might not get enough support:

“I think especially some older teachers struggled and I don't think they were always treated very well when they needed more support. And then if there were some problems and complaints, I think that the reaction was quite negative, whereas they would have needed more support and help.” (7:49)

In addition, the code “older teachers: weak digcomp” was evidenced across the data of the two experts and all the five teachers with a total of 14 occurrences. This finding is congruent with the research by Sipilä (2014) that finds Finnish teachers consider themselves unprepared for pedagogical digital competence, as well as the research by Kaarakainen and Kaarakainen (2017) that finds younger teachers tend to have higher digital competence than older ones.

Besides, T1 was assigned to be a digital tutor for teachers because her subject was one of the first to have digitalized matriculation examination, she expressed the need to be supported in order to take up this role more properly:

“I think a bit more support would be needed. I was named a kind of digital tutor for teachers, but I didn't get any help in that or any courses. It was kind of like I was given this task, I was named this tutor, and then I didn't really have anyone telling me how to do it and what to do.” (7:31)

When discussing the main weaknesses of digital skill education in Finland, both E1 and E2 pointed out in-service teacher training is the weakness that needed concern. E1 admitted:

“We don't have enough support for teachers... Our in-service teacher training doesn't support enough how to use new technology.” (3:24)

E2 quoted a survey to point out that even newly graduated teachers in Finland thought they did not have enough pedagogical competencies for digital skills education. She advocated the provision of in-service teacher training that related to attitudes rather than technical skills:

“I also think that it is necessary that we provide adequate in-service trainings for those teachers who haven't gained enough professional competencies in their initial training... I think we still have work to do related to some teachers’
competencies and attitudes and actually I assume that we have much to do in relation to attitudes than actual operation skills.” (4:38,50)

Their views echo Li and Dervin (2018)’s metaphor that teachers’ professional development is the “Achilles’ heel” of Finland’s world-famous education.

The experiences that T3 and T1 shared reflect the demand for pedagogical digital competence may have been causing stress and intensifying the need for professional digital competence development. According to Syvänen, Mäkiniemi, Syrjä, Heikkilä-Tammi and Viteli (2016), the accelerating digitalization of society has resulted in a demand to speed up the implementation of technology in teaching as reflected in the curriculum changes. This demand has been causing technostress to teachers, which refers to the “stress experienced by individuals due to the use of technology” (Syvänen et al., 2016, p.97). Their research finds that digital competence is one of the key factors associated with technostress: high digital competence teachers tend to associate with low levels of technostress, therefore, they assume that one effective way to decrease teachers’ technostress is to develop digital competence of teachers further, for example, by education (Syvänen et al., 2016). Syvänen et al.’s research supports the finding of this research that the need for teachers’ professional development of digital competence is intensified by the implementation of education curriculum with digital competence embedded as transversal competence that resulted from the rapid technological development of the society.

4.4 Context

Teachers develop strategies for their professional development of digital competence to cope with the demand caused by the above two causal conditions. The implementation of strategies is influenced by different contexts include teaching experience and subject expertise. Among the five teacher respondents, only T2 mentioned pedagogical digital competence was covered during her study:

“I'm quite a young teacher and I've been using those same skills in my studies already.” (8:39)

She had 5 years of teaching experience, yet she graduated just 3 years ago, she was the most recently graduated respondents among the five. Whereas T3, who had more than 10 years of experience mentioned:

“I think I'm the generation that the formal teacher education maybe did not prepare me for digital skills.” (9:27)
This comparison shows one possible reason for younger teachers to have a higher pedagogical digital competence could be the initial teacher training. This may have an impact on their attitudes using digital tools to enhance their teaching. Individual teacher’s beliefs, attitudes, and values make up significant aspects of their professional identity, as Syvänen et al. (2016) assert that teachers are more likely to adopt practices with technologies that reflect their beliefs about teaching, subsequently, in what ways they approach their own professional development.

The second context that had an influence on their strategies indicated in this study was subject expertise. Teacher respondents in this study had diverse expertise, including languages, media studies, mathematics, physics, and music. Each of them gave some different examples of pedagogical digital competence specific to their subjects. For example, T1 as a language teacher showed more concern on literacy skills and netiquette, T2 who is a media studies teacher focused more on access and evaluation of information:

“In my subject, we are always talking about where to find information and think about who has done this information? Why has it been done? Any bad thoughts behind? Is there something that someone wants, is it power or is it money?” (8:27)

T3 and T4 who are mathematics and physics teachers mentioned some examples of specific programs for creating mathematical models and digital crafts. T5 who is a music teacher mentioned music technology for production and studio techniques were needed in the subjects. This shows that teachers who have different subject expertise have different needs for professional development that is relevant to their reality.

4.5 Factors

In addition to context, there were also factors, which were in a broad sense, general conditions that influenced the teacher respondents’ strategies to develop their digital competence. The four factors that emerged from the data shown in Figure 3 are explained as follows.

4.5.1 Teacher autonomy

Teacher autonomy is a theme that emerged as an influential factor that affects how teachers approach their professional development. It was interesting that this theme was comparatively more prevalent among expert group than teacher group respondents—all experts shared a similar view that teacher
autonomy was a double-edged sword towards Finland’s digital skills educations whereas only two teacher respondents mentioned their autonomy during the interview.

E1 pointed out teacher autonomy is highly respected in Finland:

“If teachers say that I don't need in-service training. That's that. It's a totally teacher's decision. It is, of course, problematic, but our principal can't say that you have to take that course. You can't force them... In Finland, it's not possible” (3:38)

“Teachers have a huge autonomy in their teaching. They can adapt new digital tools quite easily because they don't have to ask for permission. It's a good thing.” (3:47)

T4 showed affirmation on the freedom and trust in the Finnish education system that served as the foundation of his professional autonomy and the strength of Finnish education:

“Freedom and trust in the Finnish system are very important. In Finland, if I want to teach digital skills, it's sort of up to me to decide how do I do it. It's in the curriculum, of course, all teachers are supposed to teach it, but how do I do it?... It's really up to me to decide what's important and how do I have to educate myself more to be able to teach these digital skills. (10:35)

However, E2 shared a similar view with E1 that it could be “problematic”, she described a high degree of teacher autonomy in Finland as a double-edged sword:

“Our teachers have pedagogical freedom to choose the methods and practical examples that they find the most relevant for the course. And I think it is a very important principle that I wouldn't change. However, in practice, it also allows teachers the freedom of not doing even though it should not go like that. This means that those teachers who for some reason have decided not to comply with the curricular's ICT content, have may be managed to do so.” (4:26)

T2 and T4 also pointed out the possibility to affect equity in education:

“It depends so much on your own teacher that maybe the weakness. For example, in primary school, you only have this one teacher with your class so many years, so if that teacher is not really motivated to teach those things [digital skills], then you don't get it so well as some other students.” (8:51)

“So one weakness of the system might be so that if you have “bad teacher”, so the teacher sort of don't teach the [digital]skills to the students.” (10:53)

In addition to E2, T2, and T4’s opinion, the code “teacher autonomy” had 6 co-occurrences with the code “educational equity”, emerging across all the three experts and two teachers as a possible correlation that teacher autonomy has an impact on educational equity. For example, when commenting on how children learn digital skills education in formal education, E3 mentioned:
E3 implied that students’ opportunities of developing digital competence were likely depending on individual teachers’ attitudes and competence. As a result, when attitudes and competence among teachers have an obvious discrepancy, it is possible to upset the principle of educational equity that everyone should have equal opportunities to access necessary educational resources leading to academic success (Simon, Małgorzata, & Beatriz, 2007).

The above correlation between teacher autonomy and educational equity probably helps to explain E2’s opinion on teacher autonomy as a “double-edged sword” (4:26)—on one hand, teacher autonomy is the strength in Finnish education that values trust and freedom and that she wouldn’t want to change it. On the other hand, it is possible that when teachers’ attitudes and values towards digital skills education do not align with the needs of the rapid digitalization of society and education, it may turn out to be a problematic situation that may eventually depreciate educational equity in Finland, in a way students may not be given equal opportunities to develop their digital competence.

According to OECD’s review, Finnish strategies towards educational equity have taken a long time to emerge and succeed as a complex of practices, however, any weakness in one component will undermine other practices (Niemi, 2012). Therefore, in this research, as an emerged theme correlated to educational equity in terms of digital skills education in Finland, teacher autonomy on professional development is an important factor that could be studied further beyond the scope of this research.

### 4.5.2 Teacher motivation to learn

The second emerged factor is teacher motivation to learn. This theme emerged with three sub-themes: to complete specific tasks, to positively influence students and their learning, and to gain knowledge based on the teachers’ own interests. Each of the themes is discussed in detail below.

**To complete specific tasks**

All the five teacher respondents mentioned some specific tasks that required them to use digital skills triggered them to learn. They saw the opportunities as obligations that, as teachers, they needed to take up. For example, T1 and T5 said respectively:
“You certainly get motivated to learn new things when you have to do it. So it's not always the willingness, but it's a must.” (7:38)

“The motivation comes from some specific tasks that need to be completed. It's not always motivation. It can also be an obligation to do something, like last spring that we had to learn how to use Teams, for example.” (12:29-30)

This indicates that teacher respondents are motivated to develop their digital skills as part of their professional responsibility. When there is a need to apply certain digital skills to perform their duty, they are motivated to learn, and willingness may not be significant.

Two codes emerged across the teacher respondents indicated two examples of a situation where they needed to learn certain digital skills and performed their duties. The codes were “digitalization of examinations” which emerged across 4 teacher respondents with 7 occurrences, and “COVID-19 pandemic as accelerator” which emerged across all expert and teacher respondents with 28 occurrences. Both situations, digitalization of examinations and school closure resulted from the COVID-19 pandemic, forced teachers to develop their digital competence in order to fulfill their obligation as professional teachers. For example, T1 mentioned:

“The fact that the matriculation examinations are done on computers forces the teachers to change the way that we may have been working previously. The motivation definitely is there.” (7:28)

Whereas T3 recalled the digitalization of examinations gave him and his colleagues pressure to accommodate the change:

“ Teachers and I too were like scared as hell that these digital skills needed to be taught in everyday teaching... But when there was this “huge must”, then teachers got to do it.” (9:13)

Despite feeling stressed, T4 expressed his worry that if he didn’t develop the skills, he might not be able to help the students to prepare for this important examination. Therefore, in his opinion, this was a pressure for teachers to change their ways.

Matriculation examination was digitalized from 2016-2019 in Finland. T1 taught one of the first subjects to be digitalized while T3 and T4 taught one of the last subjects to be digitalized. All the teacher respondents showed their motivation to accommodate the changes by professionally developed their pedagogical digital competence and integrated digital competence in their subject expertise and daily teaching.
In addition, “COVID-19 pandemic as accelerator” was prevalent among all respondents. While the interviews were conducted amidst the COVID-19 pandemic which caused teachers and students to teach and study online as a result of school closure, all the three expert respondents regarded this situation as an opportunity for a digital leap of teachers and schools in Finland. Whereas teacher respondents shared their experience to learn new digital skills to adapt to online teaching. For example, T1 mentioned her needs to learn how to use certain digital platforms to conduct lessons:

“Definitely when the corona crisis hit, it was an instant change and all of a sudden you had to learn.” (7:38)

E1 regarded COVID-19 as a tough situation that brought initiatives among teachers to develop pedagogy for online learning:

“Coronavirus was an outside force that forces our teachers to change their teaching methods and think all over again what is the pedagogy of certain things, and so. Unfortunately, we need a tough situation that put our initiatives like that…but if the situation is normal, then there will be no change.” (3:43)

While the online teaching experience that T2 shared served as an example of what E2’s said teachers need to “think all over again their pedagogy”:

“It was really challenging when we had to move to online learning, so quickly that we couldn't teach in a normal way—how you should be learning online for every student was at their home? how to reach them? What if they can't make their MS Teams work? What if they don't know how to use video or how to attend a lesson on Teams? How to keep score? How to make sure all students are listening, and are aware of what we are doing? How to control their homework doing and how to do it?” (8:48)

T2’s reflection on online teaching during the pandemic was evidence that the teacher needed to rethink even the most basic practices in her daily teaching when it was entirely moved to the online environment. The pandemic was very likely a situation that gave rise to the need for teachers to learn specific pedagogical digital skills that helped them to conduct daily teaching online.

Moreover, E2 said the pandemic had a significant effect on teachers’ digital competence in a short period:

“They [Teachers] had no choice...I think they had the only couple of days to totally change their teaching into digital form. So I think actually this pandemic has more effects on digital teaching than any project has ever had.” (4:41)

Nevertheless, the experts showed confidence in the learning ability of Finnish teachers that they were able to pick up the skills quickly when it was needed. E1 affirmed that one of the main strengths of Finland’s digital skills education was the learning ability of the highly educated Finnish teachers:
“Our teachers have an attitude that if they want to learn, then they are learning new stuff quite easily. For example, in this corona situation, our teachers were quite fast, they could change their attitude and change their system so that they can arrange the teaching and learning opportunities in a new situation.” (3:46)

T4’s opinion echoed with E1 on teachers’ ability to learn:

“That's a very characteristic thing about the Finnish teacher education system. We, teachers, are sort of individuals who think and if you think that you need to learn this thing, then you will learn it.” (10:35)

E2 commented that the teachers were able to do something that out of their own expectation during the pandemic:

“I am confident that many teachers wouldn't want to have that opportunity [COVID-19 pandemic] but I think that there are also lots of good experiences that they were able to do something that they thought that they wouldn't be” (4:42)

T3, who once experienced technostress, shared his successful experience and satisfaction in the digital transformation during the pandemic:

“I think [we had] quite successful change, change that has been made here in Finland. And I have to say that I have been extremely happy with how good these portals are and how I like Google classroom. I had never used it before. And in a few days, I think I was using it quite extensively and efficiently ... so it was like it forced me to learn these things quite fast... I think I have been able to do a lot more than I was expecting to be able to do.” (9:31,34)

It was also interesting that T3 also expressed criticisms towards digitalization of examinations that it might overwhelm the subject knowledge as the curriculum in upper secondary school had a tight schedule. However, when there was a need that teaching had to go online, T3’s successful experience demonstrated his transformation in terms of technical digital skills, as well as attitudes and confidence in using digital tools.

Nonetheless, E3, who regarded the situation as “an unusual jump” (5:31), was expecting to see the competence that educators acquired during the pandemic would stay as a new normal even after the pandemic:

“It will be interesting to see how these kinds of crisis time skills, how they transition into the new normal. I hope as much of their skills will be left and still used.” (5:34)

This hope remains speculated to evaluate the transformative effect of teachers’ digital competence during this unprecedented circumstance.
All in all, the digitalization of examinations and the COVID-19 pandemic gave rise to the need for teachers to perform their teaching with the integration of digital tools, subsequently to develop their pedagogical digital competence.

*To positively influence students and their learning*

The second sub-theme of teachers’ motivation to learn is their professional vocation to positively influence students and their learning. This theme was prevalent among all teacher respondents with the codes: *“pedagogical purposes”* with 19 occurrences. Teachers showed concern on digital competence that enabled them to connect with their students, to help students for their well-being, and to deliver pedagogical practices for effective learning.

T2 voiced her concern on connecting with her students and one of the keys was to get to know the digital world around her students:

“I want to be able to use digital skills in teaching and communicating with my students... I think it's the fact that we are living in the digital world and our students are using digital things already. So, if we don't use it, we're like we're not in the same world where our students are.” (8:41)

T2 also raised her concern as a teacher to be able to teach the students to take care of themselves in digital environments, for example, she mentioned that *“behavioral norms”, “cultural and generational diversity”, “mental well-being and physical health”* (8:19) were important to be taught in schools.

Also, T3 expressed his concern as a teacher to teach students about safety issues, for example, *“privacy and health”* in digital environments:

“I think these [privacy and health issues] are like the basics that like adult teachers have to consider and have to be sure that their students have to grasp that before they are doing anything anywhere.” (9:5)

Furthermore, T4 mentioned teachers are motivated to learn and to help their students to acquire digital competence students when they see the importance of such for their development:

“Digital skills are needed after high school for a student to function in the society and to continue studying the university. Teachers have to realize that without those skills, the students can be dropped out somehow.” (10:43)
The data shows that the teacher respondents are motivated to acquire certain digital competence that helps them to facilitate students’ development and participation as a digitally competent citizen in this digital age.

Besides, the major motivation for teachers to learn emerged from the data is to deliver pedagogical practices for effective learning. The teacher respondents shared their experience and reflections on exploring and acquiring specific digital skills that they found to improve their pedagogical practices and the effectiveness in students’ learning. For example, T4 shared his pedagogical consideration when incorporating mathematics software for learning geometry:

“I don't want the situation to be that the use of technology and digital skills lessens the need to learn the theoretical math.” (10:28)

T4 then explained with an example of what he considered reasonable incorporation of digital technology in teaching. With the use of digital tools that handled the basic and routine calculations, he was able to focus the teaching and learning on higher-order mathematical thinking than on mechanical drilling. Students could have more opportunities to apply creative thinking to be able to solve problems. He considered this kind of incorporation added value to the learning of the subject matter that he would be happy with the incorporation of digital tools.

Teacher respondents also expressed their considerations not to use certain digital tools when they did not serve the necessary pedagogical purposes. T1 emphasized the priority of pedagogical consideration:

“I first think about learning and then think about what equipment to use, not the other way round.” (7:29)

T1 also gave an example to illustrate. She mentioned the installation of a smartboard in every classroom a few years ago didn’t work quite well in the upper secondary schools as teachers rarely had students of this age coming to the board to write. She opinioned that it was “a political decision” (7:29) overriding pedagogical considerations to have this “new, cool device” (7:29) that teachers were asked to use, whereas according to her experience, many of the teachers couldn’t think of a good way to use it. She voiced out the considerations of some teachers:

“We [Teachers] are not against technology. Many of us are very advanced in using technology, but we want to see a purpose in it. It's not like you have a device there, now, you must think of something to do with that device. It has to be the other way round.” (7:29)
T3 also shared similar considerations that if he could see the pedagogical value added to the use of digital tools, it motivated him to learn:

“It's mostly that there has to be this need for this skill and that thing that I see that this is a good thing to do. It motivates me to learn it if I see this makes things easier and this is something that we truly need.” (9:22)

He further explained with two examples that had opposite effects on his motivation to learn to use the specific digital tools. He first mentioned there was a program for making digital crafts in physics that he found making things easier. He was certain that this type of application helped motivate him the most to use his time to learn and create with digital tools. He then gave another example that ten years ago, there was a command to everyone for using a particular digital learning platform. He described this as a “crazy thing to do” (9:22). He didn’t find it useful to his teaching and he was not keen on using it.

Examples shared by the teacher respondents show that teachers are willing to learn and to use digital technology when they can see the benefits to their pedagogical practices. Moreover, both examples of the smartboard and the digital learning platform seem to hint that a top-down approach to command the use of specific digital devices or tools might not be favourable to teachers’ pedagogical considerations that are highly connected to the needs in their specific contexts, for example, age group of students and their subject expertise. Teachers may find the one-size-fits-all approach not practical in their contexts, as a result, not willing to use it.

**To gain knowledge based on the teachers’ own interests**

The third sub-theme of teacher motivation to learn is to gain knowledge based on the teachers’ own interests. This sub-theme emerged across two experts and two teachers under the code “motivated teachers” which had 20 overall occurrences.

E1 mentioned that teachers’ personal interests influence their pedagogical practices:

“If you're the teacher, who like using computers or new technology on daily basis, you can see it from their teaching, you can see them teaching it too. And if the teacher likes to sing and read stories, it's a different situation.” (3:33)

When talking about practices in technology education, E3 mentioned the importance to have passionate individual educator:

“You need to have that one person who is super excited about it and is super motivated to try it out.” (5:17)
While T5, the music teacher, who was also a musician in a band and involved in music production, had just started a course on film shooting and editing, blending his personal interests in his work as a teacher:

“I’m quite interested in digital production things. I love the problem-solving factor [in digital production] for example. So, I find it really interesting to learn new skills. Now, I have been learning about making videos both for the school and the work, but also for my own interest, like on my hobbies with the band and such.” (12:31)

T5 expressed that he was self-motivated to learn the skills as this was part of his interests. He also transferred the skills from his hobbies to his teaching. Being self-directed to learn and transferring skills and knowledge are the two main principles in andragogy, which is one of the domains in the framework of teachers’ motivation to learn by Appova and Arbaugh (2018) discussed in Chapter 2. This reflects that personal interests are possible to be the motivator for teachers to develop their digital competence and have an impact on teachers’ pedagogical preferences.

4.5.3 Educational leadership

The third factor in Figure 3 that affects teachers’ strategies for the professional development of digital competence is educational leadership, which mainly involves school principals in the data. This code “educational leadership” emerged from two expert and three teacher respondents with a total of 12 occurrences, 3 co-occurrences with “ineffective teacher training and support” and 6 co-occurrences with “policy and resources”. The co-occurrence suggested that the school leaders were likely to influence teacher training and support, in connection with managing school policy and budgeting, as explained by E1:

“It’s more like what kind of teachers who have what kind of principals. What is the policy? What is the budget? You need certain kind of principals who support teachers.” (3:34)

E1 commented that some school principals would need to strengthen their professional digital competence as educational leaders, in order to make policies that support teachers for their professional development of digital competence:

“Our school principals and headmasters are way more conservative than our teachers. That’s because they don’t have the skills how to be good ICT users, they also don’t know how to arrange training for in-service teachers. There’s a huge lack of knowledge about how to arrange ICT education or ICT training or how to even arrange ICT systems or practice in schools.” (3:25)
E1 further explained that school principals had the authority to decide budgets in school, for example, what kinds of digital tools could be purchased in schools. Yet, E1 doubted if some of the decisions were well-supported with pedagogical considerations:

“They [The principal] know how to buy, for example, laptops, but they don't know why. When they have to make a decision what kind of [digital] platform they have to use, normally, they ask some ICT guys what they prefer but they don’t ask that information from those teachers who are going to use it.” (3:25)

E1 voiced that this situation could lead to merging pedagogical considerations with “bureaucratic information” (3:25) which could undermine teachers’ professional development.

Furthermore, teacher respondents also expressed the influence of school leaders’ decisions on their access and motivation to professional development. For example, when talking about what could be possibly affecting her decision on taking a professional development course:

“The cost is an issue there as well. If it costs something, then you might not be able to participate, [because] the school and the principal that makes the decision of the school budget in general. [They would consider] the cost, how much does it cost to take part? Then, whether the principal considers it a good course.” (7:33-34)

T1’s opinion showed that budget and the quality of the course were the two main concerns that affect the school leaders’ decision whether to support the teacher to take some formal professional development courses.

While T1 believed that taking courses related to technology was more favourable than other courses to the principal and could be easier to get supported:

“I think politically speaking, in education, technology, computers, and online teaching, they have been some key words for a few years. So it is much easier to convince the principal than to pay for such a course that has to do with these topics than some others. But still, it's not for sure whether you can go or not” (7:34)

When discussing her motivation to learn in relation to the financial decision made by the school leaders, she said:

“There has to be some financial motivation as well, for example, you can go to seminars, then maybe you get a substitute teacher for that day so that you don't have to do double the work. But if it's always just having to do it on your own time and extra work, then at some point it is going to be bad for the motivation.” (7:40)

By financial motivation, T1 meant the school leaders’ willingness to pay for substitute teachers when teachers went to seminars, then teachers would not be “punished” to do extra work with their own
time by participating in professional development. This would serve as positive reinforcement for teachers’ motivation to take part in professional development activities in general.

T4 affirmed that in Finland, the school principal is the key player in the developmental direction of the schools. He said:

“If the principal thinks that digital skills are important, of course, the curriculum from the government we have to follow, but in Finnish schools, the principal has some kind of leverage or this kind of free play in the decision making. So the principal is sort of a very important person when it comes to the direction of where we are going and how we are doing things.” (10:33)

This finding shows that in the Finnish decentralized educational system, school leaders have the autonomy to decide the direction of the schools, subsequently, the policy and budgeting of the school to realize the direction, which could possibly have an impact on teacher professional development of digital competence.

4.5.4 Policy and resources

The last factor that influences teachers’ strategies to approach professional development of digital competence is policy and resources, which refers more to government and municipality levels. This theme was prevalent with 41 occurrences across all respondents. The code “policy and resources” not only had high co-occurrences with “educational leadership” as discussed above in 4.5.3 but also co-occurred with “inadequate teacher training and support” for 6 times, “educational equity” for 5 times, and “municipality inequalities” for 4 times. In addition, the code “educational equity” and “municipality inequalities” co-occurred for 4 times. The co-occurrences suggested the possibility that the government’s and municipalities’ unequal distribution of resources may result in inadequate resources for teacher training and support that may undermine educational equity in Finland. The following data may support this possible understanding.

According to T3, digital resources were available in schools in Finland and he affirmed that the government had been supportive in providing resources:

“The infrastructure and digital resources are available. And I think that the government people are extremely supportive, at least they are willing to if somebody is showing interest towards this, there are resources and good interest towards it.” (9:36)
On the other hand, T1 and T4 had opposite views on resources with T3. T1 expressed the need for adequate resources from the government to enable teachers to teach with digital tools:

“The teachers can't work, if the governments and the politicians make decisions that don't support them, so the curriculum has to be good and there has to be enough money for the teachers to be able to teach.” (7:27)

For “enough money” (7:27), T1 referred to students having enough equipment, for example, personal laptop computers (7:21), and the support for teacher training (7:40), so that teachers could be enabled to teach digital skills and to enhance their digital competence.

Whereas T4 expressed his hope for more resources to support teachers:

“Resources are scarce everywhere. I shouldn't really complain about the resources of education, but I can always hope that we will receive more resources or we would be able to offer more efficient teaching to the students.” (10:22)

For resources, T4 referred to “time” (10:18) and “money” (10:20), which maintain quality and equity in teaching and learning in schools.

By the same token, E1 stated the need for more support, particularly money, for teacher training and equipment on digital skills education:

“If our teachers don't have the support, they have some problems to develop themselves. It's a problem, that's why we have to find the money for teacher training and new equipment all the time, and that's politics.” (3:36)

E1 mentioned, “lack of money” (3:49) was one of the current weaknesses for digital skills education and teacher training in Finland. When he mentioned “finding money” here, he referred to “public funding” (3:52) that was provided by the government and municipalities to schools in Finland. Thus, he framed the public funding allocation as politics, which he mentioned the Finnish National Board of Education (FNBE) and the Ministry of Education and Culture in Finland:

“They [FNBE and the Ministry] have the money for in-service training... they have to find out we need some new attitudes and programs for in-service teacher training. And of course, our ministers, they are responsible for the money.” (3:37)

Whereas three teacher respondents, T1, T3, and T4 shared a similar view on the political aspect of the public funding allocation which was managed by politicians. T4 mentioned:

“It's a political thing when they [the politician] took that decision to include digital things in the curriculum, they also have to provide sufficient funding to then be able for us to be able to teach in school... When we come down the ladder, for example,
it is in the decision of the board of the city council. So, it’s a political decision that the funds are sort of directed.” (10:31)

T4 pointed out the allocation of funding went down the ladder to the city council. Based on the decentralization of the education system, municipalities could also have their autonomy in interpreting the curriculum and making the decision on their direction and subsequently the funding on digital tools and training.

However, from the data, the code “municipality inequality”, which first emerged from E2 who pointed out this was a structural problem in Finland, was also evidenced in another expert and three teacher respondents’ data. E2 explained the financial situation of municipalities, as education providers, was very much dependent on the amount of tax and taxpayers in their municipalities, which affected how much they could afford on digital skills education, for example, buying enough equipment and building infrastructure. He described it as a “structural inequality” (4:29) in Finland.

As a result, some municipalities were able to afford more budget on digital skills education and teacher training. For example, E1 mentioned:

“There are some municipalities that they have more money to buy new equipment and they have an opportunity to use those smart boards and so on.” (3:34)

While some could face challenges in providing digital tools to students and teachers, E2 explained that:

“Between different municipalities and different cities, there is this issue of financing. So, of course, if the municipality is very poor, they probably can’t invest as much money on devices and software as the richer municipalities.” (4:36)

Besides, T1 and T2 pointed out the possible discrepancy of digital resources access according to the city one lived in. For example, T1 gave an example of upper secondary schools in rural areas which needed to compete for having more students might even provide more digital resources than schools in bigger cities that didn’t need to face the admission pressure (7:21).

Finally, E1 expressed his hope for adequate support in resources from school leaders and municipalities:

“When the principals and municipalities, officials of municipalities, they support teachers enough, give them the opportunity, give them in-service training and give them tools. It means that they have an opportunity to teach new skills to pupils, it’s a system question about how we arrange our ICT systems.” (3:35)
### 4.6 Strategies

Referring to Figure 3, the three strategies emerged from the data that teacher employed to their professional development of digital competence were self-learning, formal training, and community of practice. Each of the strategies is discussed in detail as follows. Followed by presenting the data of collective enhancement of teachers’ professional digital competence after teachers employing these strategies.

#### 4.6.1 Self-learning

“Self-learning” was a prevalent code among all teacher respondents with a total of 10 occurrences. The code co-occurred with “COVID-19 pandemic as accelerator” for 4 times and “motivated teachers” for 4 times. The data showed that the COVID-19 pandemic might have happened to exert pressure onto the teacher respondents to apply self-learning strategy, while some data also showed that the teacher respondents were self-motivated thus they learnt mainly by themselves. For example, T1 mentioned that when the school was closed during the pandemic, she got an email asking teachers to use Microsoft Teams video conferencing platform to conduct lessons, and teachers were expected to learn by themselves:

> “I hadn’t used Teams before, ... [but it was] expected everyone to know how to use Teams ... I do think that some teachers struggled. I was in a good position. I'm pretty good at using basic computer programs and so on.” (7:41)

T3 shared quite a positive experience of self-learning in response to school closure:

> “I have been extremely happy how good these portals are, [for example,] Google classroom, I had never used it before... So it forced me to learn these things quite fast. I know these are very good resources to do digital teaching from home to students.” (9:31)

The data shows that since the decision of closing school was very short-noticed at the beginning of the pandemic, teachers may find self-learning the most immediate strategy to cope with the needs of teaching online.

On the other hand, teacher respondents also showed their self-motivation towards self-learning, for example, T2 mentioned self-learning was an effective strategy to polish up digital competence:

> “... When you really want to do something with it [digital skills], like to be creative yourself and create some content, for example, then you really learn it when you
are doing it by yourself. You can learn the basics from taking courses, but maybe you have to deepen [the skills] on your own.” (8:40)

T4, who mentioned he had been mainly learning by himself, affirmed that teacher education in Finland had strong reliant on teachers as independent learners to make pedagogical decisions, he mentioned:

“I completed the teacher studies so many years ago that didn’t have anything about it [digital skills]. In my case and with the older teachers, you have to educate yourself.” (10:37)

T4 showed that the ability to learn by themselves was a criterion of their professionalism:

“Teacher is much on his own. So I just have to figure out how to teach math in Teams. There are no instructions. And again, the teacher education in Finland helps because it's sort of very reliant on the notion that teacher is able to think what is important and what is not and how to teach it, no matter if it's in TEAMS or if it's in the classroom or wherever I am teaching.” (10:50)

Also, T5 shared that he invented new assignments by himself for his music students to make them more suitable in the digital environment. T5 transformed the in-class band instrument performances and practices into a soundtrack recording assignment. Students sent him their recorded soundtracks and he connected them to one song. T5 had been making a couple of these projects with his students to make electronic music with free software. Moreover, students were also guided on Microsoft Teams to edit together a music file (12:28).

Furthermore, T5 demonstrated how he applied his self-learnt pedagogical digital competence. He also mentioned that he learnt most of the things by himself by “Googling” (12:29) and “asking from friends” (12:29) which he found effective for him as topics he needed to learn was quite specifically related to music technology, which may not be easily shared among colleagues.

The data shows that self-learning is one of the strategies the teacher respondents employed to develop their digital competence and the teacher respondents mainly found this strategy effective.

4.6.2 Formal training

The code “formal training” was prevalent across all the teacher respondents, with a total of 9 occurrences. It was interesting that all the teacher respondents were somehow having doubts about the effectiveness of formal training on digital competence when sharing their experience on taking
formal training courses. For example, T1 shared she had some frustrations in some of those courses as she found them lack connection to her reality in school. She commented on the disparity between the decision-makers and teachers:

“I think that there is a certain gap that the people who make decisions and who plan the courses, they don’t necessarily know what is actually needed.” (7:35)

She also criticized some courses that were too information-driven, she didn’t find them useful:

“I have also taken part in some short courses and seminars where they just list a lot of apps or things like that… You don't really learn anything. You just see a glimpse of many things, whereas I think it's more useful if you can concentrate on a few that you could actually use in your work.” (7:37)

T1’s experience reflects that the formal training did not satisfy her needs in real-life working at school, that she pointed out the gap between the organizers and the reality of teachers.

T3 mentioned one form of formal training was the school organized theme day for teacher development, he found them usually too general for him:

“Our school gave this not subject-specific theme days with the teachers that now let's see what's the structure of the exams and how are we going to do them in our school. But they were more like a level of everyday life, not that much of a teaching of a particular subject.” (9:18)

T3 also explained he didn’t participate in the formal training courses related to the digitalization of examination because there was quite a little information available. Skills taught in those courses were speculative at that time when almost nobody knew what was coming. He later found out that the programs taught in those early courses got developed soon to a higher degree to be used in everyday teaching, in this sense, he believed the training course might have been just wasted time (9:19).

T3 experienced the digitalization of examinations and the rapid technological changes along the way. The versatility of the technology was like a paradox that some technical skills of using certain software could be outdated in a short period, teachers might need to learn them, yet they might also find them useless soon.

T5 who started teaching with a strong background from his music expertise found the formal training offered by the university too general and not so important for him.

“We had some basic courses, sort of basic skills, like text editing and PowerPoint… Also, the music technology, we had a couple of courses. To me, I learned most of
All teacher respondents expressed their doubts on the effectiveness of formal training for digital competence.

4.6.3 Community of practice

Community of practice is the third strategy that emerged from the data. The code “community of practice” was prevalent across one expert and all the teacher respondents with a total of 19 occurrences. It also co-occurred with the code “COVID-19 pandemic as accelerator” 5 times and with “Inadequate teacher training and support for digcomp” for 4 times. It was evidenced in the data that the COVID-19 pandemic was an accelerator to boost the growth of community of practice for teachers’ digital competence, while teacher respondents showed appreciation to the helpfulness and usefulness of this strategy, especially when they needed suitable and timely support.

This code was taken from E1’s data, when discussing the main opportunities for Finland’s digital skills education, E1 shared that he was witnessing the growth of community of practice (CoP) for pedagogical digital competence during the pandemic:

“I think it's happening now. It's that we have created, in pedagogical language, the concept of community of practice, CoP. So we have created a lot of CoPs now and that's the future there. It's a real opportunity.” (3:54)

He further explained what he meant by CoP with some examples:

“Now we know that we have the experience that teachers can share, and they are willing to share their experiments and their experiences. And they are also asking for help. Normally, they are our teachers, so individual that they don't need any help... But now it's changed... they have to ask publicly.” (3:54)

E1’s description of the CoPs happening in Finland reflected the processes of CoP for teachers’ professional development. First, participants in the CoP are teachers who shared similar professional practices and needs. Second, these participants involve in sharing experiences and reflections of their experience. Third, they help each other to grow their professional capacity through engaging in sharing and discussion. Fourth, instead of hierarchical relationship and privacy, participants in CoP are more equal that everyone could contribute in different ways, and knowledge is shared publicly in a community (Kennedy, 2005). Evolving from Wenger (1998)’s work, CoP is introduced as informal learning organizations that promote knowledge exchange by supporting participants to interact with each other (Li, L. C. et al., 2009). E1 regarded this social learning process of CoP as an opportunity
for the professional development of digital competence of teachers in Finland, which may have brought some transformation to the sharing culture.

He followed by sharing an example of organizing an online teacher training session during the pandemic, not only the participating teachers were happy that it saved their travel expenses and time across cities, but also saw the opportunities to arrange teacher sharing by themselves through online platforms because they realized they didn’t need expensive equipment to arrange so (3:58).

E1 also expressed his hope that in the future teacher training, teachers should be taken as teacher educators who share their practices in the community:

“If you think about the future of Finnish education, and the in-service teacher training...We should have made more opportunities for normal teachers to be teacher educators because we have a lot of good teachers who have good ideas, but they have no opportunities to share their experiences.” (3:58)

E1 showed affirmation to the rise of CoPs and took the popularity and low technological threshold of online platforms as an opportunity to the further growth of CoPs among teachers. His view is supported by teacher respondents’ positive comments on this strategy. All teacher respondents shared that they found learning from fellow teachers, whether online or face-to-face interaction, was quite an effective way they experienced to develop their digital competence.

T1 expressed that the most useful courses she had taken usually involved teachers sharing their own experience:

“I think the courses are much better if there was actually a teacher who does it. So then they know what the teachers need.” (7:35)

T2 also said that she found learning from colleagues was very helpful:

“We have this thing called digital mentors. It’s like training some teachers at every school and then the trained teacher teaches their colleagues. And that was very helpful... So, when you can't get something done, you have someone to refer to.” (8:49)

T2 continued with an example of her older colleagues asking for help to conduct online teaching and she helped them out. What T1 and T2 mentioned echoed E1’s view that teachers are effective teacher educators themselves and it was happening that teachers who need support were seeking help from the community.
Also, T3 and T4 said that having one or more colleague who learnt some new things and discussed in the subject team was an effective way to help them to learn together. T3 mentioned his colleagues took courses on digitalization of examination and shared with him so that they found the core of what was needed together:

“My colleagues went there and then I asked what was good and what was bad. And I think we found the core of what was needed in that way.” (9:17)

Other than learning by himself, T3 also expressed that he mostly learnt from colleagues in the past few years when discussing how he prepared for the digitalization of examinations:

“I've been learning by myself as there are also videos and resources on the Internet. Other teachers and some program developers have also made their own databanks. But mostly I have learned from my colleagues here.” (9:21)

T4 also expressed that he found learning together with fellow teachers from similar subject expertise was effective and easier:

“There are five or six math or mathematical subject teachers in our school. And of course, we think about these things together as a group. There's no point for everybody to try to figure out how to solve the same problem. It's easier if we put our heads together and see how we do it together.” (10:38)

T3 and T4’s experience of having one or more colleagues as knowledge sharer is what Wenger (1998) called broker in CoP, which refers to the ones who break new ideas into existing practices and influence the CoP to develop new practices together (Laksov, Mann, & Dahlgren, 2008). This component of CoP was also evidenced in T1’s role as digital mentor and T2 who mentioned she found having a digital mentor was a helpful way to support her. Teacher respondents mostly showed affirmation of the effectiveness and helpfulness of CoP to support their development of pedagogical digital competence.

Two conditions emerged from the data that would facilitate the sustainability and growth of the CoP among teachers. First, T2, T3, and T4 mentioned that the positive sharing culture in their schools was crucial to support and facilitate the exchange of knowledge to happen. T3 was alert that there could be some tensions happening in sharing, though he has been experiencing quite a positive relationship with his fellows. He said there was “a shame factor” (9:21) that teachers in Finland were “a bit protective” (9:21) of what they have done and could also be “afraid of being criticized” (9:21) by their fellows. He said:
“I’m lucky to have a few colleagues that are extremely supportive and that we have a good relationship. But as a whole, it’s not that fruitful always like teachers just shared these skills and all happy in the workplace.” (9:21)

Whereas T4 said having a smaller group of the teaching staff may be a plus to maintain the positive sharing culture in his school. He found informal sharing between colleagues the most helpful. He then affirmed that the informality of such a learning community is the key to sustain this strategy.

“I have noticed that when something informal turns into something formal, it usually dies out for some reasons. We shouldn't organize things to death.” (10:39)

He then added his worry that when the informal sharing works well, there was a tendency for the school leaders to try turning it into official and regular activities. Yet, he noticed that when informal sharing among colleagues was turned into something formal and official, it didn’t work anymore. (10:40)

Last but not least, T5’s experience of support from some online teacher groups provided a broader sense of teacher’s CoP of digital competence:

“I think that there are good peer groups of teachers on Facebook. All the music teachers in Finland belong to one Facebook group. There were a lot of discussions, especially when everybody was in the same situation. They were sharing a lot of things.” (12:24)

Among the online communities, he found the local group of music teachers and high school teacher community the most important support:

“Every week there were kind of support chats or something. I asked something, some specific questions and got an answer. I think the peer network was the most important support last spring.” (12:24)

He found these online CoPs particularly helpful because of his specific needs as a music teacher:

“I think the best I could have would be a colleague that deals with the same things and could help me because I think most of the time, the problems I encounter are so specific that any overall guide in the high school area is too general. Nobody can help me with the music technology stuff except another person who has experienced those things.” (12:32)

T5’s participation in online CoPs facilitated his knowledge exchange with fellow music teachers in both local area and non-local areas.

Outcome: Collective enhancement of teachers’ professional digital competence

The outcome of employing the above three strategies for teacher professional development of digital competence is the collective enhancement of teachers’ professional digital competence. Among all the expert and teacher respondents’ data, successful experience of enhancing digital competence was
evidenced, both among individual teachers and teachers’ community. For example, T1 mentioned she has taken the formal training course and learning by herself to adapt to the role of digital tutor of her fellows. T2, who probably took the “broker” role in CoP, shared her experience of helping other colleagues with their digital skills. T3, who once experienced technostress, managed to learn with colleagues and by himself to breakthrough the obstacles and was able to foster his professional capacity towards digitalization of examination and online teaching. T4 emphasized his professional capacity as a teacher to learn by himself, as well as participating in an informal learning community with his colleagues. T5, who possesses specific digital competence related to music and media, found support from some online CoPs. Furthermore, the expert respondents, E1 and E2, shared their observations of quite many teachers in Finland were able to adapt to online teaching in a short period mainly through self-learning and participation in CoPs. All in all, the data showed that there was a collective growth of teachers’ professional digital competence with the strategies employed, especially during the COVID-19 pandemic.

4.7 Mapping of findings

To conclude this chapter, some of the above findings are mapped with literature in Chapter 2. The findings in 4.2.1 versatility of digital competence are supported by the comprehensive and multifaceted framework of Digcomp 2.0 framework by Carretero et al. (2017) and Vuorikari et al. (2016). And 4.2.2 digital competence in education echoes with Markauskaite (2007) who points out the lack of common understanding on digital competence in formal education affects the implementation of relevant policies. While 4.3 teachers’ needs for professional development of digital competence supports the studies by Krumsvik (2008) and Redecker (2017) which both provide frameworks for continuous adaptation of teachers’ capacity towards professional digital competence. And the findings in 4.4.1 teacher autonomy was congruent with Vitikka et al. (2012) and Lavonen (2018), that it is evidenced as element of professionalism of teachers.

Whereas the following findings require further inquiry and renewal from previous literature. For example, although the elements of teacher motivation to learn by Appova and Arbaugh (2018) was evidenced in the findings in 4.4.2 teacher motivation to learn, 4.4.3 educational leadership and 4.4.4 policy and resources, the original purpose of this framework was for general teacher professional development, a more precise and specific framework for digital competence professional development could be renew based on this framework and the findings of this research. For example, versatility of digital competence needs to be addressed when discussing the motivation for teachers.
to learn. Last but not least, two aspects are not covered in the previous literature regarding the three strategies for professional development of digital competence emerged from the data. First, in Kennedy (2005)’s nine models of teacher professional development, self-initiated learning was not included. However, in this research, self- initiated learning was found to be an effective way for teacher professional development of digital competence. Second, the increasing online happenings of teacher professional development through self-initiated learning and community of practice is not addressed in the previous study. Therefore, further inquiry from literature to support these findings and renewal of the related frameworks are needed. The next chapter is going to discuss the findings in further details.
5 DISCUSSION

This chapter discusses the key findings with respect to the research question and the implications of the findings to support teacher professional development of digital competence and for further scientific research.

The research question is reiterated as follow:
How is digital competence integrated in teacher professional development?
By answering the following three sub-questions, the main research question is resolved:

1.1 How is digital competence understood among educational experts and teachers?
1.2 How is motivation shown for teacher professional development of digital competence among educational experts and teachers?
1.3 How is professional development of digital competence shown among educational experts and teachers?

5.1 Understandings of digital competence

The understanding of digital competence by both educational experts and teachers is supported by Tømte (2013), Mcgarr and Mcdonagh (2019), and the Digcomp frameworks by Carretero et al. (2017) and Vuorikari et al. (2016). The respondents agreed that digital competence is not a static set of skills but an evolving constellation of knowledge, skills, and attitudes alongside technological advancement. Their views are congruent with Tømte (2013) who describes the notion as “a moving target” and Mcgarr and Mcdonagh (2019)’s explanation of the dominant technologies of a specific era contribute to the evolution of what digital competence encompasses. Also, both expert and teacher interviewees highlight the versatility and multifacetedness of digital competence and tend to prioritize critical thinking and social digital competence over operational technical skills. While they also affirm that general operational and technical skills should be learnt as basic skills that facilitate the acquisition of other essential skills, particularly soft skills like collaboration and communication. These views are congruent with the Digcomp frameworks by Carretero et al. (2017) and Vuorikari et al. (2016)
that emphasize the multifacetedness and that digital competence has been evolving beyond technical skills, moving towards the wider scope of social and ethical aspects.

The need for teachers’ continuous development for their professional digital competence echoes with Krumsvik (2008) and Redecker (2017). As Krumsvik (2008) discusses the double dimensions of teachers’ digital competence, teachers not only make a pedagogical judgment on the technological integration in their teachings but also become the role model of young people on critical and creative use of digital tools and information. Therefore, the versatility of digital competence causes the constant need for teachers’ professional development on digital competence so as to become role models of young people and make informed pedagogical decisions when integrating digital technology in teaching. Furthermore, Redecker (2017) outlines the framework for six proficiency levels of digital competence of educators, which also points towards the need for continuous and systematic development of digital competence.

Also, the finding is in line with Markauskaite (2007) that the fuzziness of digital competence results in the lack of common understanding of the curriculum among teachers and other stakeholders, causing a negative influence on the synergy effect in educational policy implementation. The data shows that although teachers are aware that digital competence is included in the latest Finnish national core curriculum (FNCC14) as transversal competence across all subjects, they tend to focus on their subject-specific digital skills and lack a clear and holistic overview of students’ development of digital skills. The data also reflect the lack of a common understanding of digital competence in the curriculum by various stakeholders, including policy makers, school leaders and teachers. Experts opinion that the curriculum needs to be more concrete and suggest that a shared understanding and clear framework of evaluation on digital competence are needed. There lies a need to seek a common understanding among teachers and other stakeholders in educational settings to enhance systematic teacher professional development, subsequently the students’ digital competence.

5.2 Teacher motivation

The four factors found in this research that affect teacher professional development of digital competence are teacher autonomy, teacher motivation to learn, educational leadership, and policy and resources.
Firstly, the extensive professional autonomy was evidenced and supported by Smith (2003) and Lavonen (2018). As autonomous professionals, teachers are likely to have a large capacity to make self-directed decisions on professional actions and professional development and free from control from others, which are the three dimensions of teacher autonomy suggested by Smith (2003). Teacher autonomy, according to Lavonen (2008) is one of the cornerstones of the professional identity of teachers, is evidenced in the data as an influential factor for teachers’ professional development of digital competence. However, this gives rise to a paradox that teachers who have weak digital competence are self-directed to decide for their professional development of digital competence. Questions are raised regarding teachers’ capacity to make professional judgments on developing their digital competence. With reference to Smith (2003), in addition to teacher autonomy, he advocates teacher-learner autonomy which emphasizes teachers’ ability to develop their skills, knowledge, and attitudes as a teacher and cooperate with others. His advocation does not diminish the importance of the self-directed capacity and the freedom from being controlled by others, yet, offering a useful perspective to enhance teachers’ capacity to make self-directed decisions for their own professional development from the learner’s perspective.

The second factor is teacher's motivation to learn which is mapped with the conceptualization by Appova & Arbaugh (2018) discussed in chapter 2. Three types of motivation are observed from the data. First, teachers are motivated to learn when there is a need to complete specific tasks. This connects with the policy and accountability and self-determination in educational psychology aspects in Appova and Arbaugh (2018)’s framework. When there are tasks to be completed that require the use of digital skills, teachers are motivated and competent to learn new skills. This is strongly evidenced when examinations are gradually digitalized, as well as during the COVID-19 pandemic. Also, teachers are motivated to develop their professional digital competence when they could positively influence students and their learning. This supports the teacher education and professional development aspect that emphasizes the ability to facilitate students’ learning and address their learning needs. For example, staying connected with students in digitalization of daily experience, and preparing students for digital examinations, are evidenced as the motivation of teachers to learn digital skills. Furthermore, teachers are motivated to learn in order to gain knowledge based on their own interests. This reflects the motivation in andragogy and adult learning in Appova and Arbaugh (2018) ’s study that they are self-directed and self-initiated to apply their knowledge to their teaching. In addition, these findings are also likely reflecting teachers’ preference for technological pedagogical content knowledge (TPACK) proposed by Mishra and Koehler (2006). The TPACK framework conceptualizes the effective use of technology in pedagogical practices and how technology
knowledge interacts with pedagogical content knowledge. Therefore, strengthening teachers’ TPACK helps them to enhance their professional capacity and self-efficacy to make meaningful pedagogical decisions when there is a need to employ digital tools in their teaching, subsequently deciding on what they would need to learn. With extensive teacher autonomy in Finland, the main responsibility to decide on the professional development of digital competence lays on the teachers themselves, thus, their motivation to learn plays a substantial role and needs to be studied further, beyond the scope of this research.

Thirdly, the influence of educational leadership found in this study supports Pettersson (2018)’s and Appova and Arbaugh (2018)’s research. Pettersson (2018) points out the important roles of school leaders to realize possibilities and constraints in educational technologies, and to become pedagogically and technologically competent in their roles as ICT leaders to facilitate teachers to develop their digital competence. The finding shows that school leaders have the autonomy to decide the direction of the schools. Subsequently, the policy and budgeting of the school to realize the direction could possibly have an impact on teacher professional development of digital competence. Also, Appova and Arbaugh (2018)’s framework of teachers’ motivation to learn indicates that school leadership plays a role in affecting school policy, which could either create positive or negative reinforcement to teachers’ motivation to participate in professional development activities. In this research, whether teachers could get adequate support for the professional development of digital competence, for example, essential digital tools and budget for formal training courses, largely depends on the school leaders’ professional capacity and attitudes towards digital skills education. Nevertheless, principals were not included in the interviews in this research, further understanding on this theme would need further theoretical sampling to get principals’ view on their role.

Lastly, in congruence with Li & Dervin (2018, p.101) that financial support for teachers’ development depends on municipalities, which is possibly leading to inequality, this research highlighted that policy and resources affect teacher professional development of digital competence. The findings suggest that municipality financial inequality could be a possible hindrance for maintaining equity across cities with diverse financial status, especially with digital skills education which usually involves a considerable budget for infrastructure and equipment. When teachers and students are both systematically well supported with and are able to have equal access to necessary resources, for example, digital infrastructure, devices, and tools, together with sufficient in-service teacher training, it is possible to enable teachers to develop their digital competence, subsequently, benefiting to students’ digital skills development.
5.3 Professional development

The findings reveal that teachers have experienced three main forms of teacher professional development of digital competence, including self-learning, formal training, and community of practices.

For formal training, the findings echo Li and Dervin (2018)’s criticism that many of the formal courses for teacher professional development are market-driven and fragmented which couldn’t meet teachers’ expectations and needs. The findings show that teachers find formal training model not effective for developing professional digital competence, especially with the fast-paced technological advancement that things taught in formal courses are soon outdated. Also, teachers find formal training irrelevant to their daily teaching contexts as the organizers don’t seem to know the reality of teachers.

Besides, mapping with the three categories of teacher professional development framework by Kennedy (2005) helps to explain the ineffectiveness of formal training for digital competence. Formal training falls to the transmission mode with a low degree of teacher autonomy involved. Although formal training has been a commonly recognized model for teacher professional development for it provides effective ways for dominant stakeholders to control and limit the agenda, teachers are placed in a passive role as knowledge recipients. Whereas digital competence is versatile and multifaceted which does not fit into the purpose of transmission mode. For example, many hands-on skills practiced in digital environments are not usually easily practicable in transmission mode. This also partly explains why teachers find the formal training for digital competence ineffective. Tour (2017) also points out that the traditional transmission model of professional development is gaining criticism on its lack of continuity, coherence, and long-lasting effect on pedagogy. One reason that the traditional transmission mode continues to persist, according to Tour (2017), is due to the impracticality and limitations for many schools and organizers to make relevant changes. Thus, there is a need to understand how to address the challenges in order to promote effective professional development by gaining knowledge on teachers’ preference on how and what to learn in terms of digital competence.

Furthermore, Tour (2017)’s affirmation on self-initiated learning is supported by the findings in this research. Self-initiated forms of learning refer to people having certain educational objectives and taking the initiative to seek relevant learning experiences, which are often intentional, deliberate, and
non-formal (Tour, 2017). The findings also show that teachers have experienced self-learning and mostly find the experience positive. Tour (2017)’s findings suggest that self-initiated forms of learning, for example, seeking and consolidating online resources, collaboration, and socializing, have been proven valuable, meaningful, and relevant as an authentic learning experience for teachers’ professional purposes to develop their digital competence (Tour, 2017). Barton and Lee (2013) also observe the bloom of voluntary and purposeful informal learning opportunities amongst adults who use online platforms to access, generate and share knowledge. Nowadays, it’s getting increasingly common for people to engage in independent learning through digital technology. However, this model is not included in Kennedy (2005)’s framework. An updated model is needed to address the needs for new strategies of teachers to develop professional digital competence.

Lastly, Kennedy (2005)’s discussion on the pros of a community of practice (CoP) is supported by the findings in this research. Respondents in this research show affirmation of the effectiveness and helpfulness of CoP to support their development of pedagogical digital competence. In Kennedy (2005)’s analysis, community of practice is categorized in the transitional mode that requires partial teacher autonomy to participate. Instead of passive knowledge receivers, teachers in CoP actively take part in knowledge sharing and generation. One of the strengths of this model is that hierarchical structure does not exist, participants are comparatively equal to contribute their knowledge (Kennedy, 2005). Teacher participants in this research are socially supported in CoPs without hierarchy, knowledge shared among fellow teachers is authentic and relevant to their professional needs.

Besides, Li, L. C. et al. (2009) support the findings that positive sharing culture and informality are keys to effective learning in CoPs. Li, L. C. et al. (2009) emphasize that much of the learning happened during informal gatherings where practitioners interacted with each other and shared stories about their experiences. Through this process, the informal interactions eventually became the means for the participants to improve their practices and generate new knowledge to address the needs. The finding shows that establishing positive sharing culture that supports the informal exchange of knowledge on pedagogical digital competence could be a catalyst that strengthens the function of CoPs.

Moreover, Tseng and Kuo (2014) support the finding that teachers and experts find the growth of online CoPs for the professional development of digital competence effective. According to Tseng and Kuo (2014), in online professional CoPs, members post messages to seek help or advice while fellow members respond with suggestions. This form of exchange provides solutions to similar
problems that foster effective learning as well as cooperation (Tseng & Kuo, 2014). In the respondents’ experience, online CoPs allow them to learn and cooperate with fellow teachers both locally and non-locally. In this respect, online CoPs, which are much less constrained by time, location, and resources, could be a possible remedy for the inadequate budgets and resources of schools and municipalities to provide relevant training to support teachers’ professional development of digital competence that requires further study to explore.

Finally, the traditional models of CoP by Wenger (1998) that were quoted in Kennedy (2008) may need renewal to address the differences in online CoPs from traditional ones. For example, the traditional models of CoP by Wenger (1998) tend to require a more committed and stable community to tune to a joint enterprise. However, in online CoPs that the respondents mentioned in this research, they don't need to emphasize the commitment with other members to reach a joint enterprise. Instead, people who have similar backgrounds and needs share content and help each other. Moreover, online CoPs tend to be open groups with certain fluidity than traditional ones. It is not always practical or necessary to reach a joint enterprise. Tseng and Kuo (2014) find that teachers in online professional CoP are socially connected when they are willing to share useful resources and solve other members’ problems. Thus, knowledge-sharing behaviours promote social connection in online CoPs rather than a joint enterprise. A renewal of the models for CoP is needed alongside the surging of online CoPs for teacher professional development of digital competence.

5.4 Implications of the findings

The findings suggest the need for teacher professional development of digital competence to move beyond activities, instead, to designing conditions that facilitate teachers’ continuous learning. Four conditions implied from the findings are discussed as follows.

Firstly, the findings infer the need for ongoing deliberation for common understanding on digital competence in formal education setting among policy makers and teacher communities would help to provide clear guidance for teachers to develop their digital competence. Ottestad, Kelentić, & Guðmundsdóttir (2014) share the same view that there is an obvious need to simplify and straighten up the concept of teachers’ professional digital competence to provide a common ground for professional development. Also, one of the features of effective teacher professional development suggested by Darling-Hammond, Hyler and Gardner (2017) is content-focused, which means professional development intentionally focuses on discipline-specific curriculum content that
supports teachers’ learning. Thus, teachers’ diverse subject expertise and the associated specific digital competence need to be taken into account to systematize the teacher professional development of digital competence. For example, consensus could be reached on some specific digital competence required in different subject expertise, so that teachers when approaching their professional development, can have a context-specific dimension as reference. Since digital competence is a moving target that could be interpreted and reframed as time goes by, ongoing deliberation is needed.

Secondly, this study also indicates that designing conditions that teachers need to make use of digital competence that practically add value to their pedagogical practices could be a strong trigger for teachers to participate in professional development for their pedagogical digital competence. As suggested by Huhtala and Vesalainen (2017), in-service teacher training should have a genuine connection with teachers’ everyday teaching and school reality, the training could then be more effectively transforming the pedagogical practices of teachers. Thus, when teachers are placed in job-embedded conditions that would need integration of digital competence into their pedagogical practices to succeed, they will be able to motivate themselves to professionally develop their digital competence.

Thirdly, the finding implies that strengthening positive sharing culture and emphasizing social elements in teacher professional development for digital competence would be able to facilitate teachers to learn as a professional community. According to Mak and Pun (2015), the sustainability of teacher CoP lies in the willingness of its members to share their pedagogical practices within and outside schools. In CoP with positive sharing culture, members could turn to their fellows for help when encountering challenges and could share their success in transforming their pedagogical practices with the integration of digital technology. CoP seems to have the potential to bring collective enhancement to teachers’ professional digital competence. To realize this potential, Mak and Pun (2015) also emphasize that planned efforts by different stakeholders are also needed to build a sense of community and the rapport of sharing culture.

Besides, the findings also imply that teacher professional development of digital competence needs to take into account that many self-initiated learning and CoPs have been happening online. These effective models of professionalism and professional community need to be recognized, understood, and supported. For example, designing policies where teachers are given more space and time to engage in these learning strategies (Tour, 2017).
Last but not least, further study on some areas in this topic is needed, as Huhtala and Vesalainen (2017) suggest, teacher professional development in Finland should emphasize the importance of research-based planning and implementation. The findings indicate that instead of an isolated individual competence, teacher professional development of digital competence should be regarded as an organizational development that is influenced and driven by factors in the wider educational context including educational leadership, school culture, and policy (Pettersson, 2018). Therefore, it is also suggested that further study on how organizational culture and practices, such as educational leaderships might impact teacher professional development of digital competence. Furthermore, the research could also be done on the proliferation of self-initiated learning and CoPs for teachers’ development of digital competence, to bring diverse perspectives, and to enrich the discussion with more empirical data than could have been possible in this research.

Based on the above discussion that sheds lights on the three aspects of this research mentioned in Figure 1 in Chapter 2, the mapping of this research is renewed as follow in Figure 4:

![Mapping of the findings in this study on the integration of digital competence in teacher professional development](image)

**FIGURE 4.** Mapping of the findings in this study on the integration of digital competence in teacher professional development

To conclude this chapter, Figure 4 integrates the implications of the findings from this research to enrich the initial mapping in Chapter 2. Figure 4 presents that ongoing deliberation on the
understanding of digital competence is needed in the formal education setting. Also, the increasing happenings of self-initiated learning and community of practice, especially online, should be addressed and recognized with relevant policies. Last but not least, educational leadership, positive sharing culture, and professional development with a genuine connection with school reality are conditions that support and encourage teacher professional development of digital competence.
6 EVALUATION

This chapter discusses the evaluation of this research in three aspects, including trustworthiness, research ethics, and limitations.

6.1 Trustworthiness

The quality of qualitative research is linked to its trustworthiness, which is crucial to the usefulness and integrity of the findings (Connelly, 2016). Quoting Polit and Beck (2014), “trustworthiness refers to the “degree of confidence in data, interpretation, and methods used to ensure the quality of study” (Connelly, 2016). According to Lincoln and Guba (1985), criteria to maintain trustworthiness include credibility, dependability, confirmability, and transferability. Credibility refers to the truth of the data if it is able to accurately reflect the multiple realities of the phenomenon (Sikolia, Biros, Mason, & Weiser, 2013). Dependability refers to the constancy of data over similar conditions (Cope, 2014). Confirmability refers to the researcher’s ability to minimize or to remain unbiased (Connelly, 2016). Transferability refers to the applicability of the findings to other settings (Sikolia et al., 2013).

Various ways were used to enhance trustworthiness in this research. Credibility was enhanced when participants were also able to discuss the phenomenon studied with the researcher (Lincoln & Guba, 1985), and when the researcher used the participants’ words in the emerging theory (Sikolia et al., 2013). The semi-structured interview with open-ended questions was employed to give space to the participants to discuss their views. Also, rich quotes from the participants that derived the emerging themes were used to demonstrate credibility and confirmability (Cope, 2014). For example, the theme “community of practice” was adopted from E1’s data while code “digital savvy myth” was adopted from E2 and T1’s data.

For dependability and transferability, a thick description of this research, including the participants, methodology, the data obtained, the data analysis process, and the interpretation of the results was crucial as they facilitated the applicability of the research by offering transparency (Sikolia et al., 2013). Moreover, memo writing, record tracking with the help of the software atlas.ti, and constant
comparison that happened regularly during the research helped to enhance confirmability and
dependability as the reflective practices provide an audit trail for examination (Cope, 2014). In
addition, the thick descriptions of how the findings were derived from data contributed to minimizing
bias and facilitated the researcher to engage in the analysis in more objective ways (Sikolia et al.,
2013).

6.2 Research ethics

Ethical concerns were of high concern during the whole research. Different measurements were taken
to inform, shield privacy, anonymize, and manage data security, to protect the participants from all
possible harm.

Informed consent

Informed consent requires participants to comprehend and to agree voluntarily to the nature of the
research they participate in (Israel & Hay, 2006). Participants must also be autonomous and free to
withdraw at any time without any consequences (Khan, 2014). In this research, participants were
informed of the nature and the purpose of the research through an email invitation, all the interviews
were conducted after obtaining their consent with signature on the informed consent letter. All
participants were professional adults who decided to participate voluntarily and were allowed to
withdraw anytime without any consequences, as there was no personal or direct relationship between
the researcher and the participants that no conflict of interest could result. Also, informing should be
a continual task (Pienimäki & Kotilainen, 2018), participants were also informed of the research
findings at the end of the research process by emailing them the completed thesis.

Anonymity

The essence of anonymity is that information provided by participants should in no way reveal their
identity (Cohen et al., 2013). Anonymity was guaranteed through masking unique and specific
personal details to eliminate the risks of them being identified. Instead of their names, all participants
in this research were given a code to represent them, for instance, E1, E2, T1, T2, etc. (Cohen et al.,
2013). Although the three educational experts consented their names and affiliations could be
published on the ySKILLS official report, their personal identifiable information was also masked in
this thesis. Only minimal essential background information of the expert and teacher participants
were reported in this thesis to avoid them being identified, thus protection of the participants’ privacy
is guaranteed.
Confidentiality
Maintaining confidentiality was the second way to protect the participants’ privacy. Quoting Cooper and Schindler (2001), Cohen (2013) suggests that confidentiality can be protected by restricting access to data that identify participants and seeking approval of the participants before any disclosure about the participants takes place. In this research, the researcher strived to provide a credible promise of confidentiality by securing all the data collected in any forms, including emails, audio-visual recordings, transcripts, was kept in a private cabinet, password-protected platforms, and computer to ensure the data was not accessible to any unauthorized people (Khan, 2014). Also, it consented that all data collected were kept confidential unless explicit permission was obtained from the participants (See Appendix 1).

Data security management
Responsible and ethical research requires good practices on data management, which refers to how data is collected, stored, shared, and reported based on ethical principles (Finnish social science data archive). During this research, data was collected and stored temporarily on two online digital platforms, including the video and audio recording of the interviews on Microsoft cloud drive and amberscript, the artificial intelligent transcription application. Both platforms were password-protected, only the researcher could have access. After downloading the video from Microsoft cloud drive, the files were immediately deleted from the platform. Also, after the transcriptions were completed and downloaded, the audio, video and transcription files were all deleted from the amberscript application. During data analysis, the data was stored and processed on the researcher’s personal laptop which was password-protected and not accessible to anyone else other than the researcher. Data were analyzed using the software atlas.ti, which is an offline tool protected with a password in the researcher’s personal laptop. The data remained protected until the end of the research and will be retained under protection for 3 years before being permanently deleted (University of Oxford, 2016).

6.3 Limitations
The grounded theory method was applied in this research, however, the research findings were not substantive to develop a theory due to limited time and sample size, and limitations as a novice researcher. According to Timonen et. al. (2018), although grounded theory research aspires to build theory, practicalities such as theoretical sampling, limited time, could be obstacles to developing a theory, yet they also mention the application of grounded theory could amount to a new or better
understanding on existing conceptualization or framework but not necessarily a fully-fledged theory. This research achieved a systematic understanding grounded from data instead of a theory.

Second, though the sample size is relatively immaterial in grounded theory research (Cohen et al., 2013), the limited sample size in this research risked inadequacy for data to reach theoretical saturation. For a robust theory to be developed on teachers’ professional development of digital competence, data collection could be done more extensively in the future than could have been possible in this research. Thus, the results of this research remain open for revision as scientific knowledge progresses.

The main goal of qualitative research with the grounded theory approach is to allow an opportunity to explain the unique experience in specific settings and to provide a rich and contextualized understanding of the phenomenon (Cohen et al., 2013). Yet, one of the most common limitations was the issue of generalization due to the highly contextualized and idiosyncratic properties of the approach (Ochieng, 2009). Although the results have challenges to be applied to a wider context, it attempts to provide a systematic understanding that may anticipate different stakeholders to create more favourable conditions and adopt suitable strategies that facilitate teachers’ professional development for digital competence.
This research aimed to understand how digital competence is integrated in teacher professional development in Finland. Based on grounded theory methodology, qualitative methods were introduced to collect and to analyze views and experience of educational experts and teachers, subsequently, a systematic understanding of the integration was consolidated. This chapter first summarizes the findings and their implications, followed by recounting the limitation of this research, and closes with some suggestions for future research.

Derived from ySKILLS research project work package 3, the objective of this research was to understand teachers, as one of the key actors of digital competence education in Finland, in what ways digital competence was integrated in their professional development. The findings indicated that both educational expert and teacher respondents shared the understanding that digital competence is versatile and multifaceted. Teachers need to continuously adapt to the changes by professionally develop themselves. However, the findings also reflected the lack of common understanding of digital competence in the curriculum by various stakeholders, including policy makers, school leaders and teachers. Besides, although teachers in Finland possess extensive professional autonomy, it was affirmed in the findings that teacher professional development of digital competence was not only an individual issue of teachers’ personal motivation, but it could also be positively or negatively influenced by various external factors such as educational leadership, and policy and resources. While taking the contexts of teachers’ subject expertise into account, the proliferation of self-initiated learning and community of practice as effective ways for teacher professional development of digital competence was also highlighted.

These findings provide a glimpse of the current picture of teacher professional development of digital competence in Finland in terms of their understanding of digital competence, the ways of professional development of digital competence, and the factors that affect the process.

Several limitations should be considered when drawing the findings from this study. First, as a novice researcher with limited time and sample size, this research using grounded theory as
methodology amount to a systematic understanding of the studied phenomenon instead of substantiating enough to develop a theory. Second, due to the limited sample size, this research risked the inadequacy to reach theoretical saturation. Third, the qualitative nature of this study limits the generalizability of the results to a wider context. Therefore, more extensive research could be done in the future with a larger number of participants with more diverse backgrounds than could have been possible in this research.

Furthermore, future research on teacher professional development of digital competence could focus on the influence of organizational culture and practices that might shape the contextual conditions of teacher professional development of digital competence. Further study could also focus on the proliferation of self-initiated learning and teacher community of practice for digital competence, to bring diverse perspectives and enrich the discussion with more substantiate ground than could have been possible in this research.

Last but not least, this research implies the need for teacher professional development of digital competence to move beyond activities. Instead, it is important to design conditions that support teachers’ continuous learning on digital competence. The following three aspects could be considered. First, promoting ongoing deliberation for common understanding on digital competence in the curriculum. Second, designing conditions for practical use of digital competence in the daily educational setting. Third, nurturing positive sharing culture to facilitate professional knowledge exchange. Last, designing policies that recognize and support the increasing online happenings of self-initiated learning and CoP for teacher professional development of digital competence.

This research attempts to offer insights that may anticipate different stakeholders to create more favourable conditions that facilitate teacher professional development of digital competence. The heightening needs of teacher professional development of digital competence is a global phenomenon alongside the increasingly ubiquitous digital environments and the digitalization of educational settings. This small-scale qualitative study may need to be broadened to understand a bigger population, to explore ways to better support teacher professional development of digital competence in a different contexts around the world.


Finnish Board of Education. (2014). National core curriculum for basic education.
Finnish social science data archive. Data management guidelines. Retrieved from


You are invited to participate in an interview which is carried out as part of the ySKILLS (“Youth Skills”) project. “Youth Skills” (ySKILLS) is a four-year project running under the European Union’s Horizon 2020 Research and Innovation Framework Programme as a so-called “Research and Innovation Action” (RIA). It aims to enhance and maximise long-term positive impacts of the ICT environment on the wellbeing of all children.

You must be 18 years or older to participate in this interview. Your participation is voluntary. Please take as much time as you need to read this form and the accompanying information sheet. You will be given a copy of this form.

We identified you as an expert in the education and/or the labour market. All experts invited have a minimum number of years of experience working in the educational or the labour market sector and they are knowledgeable and experienced in the sector they represent. Your participation will help us analyse the role of digital skills education both in formal as in informal such as the school or home, as well as the (digital) skills needed in the 21st century to cope with technological transformations in the labour market.

Purpose of the study
We are asking you to take part in this interview because we are trying to 1) acquire extensive knowledge and better measurement of digital skills, 2) develop and test a model predicting the complex impacts of ICT use and digital skills on children’s wellbeing, 3) explain the ways in which at-risk children can benefit from online opportunities despite their risk factors, and 4) generate recommendations and strategies for key stakeholder groups to promote digital skills and wellbeing.

The knowledge acquired via these expert interviews will inform future project activities and ultimately be translated into specific digital skills measures and school education recommendations.
Appendix 1

Procedures
You will be interviewed by a ySKILLS project partner who will ask you some questions about your opinions regarding the digital skills that youth should possess, if you find the development of these skills important and how these skills are currently being supported or developed in your sector (e.g. education, labour market, etc.). The interview will take approximately 90 minutes and will be carried out online (e.g. via a conference call or chat service) by members of the ySKILLS consortium, and/or partners appointed by them. There will be a maximum of two interviewers present. If a second person is present, he or she will take notes during the interview, but will not participate in the conversation. The interview will be audio-recorded. We will transcribe the recording fully or partly and remove any names.

Potential risks and discomforts
There are no anticipated risks to your participation. When you feel some discomfort at responding some questions, please feel free not to answer them. If you decide that you want to stop during the course of the interview, then it is possible to do so at any time, without having to give a reason. Moreover, you have a right to the deletion of your data from the project after the interview has concluded.

Potential benefits to subjects and/or to society
You will not directly benefit from your participation in this interview. However, your participation will be valuable to better understand which skills adolescents must possess to knowingly and critically use digital technologies for their wellbeing, education, social life and how they can build resilience against their potential negative impacts. The project will enable new strategies and policy recommendations in this area.

Payment/compensation for participants
You will not receive any payment for your participation in this interview.

Confidentiality
The data obtained from this interview, such as the interview recording and transcripts, will only be used by ySKILLS members and project partners for analysis and to inform the further project activities described above. It may also be included in possible project reports or research publications. The acquired data might moreover be used in future projects investigating a similar topic to advance knowledge in the area, but never for other purposes, such as economic gain. Everything you say to us is kept confidential.

We will change your name and other identifiable information in publications based on this research. All transcripts of the interviews will be pseudonymised before being shared with the researchers in the ySKILLS project as well as in any ySKILLS project publications, unless explicit permission is obtained from you to share your name and affiliation in ySKILLS publications to acknowledge your participation in the project and/or to be cited in selected quotes from the interview.
Accessing project outcomes
The “Report on the interviews with experts on digital skills in schools and the labour market” will be sent to you. This report together with all other project-related publications will be publicly available via the ySKILLS project website: [https://yskills.eu/](https://yskills.eu/)

Participation and withdrawal
You can choose whether to be part of this interview or not. If you volunteer to participate in this interview, you may withdraw at any time without consequences of any kind. During the interview, you may also refuse to answer any questions you are reluctant to answer, and still remain in the study. You may be withdrawn from this research if circumstances arise which warrant doing so (e.g. conflict of interest).

Further information
If you have any questions or concerns about the research, please feel free to contact the national project leader at any time: Prof. Sirkku Kotilainen and Dr. Jussi Okkonen Tampere University (sirkku.kotilainen@tuni.fi, jussi.okkonen@tuni.fi) or the ySKILLS interviews coordinator, Dr. Verónica Donoso (veronica.donoso@eun.org).

Should you have any complaints or comments about the course of the interview and the procedures it involves in relation to your participation, you can contact the European interview coordinator of the ySKILLS project, Dr. Verónica Donoso or the ySKILLS project coordinator, Prof. Leen D’Haenens (leen.dhaenens@kuleuven.be). For any complaints or concerns related to ethical aspects of this study, you can get in touch with the Social and Societal Ethics Committee of the KU Leuven (smec@kuleuven.be). Any complaints or comments will be treated in the strictest confidence. We hope that we have provided you with sufficient information. We would like to take this opportunity to thank you in advance for your assistance with this research, which we greatly appreciate.

Kind regards,

Sirkku Kotilainen Jussi Okkonen
Tampere University
Faculty of Information Technology and Communication Sciences (ITC)
Informed Consent
Please read the statements below and return the completed form:

- I have been clearly informed about the nature of the research, as described in this fact sheet.
- I understand that my participation is voluntary.
- I understand that I can withdraw at any time without adverse consequences.
- I understand that information gathered will be used for the purposes of the project and may be used for academic articles and conference presentations in pseudonymised form.
- If the research results relating to me are used in publications, or are made public in another way, any data which could potentially be used to identify me, will be pseudonymised in order to safeguard my privacy.
- My personal data (e.g. quotes from the interviews) will be accessible to researchers in the ySKILLS project. In case of joint publications, this data may also be made available to partner institutions or individuals who are not part of the ySKILLS consortium.
- I understand that I will not receive any payment for participating in the interview.
- I agree, fully and voluntarily, to participate in this research.

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have read the statements above and give consent to my participation in the interview.</td>
<td></td>
</tr>
<tr>
<td>I agree for the interview to be recorded for the purpose of data analysis and subsequent project-related publications.</td>
<td></td>
</tr>
<tr>
<td>I authorize the ySKILLS consortium to share my name and affiliation in ySKILLS publications to acknowledge my participation in the project.</td>
<td></td>
</tr>
<tr>
<td>In case quotes from my interview are selected for ySKILLS publications, I authorize the ySKILLS consortium to add my name and affiliation to these quotes.</td>
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Signed in duplicate:

Name: .................................................................
Date: .................................................................
Signature:
Work package 3: Educational experts’ interview

1 Conceptualizing digital skills
   1) According to you, what makes a person “digitally skilled”?

   2) In your view, how important (or unimportant) are digital skills for adolescents now and in the future (10-15 years from now)? Why?

   3) What digital skills do children, especially adolescents, need these days? You may think about different possibilities, such as digital skills to support learning, creativity, civic engagement, etc.
      a. You may also consider those beyond technical skills (soft skills such as communication, critical thinking, etc.)
      b. You may also consider learning in a broad sense, including formal, non-formal and informal learning experiences (e.g. formal ICT classes, coding camps outside school, talking about online safety with parents, learning about new videogames with friends, etc.).

2 Core skills needed in the digital age
   1) A document of cards will be sent to you during the interview. The cards contain different digital skills which are contained in the EC Digital Competence Framework 2.1 (DigComp 2.0)
      a. Read the cards (21 competences in total). Would you add any other digital skills to the current list of competences? If so, which ones?
      b. Select the 5 competences, including the ones you may have added, that you consider as the most important to be taught/developed at school. Rank them in order of importance.
      c. In your opinion, why are the selected skills more important than the rest?

   2) Think about 15 years from now. Probably new types of jobs will exist, and existing jobs may demand different skills sets. Which skills will adolescents need in the future to succeed in the workplace and be able to fully participate in society?

   3) Do you consider digital skills as important, less important or more important than non-digital skills such as literacy and numeracy?

3 The role of education in the development of digital skills
   1) Do you think that children’s development of digital skills is well supported in Finland?
      a. Is the current support/provision (good) enough?
      b. What works well? What doesn’t work (so) well?
      c. What is currently missing?
Appendix 2

2) In which way do children, especially adolescents, develop digital skills in Finland?
   a. You may reflect on both formal, non-formal as well as informal learning contexts. 
      *By formal education we mean the formal school system (i.e. primary, secondary and tertiary educational levels which lead to a diploma) and by informal/non-formal education any instance outside of schools which could offer children the opportunity to develop their digital skills (e.g. home, educational software, apps, TV programmes, after-school workshops or activities, etc.)*

   b. You may reflect as broad as possible, e.g.
      i. What types of activities help develop children’s digital skills?
      ii. From which age do children start developing digital skills in Finland? 
         From pre-school, primary school, secondary school, etc.?
      iii. Where are digital skills developed? At school? at home? Somewhere else?

3) Are digital skills explicitly covered by the curriculum in Finland? Tell us about it.
   a. Are digital skills taught in schools? Give us some concrete examples.
   b. Are there any important differences/gaps among different school levels (e.g. pre-school, primary and secondary school)
   c. Are there any important differences among different types of schools (e.g. public vs. private; technical vs. vocational; rural vs. urban; boys’ schools vs. girls’ schools, etc.)

4) What is necessary for children to develop adequate digital skills at school and out of school? 
   *Such as school infrastructure, knowledgeable teachers/adults/parents, teacher training, clear school policies/rules, after-school workshops, coding or ICT camps, workshops, awareness-raising, etc.*

5) Who is responsible for supporting the development of children’s digital skills in Finland? 
   *Try to identify all possible stakeholders/actors involved in this process (e.g. governments, ministries, schools, civil society, the industry, etc.)*

6) (For teachers only) How are teachers professionally developed to support the development of children’s digital skills in Finland?
   a. What kinds of experience in professional development of digital competence do you have?
   b. What motivate you to develop your digital competence as a teacher?
   c. What kinds of support do you need to develop your digital competence?

7) Do families/parents also support these efforts?
   a. Are families and/or parents motivated to cooperate with schools in this field? If so, how?
   b. Whether and to what extent do teachers and parents/carers discuss ICT education-related issues and have a dialogue about children’s digital skills and literacies? Who initiates these discussions more likely?
   c. Can you give us an example of school and home working together on digital skills development?
   d. To what extent is this kind of cooperation on the public and/or policy agenda? If not very present, what needs to be done to put/keep such cooperation on the public and/or policy agenda?
Appendix 2

8) The coronavirus crisis/emergency is affecting countries around the world in unprecedented ways. In your opinion, how is this crisis affecting the educational sector, in particular as regards the use of digital technologies for home-school communication and collaboration?

4 Digital skills education: Strengths, Weaknesses, Opportunities and Threats

1) In your opinion, what are Finland’s main strengths as regards digital skills education?
   
   Note: **Strengths refer to internal factors**, i.e. aspects which are under the control of educational actors, such as:
   - The current provision is universal. All children receive digital skills education through schools
   - The quality of the current provision is good
   - Highly qualified staff able to provide good quality education
   - Schools are interested in the topic
   - Schools have adequate infrastructure to support the development of digital skills

2) In your opinion, what are Finland’s main weaknesses or gaps as regards digital skills education?

   Note: **Weaknesses refer to internal factors**, i.e. aspects which are under the control of educational actors, such as:
   - The curriculum does not consider (the development of) digital skills
   - The current provision is not accessible to all, only children from certain schools or segments of society benefit from such programmes
   - The current provision depends on every school/region. Therefore, there are big differences in the offer and quality of digital skills education offered by different schools

3) In your opinion, what are Finland’s main opportunities as regards digital skills education?

   Note: As opposed to strengths, **opportunities refer to external factors**, i.e. aspects which are outside the control of educational actors, such as:
   - National, local, EU policies supporting and/or encouraging children’s development of digital skills (at school).
   - Good collaboration between external stakeholders and schools, such as the police, safer internet centres, the industry, etc.
   - Increased public media attention as regards digital-related issues (e.g. fake news, (online) radicalisation, GDPR, online risks, etc.) encourages schools and the educational sector to invest in children’s digital skills

4) Last, what are your Finland’s main threats as regards digital skills education?

   Note: As opposed to weaknesses, **threats refer to external factors**, i.e. factors beyond the control of educational actors, such as:
   - EU or national regulation, such as the GDPR, “scares schools” and make them limit the use of digital technologies, limiting also opportunities to learn or practice digital skills.
   - There are plenty of out-of-school opportunities available for children to develop their digital skills, but not all children can afford or have access to such opportunities.
   - Most of the out-of-school offer targets boys and older children. This limits the opportunities of girls and younger children to develop their digital skills.

5 Summing up

   From your experiences in working in the educational sector, is there anything you would like to add?
<table>
<thead>
<tr>
<th>Appendix 2</th>
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<tbody>
<tr>
<td><strong>Skills cards for Section 2 - Question 1</strong></td>
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</table>

<table>
<thead>
<tr>
<th>1.1 Browsing, searching and filtering data, information and digital content</th>
<th>1.2 Evaluating data, information and digital content</th>
<th>1.3 Managing data, information and digital content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyse, compare and critically evaluate sources of data and interpret and critically evaluate it.</td>
<td></td>
<td>Organise, store and retrieve data, and organise and process it in a structured digital environment.</td>
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</tbody>
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<table>
<thead>
<tr>
<th>2.1 Interacting through digital technologies</th>
<th>2.2 Sharing through digital technologies</th>
<th>2.3 Engaging in citizenship through digital technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Share data through appropriate digital technologies and know about attribution practices.</td>
<td>To participate in society through digital services; self-empowerment and participatory citizenship.</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>2.4 Collaborating through digital technologies</th>
<th>2.5 Netiquette</th>
<th>2.6 Managing digital identity</th>
</tr>
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<tbody>
<tr>
<td>For instance, through co-construction and co-creation of resources and knowledge.</td>
<td>To be aware of behavioural norms and cultural and generational diversity in digital environments.</td>
<td>Protecting data as well as one's own reputation.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>3.1 Developing digital content</th>
<th>3.2 Integrating and re-elaborating digital content</th>
<th>3.3 Copyright and licences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create and edit digital content, express oneself.</td>
<td>Modify, refine, improve, integrate information and content into an existing body of knowledge to create new, original and relevant content/knowledge.</td>
<td>Understand how copyright and licences apply to data, information and digital content.</td>
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<thead>
<tr>
<th>3.4 Programming</th>
<th>4.1 Protecting devices</th>
<th>4.2 Protecting personal data and privacy</th>
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<tr>
<th>4.3 Protecting health and well-being</th>
<th>4.4 Protecting the environment</th>
<th>5.1 Solving technical problems</th>
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<tbody>
<tr>
<td>Be aware of the environmental impact of digital technologies and their use.</td>
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<table>
<thead>
<tr>
<th>5.2 Identifying needs and technological responses</th>
<th>5.3 Creatively using digital technologies</th>
<th>5.4 Identifying digital competence gaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>To assess needs and to identify, evaluate, select, customise and use digital tools and possible technological responses to solve them.</td>
<td></td>
<td>Understand where one’s own and others’ digital competence needs to be improved or updated.</td>
</tr>
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</table>
# Final codebook

<table>
<thead>
<tr>
<th>Codes</th>
<th>Code Groups</th>
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<tbody>
<tr>
<td>Community of practice</td>
<td>Community of practice</td>
</tr>
<tr>
<td></td>
<td>Teacher autonomy</td>
</tr>
<tr>
<td>COVID-19 pandemic as accelerator</td>
<td>Community of practice</td>
</tr>
<tr>
<td></td>
<td>Teacher motivation to learn</td>
</tr>
<tr>
<td>DC: access and evaluation of information</td>
<td>Versatility of digcomp</td>
</tr>
<tr>
<td>DC: communication and interaction</td>
<td>Versatility of digcomp</td>
</tr>
<tr>
<td>DC: content creation and production</td>
<td>Versatility of digcomp</td>
</tr>
<tr>
<td>DC: daily life and survival skills</td>
<td>Versatility of digcomp</td>
</tr>
<tr>
<td>DC: internet safety knowledge</td>
<td>Versatility of digcomp</td>
</tr>
<tr>
<td>DC: learning to learn</td>
<td>Versatility of digcomp</td>
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<tr>
<td>DC: literacy skills</td>
<td>Versatility of digcomp</td>
</tr>
<tr>
<td>DC: media literacy</td>
<td>Versatility of digcomp</td>
</tr>
<tr>
<td>DC: nature: intertwined</td>
<td>Versatility of digcomp</td>
</tr>
<tr>
<td>DC: nature: versatile</td>
<td>Versatility of digcomp</td>
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<tr>
<td>DC: participation in society</td>
<td>Versatility of digcomp</td>
</tr>
<tr>
<td>DC: problem solving skills</td>
<td>Versatility of digcomp</td>
</tr>
<tr>
<td>DC: technical and operational skills</td>
<td>Versatility of digcomp</td>
</tr>
<tr>
<td>Digital savvy myth</td>
<td>Versatility of digcomp</td>
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# Appendix 4: Code co-occurrence table

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