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Korte, S-M and Körkkö, M and Maxwell, G and Beaton, M and Keskitalo, P and Hast, M and Kyrö-Ämmälä, O and Mommo, S (2023) Professional educators in the Circumpolar North: A model for the digital competence of future teachers. Arctic Yearbook. pp. 296-309. ISSN 2298-2418

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Professional educators in the Circumpolar North: A model for the digital competence of future teachers

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Abstract

This article is based on a study that considers future teachers' digital competencies in the Arctic education context with special attention to the necessary cultural and contextual dimensions of teachers' work. This study explored the professional competencies teachers require when teaching diverse and multicultural pupils in the Circumpolar North drawing on the multiple affordances offered by the digital world. Previous research draws attention to specific teaching and teacher competencies required for rural schools in the Circumpolar North considering the unique assets and characteristics of rural places in this region. This study presents a model of Digital Competence for Future Teachers (DCFT) that illustrates the competencies required by teachers in rural schools in the Arctic. Within the proposed model, four types of digital knowledge-based competencies necessary for holistic education were identified: *techno-cultural*, *intercultural*, *self-cultural*, and *micro-cultural*. The model was created through a process of analysis of existing models of teachers' digital competencies: MAP-, TPACK- and PEAT-models which are then reflected on the findings of an earlier international comparative multiple-case study by the same authors examining the sudden change to remote online teaching during the COVID-19 pandemic, and the Cultural Competence for Equity and Inclusion (CCEI) framework. Although the presented study focused on the Circumpolar North, the findings have implications for teacher education and policy production more widely in national and international educational environments.

Keywords: Learning in the 21st century, digital competencies, teachers' teaching skills, intercultural, Arctic, rural, future teachers

Introduction

This article builds on the findings from an international comparative multiple-case study (Korte et al., 2023) that examined the sudden change to remote online teaching during the COVID-19 pandemic, and an analysis of current theoretical models regarding teachers' digital competencies. The comparative multiple-case study (Korte et al., 2023) explores the crisis management experiences of teachers in the Arctic regions of Finland and Norway and in northern England and

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provides insights from the rapid changes to education provision during the early stages of the COVID-19 pandemic. Data for the previous study were collected in three different ways in three different rural and northern contexts: via an online survey of in-service teachers in Lapland, Finland (N = 164), and through semi-structured interviews with teachers in England (N = 20) and northern Norway (N=30). The cross-case analysis had two phases, of which the first focused on teachers' experiences of teaching and learning and the second on teachers' challenges.

The previous study's findings highlight technological, pedagogical, and psychological aspects of schooling, which must all be taken into consideration when preparing teachers for changing learning environments and possible future crisis situations. (Korte et al., 2023.) These findings are significant in the understanding and development of online pedagogy, practices, and pre- and in-service teacher education, so the future workforce will be better equipped and have the competence to face unpredictable future events. To achieve this, the study illustrated the kind of digital teaching skills needed in a post-pandemic world. In this study, the authors draw on findings from the comparative multiple-case study and consider these findings in relation to current models and the specific needs of educators in rural areas of the Circumpolar North. The Arctic regions are generally sparsely populated and have more rural than urban communities (Heleniak, Turunen & Wang, 2018). Even though rural communities have received increasing research interest in recent years, little is known about how teachers should be prepared to work in rural schools (Reagan et al., 2019). As a consequence, there is also a lack of models illustrating the competencies teachers need to work in rural schools. We see it as important to develop this kind of model because rural communities are specific environments requiring further attention. For the purposes of this study, we adopted Vijayarathan-R. and colleagues' (2022) definition of rural schools as those located away from more densely populated areas in the countryside, villages, or small towns; in other words, rural is viewed as a measure of geographic separation from metropolitan centres. Although we acknowledged that there is evidence of causal relationships between rural areas and poverty and a lack of services, this definition does not specifically address poverty and other socio-economic variables (Reagan et al., 2019).

Vijayarathan-R. et al. (2022) also suggest that a lot of teacher education is based on a metrocentric understanding of education provision. Instead, the authors call for a recognition that education, and teacher education in particular, needs to be based on an 'ecological understanding of teaching' (Karlberg-Granlund, 2019: 294) and that it must be underpinned by an awareness of the place in which education is occurring. One part of this ecological understanding is the notion that access to adequate digital learning is very uneven across the circumpolar north, for instance, Internet linkages and individual access to relevant equipment can vary widely. According to the 2017 Arctic Council report on telecommunications infrastructure, the Faroe Islands, Finland, Iceland, Norway, northwest Russia, and Sweden are more populated within the Arctic states and therefore frequently have access to a wider range of telecommunications infrastructure and services. The vast areas of the Canadian, Greenlandic, Russian, and American Arctic, on the other hand, have incredibly low population concentrations and frequently have limited access to telecommunications equipment and services. In seeking to address a lacuna within the current literature on teacher education for rural schools in the circumpolar north, Vijayarathan-R et al. (2022) identify three specific factors to be considered in the preparation and support of teachers to work in rural areas: teacher and teaching competencies and a high degree of self-efficacy. They also point to the need to be aware of the "social relations and cultural and political practices that are paradoxical, provisional, and constantly in the process of becoming" (Schafft & Jackson, 2010: 11) within rural schools.

Taking into consideration the need for an ‘ecological understanding of teaching’ (Karlberg-Granlund, 2019: 294) and having identified the need for awareness of ‘social relations and cultural and political practices’ (Schafft & Jackson, 2010: 11) in rural schools, the research team sought to examine the following research question: What teaching and teacher competencies with a specific focus on the digital domain are required to work in rural schools in the Circumpolar North? Even though we focused on rural schools, we acknowledge that this study has implications for teacher education more widely because all future teachers will need these skills despite their geographic and sociocultural contexts.

Digital competency and models that were analysed

Teachers’ digital competency

Competence can mean the quality or state of being competent, adequately or well qualified for a particular task, and the ability to do something well. Competence is, on the one hand, an important skill for certain jobs, and on the other hand, a standardized requirement for individuals to properly and efficiently perform specific jobs, such as teaching (Blömeke et al., 2015). When characterizing teachers’ competence, it is crucial to distinguish two elements: first, the concrete and evident actions teachers employ in their professions, such as teaching, and second, the knowledge, skills, and processes of perception, interpretation, and decision-making (including cognitive and non-cognitive competencies) that are critical for implementation but difficult for outsiders to determine (Weinert, 2001). According to Koster and Dengerink (2008), teachers’ competencies include a combination of knowledge, skills, attitudes, values, and personal characteristics that allow them to act professionally and effectively in particular teaching and learning situations.

Educators now need a larger and more complex set of competencies than ever before as they deal with continuously changing demands. Particularly, instructors must become digitally literate given the prevalence of digital devices and the need to support pupils in doing so. (Redecker, 2017.) Teacher competence therefore involves knowledge and skills and the potential to apply these in current situations and different contexts (Brynildsen & Hausbakken, 2023). Teacher competence will therefore include various forms of special educational information that teachers have acquired and systematized in education and professional practice (Cardona, 2009). Special educational knowledge also includes knowing how to acquire the necessary information and where to get help with special educational questions. With skills we can understand the use of practical special educational tools for teaching and for interacting with support systems.

The Organisation for Economic Co-operation and Development (OECD, 2005) states that ‘teacher quality’ (p. 2) is the single most important variable influencing student achievement. It is generally accepted that teacher retention is a critical issue in many geographically rural areas including in the Circumpolar North with Lazarenko and Shamarina (2019) highlighting the importance of improving the pedagogical training in rural schools to improve teacher retention. This importance is confirmed by Bjøru (2023) in highlighting three didactical tools key to working in small rural communities. However, Bjøru (2023) also notes the link between these didactical tools and the need for culturally responsive curriculum and social learning occurring in these same schools. Deep understanding of the pedagogical tools and culturally relevant curriculum are key to effective teaching and learning in schools in the rural north. Nasibulov et al. (2016) also highlight the need for teachers to reflect the culture of the community in which they work and consider the values and attitudes of that specific context. This includes an awareness of the need to be culturally and linguistically responsive to Indigenous and minority heritage languages as identified by Beaton et al (2023) in their comparison of Saami and Scottish Gaelic education provision.

Windsor et al., (2022) recommend that teacher education programmes strive to produce research-literate teachers who are welcomed by research-rich schools; although this is not always the case as seen for example in Norway where newly qualified teachers graduate with research competence but seem to be sent out into schools that operate under an experience-based learning model where teachers rely more on experience than taught knowledge (Jakhelln et al., 2019). It is the professional community in research-rich schools that provides teachers with the framework to collaborate on research and development (R&D) work in school. The terms express the importance of R&D competence in promoting the ideal of working in a knowledge-based manner and enabling R&D in everyday work in school (Furlong et al., 2014). Additionally, teachers who teach outside of their specialised competence – both as their academic subject and as being asked to do something new like teaching digitally – perceive that they are not specialists (Du Plessis, 2019).

How competencies are realized can be explored using theoretical models that represent the practical and contextual factors involved. Three models are now presented.

MAP-, TPACK- and PEAT-models

To investigate future teachers' competence, the research team analysed three models regarding teachers' digital competence. All these models are research-based and present teacher competence through non-hierarchical, relatively generic and interlinked elements. First, the team utilized the theory-driven Multidimensional Adapted Process (MAP) model of teaching developed by Finnish researchers in the context of Finnish research-based pre-service teacher education (Metsäpelto et al., 2021). Second, the team looked into Technological Pedagogical Content Knowledge (TPACK) model developed by Mishra and Koehler (2006) in the USA, and third the Pedagogical, Ethical, Attitudinal and Technological (PEAT) model developed by McDonagh, Camilleri, Engen and McGarr (2021) in the international project including universities from Ireland, Malta and Norway.

The MAP model is based on the research of Blömeke et al. (2015), which combined teachers' competence dimensions and the situation-specific skills used in professional practices at three different levels. In the model, the ultimate goal of teachers' activities is teacher effectiveness at the student-level regarding students' learning, motivation, and well-being. As Berliner (2001) and Klassen et al. (2018) stated, some attributes included in teachers' competence are specific to the educational environment and to cultural, social, and task-specific contexts, while other attributes are universal. Regarding online teaching, all dimensions of teacher competence are essential (Gess-Newsome, 1999). Our research focused on the knowledge base for teaching and learning, which in the MAP model includes teacher's *content knowledge*, *pedagogical knowledge*, *pedagogical content knowledge*, *practical knowledge*, and *contextual knowledge* (Metsäpelto et al., 2021). We examined the MAP model because it is firmly based on wide research literature on teacher competence summarizing the most universal, including cognitive, motivational, social and emotional dimensions of teacher competence. Moreover, the strengths of the MAP model include that it presents teacher competence as a continuum from individual competencies to actual teaching and student outcomes. Through including situation-specific skills, the model illustrates the essential link between teacher competence and visible practice. Moreover, the model includes social aspects of teacher professional community suggesting that application of competence is affected by the contexts where teachers work. Finally, the MAP model considers that teachers can learn from their experiences through reflection which affects the development of their competence. One shortcoming of the MAP model is that it entails rather detailed descriptions of different competence areas and might therefore be even too prescriptive and limited in terms of innovating practice. Moreover, digital competence as such is not included in the model and therefore, we see

it as essential to create a new model in which this aspect is a more visible part of teachers' competence repertoire.

As a result of the rising pressure on schools and teachers from governmental organizations and society to become more digitally competent, there are many frameworks for teacher digital competence that aim to support teachers in integrating digital technologies to their pedagogical practices. We therefore investigated the Technological Pedagogical Content Knowledge (TPACK) framework designed by Mishra and Koehler (2006) and further developed by Koehler and Mishra (2009) and Koehler et al. (2014) as it also includes *technological knowledge*, which we see as crucial for future teachers' digital competence. The TPACK model has been utilized particularly in research and development pertaining to technological pedagogical competence and its development among pre-service and in-service teachers. The current research adds to previous TPACK studies that have concentrated on the evaluation and development of the TPACK model and its competencies (Chai, Koh & Tsai, 2016; Sointu et al., 2016). The paradigm suggests that teachers must possess relevant content knowledge (CK), regarding subject matter, pedagogical knowledge (PK) regarding teaching and learning methodologies, and technological expertise in order to integrate technology into the classroom effectively (TK). Additionally, they require understanding of the interfaces between these components, as the TPACK model is made up of technical content knowledge (TCK), technological pedagogical knowledge (TPK), pedagogical content knowledge (PCK), and technological pedagogical content information (Mishra & Koehler, 2006). The TPACK model was chosen because it has been extensively employed in studies of teacher digital competence (Abell, 2008; Korte et al., 2022; Kyllönen, 2020). The model has contributed significantly to the theoretical and practical field of education by illustrating relationships between teachers' knowledge highlighting the integration of digital technologies, teaching, and learning. One advantage of the TPACK model is that it presents relatively generic knowledge areas which leave room for contextual interpretations. The disadvantages of the TPACK model include that it lacks especially ethical, social, and attitudinal dimensions of competence and thus, it is rather cognitive in nature and is somewhat disconnected from teachers' actual practice and context. Moreover, because the model was developed in the early 21st century, the model fails to consider sufficiently the changing realities of the digital world today. Therefore, for instance Falloon (2020) has added personal-ethical and personal-professional competencies to the model, the former indicating cyber ethics and digital safety and the latter teacher information literacy and involvement in online professional networks.

Further, we looked at the PEAT model, acronym for Pedagogical, Ethical, Attitudinal and Technological, that includes key dimensions of existing models of teacher digital competence (McDonagh, Camilleri, Engen & McGarr, 2021). In a dynamic digital culture, digital knowledge for teaching and learning is the basis for developing future teacher education. For example, McDonagh et al. (2021) conducted a comparative study of models of teachers' digital competence based on a comprehensive review of existing competency frameworks. It presents all dimensions as equally important. The technical dimension refers to teachers' understanding and skills of using various technologies. The pedagogical dimension compounds with teachers' general pedagogical skills meaning teachers' ability to choose pedagogically appropriate technologies for their teaching and integrate them to their practice. The ethical dimension covers issues related to cyber ethics, such as online privacy, data security and online safety, while the attitudinal dimension means teachers' general attitude towards using digital technologies in education highlighting especially critically engaged attitude. Finally, we considered the PEAT model suitable for the theoretical basis of our study because this model has successfully included those dimensions of competence that previous models of digital competence have ignored, these are ethical and attitudinal dimensions,

that are essential to take into account in the work of teachers today. Another advantage of this model is, according to its creators, that it allows a wide contextual interpretation because it is generic and does not set detailed lists of aspects for each competence. Thus, the model is flexible and applicable to be used by teachers and teacher-educators regardless of their levels of familiarity with the digital milieu. However, even though the PEAT model allows contextual variations, contextuality is only implicitly present in the model and therefore this aspect should be emphasized.

In summary, we see that the above-described models, even if they are all linked to teachers' competent practical work, are still missing cultural and linguistic dimensions, which can be regarded as essential elements in promoting a culturally responsive approach to education. Online education may not be compatible with Indigenous cultures' practices of observational learning. Online education might not support Indigenous knowledge systems and could be challenging for those with diverse learning traditions. For example, the Inuit Qaujimaqatuqangit (IQ) is learned spontaneously over time and through observation, training, and experience in Inuit culture, in contrast to western educational systems (Sadowsky et al., 2022).

Therefore, after pondering the advantages and disadvantages of the three chosen models, we next present the process of developing a new model for teaching skills and its relations to the three models and our previous comparative study, with a particular focus on the requirements of teachers working in rural areas within the Circumpolar North.

Analysing teachers' pedagogical digital competencies

Teacher competence can be described as “an integrated unit of doing, knowing, reflecting and being. To do shows practical skills, while knowing refers to knowledge in educational subjects, as well as in subjects and subjects taught in primary school” (Brekke, Bjarnadóttir, & Søndena, 2008: 10, authors' translation). In addition, the teacher's ability to reflect on his or her own educational activities and perceptions is emphasised, both in the classroom and in the school context.

Although new models of teachers' digital competence have been developed, there is a need to construct empirical-based models to capture the richness of digital competence and to inform the development of culturally responsive teacher education. The research team was particularly interested in the digital competence of teachers in rural areas and the kind of support teachers needed to continuously develop their competence. We reflected on the findings of the empirical study by Korte et al. (2023) and the particular contextual factors of the circumpolar North to underpin a holistic view of teachers' digital skills. Based on the findings, we first developed a framework of the dimensions of teaching skills (DOTS; Figure 1). We focused on online teaching, and on the teacher skills that are crucial for teaching remotely. The results of the three case-studies corroborate the findings of a previous study showing that teachers lack adequate technological pedagogical content knowledge for applying technology to certain teaching contexts in ways that support students' learning (Koehler & Mishra, 2009). This framework can be used to reflect on the various skills and competencies necessary to perform effectively in the teaching profession.

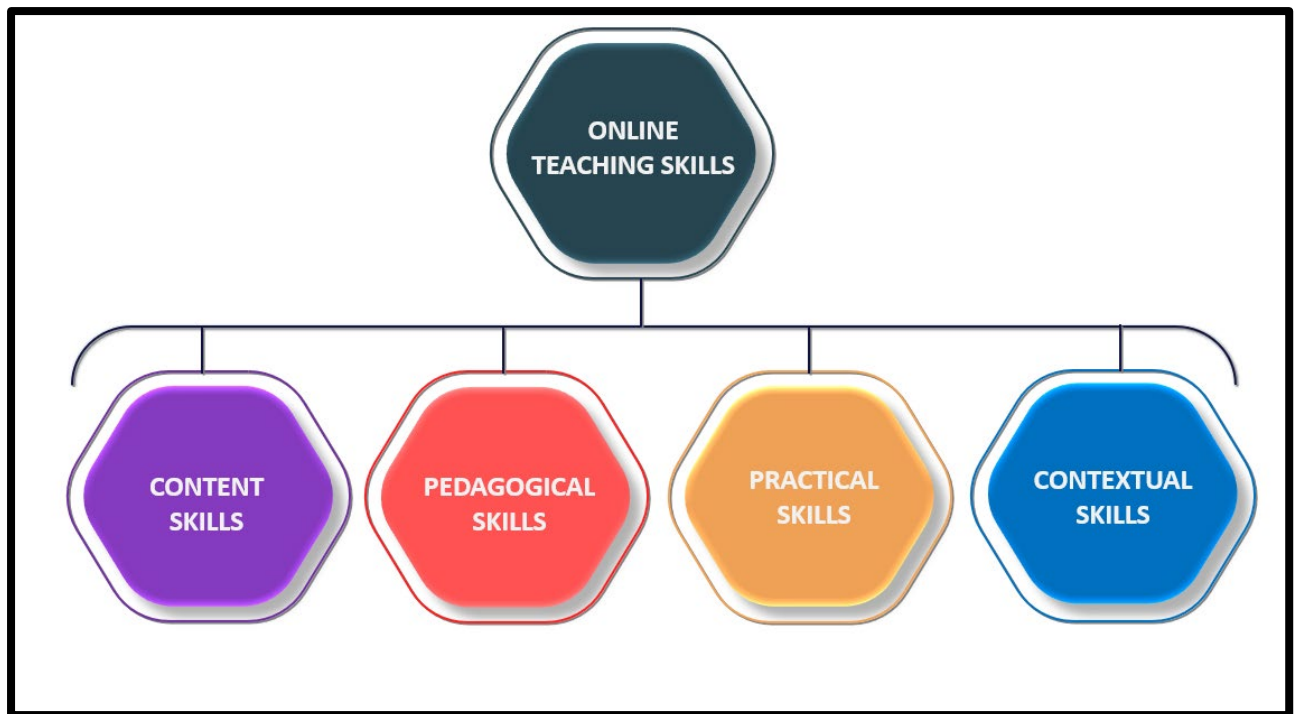


Figure 1. Framework of dimensions of online teaching skills (DOTS).

The DOTS framework consists of four skills: content, pedagogical, practical, and contextual. First, teachers need to consider what they teach and what they want students to learn, which relates to teachers’ content skills. Second, teachers’ contextual skills include skills in using digital tools as well as situational awareness and flexibility. Third, practical skills encompass the capacity to plan teaching and to teach at the individual and group levels in synchronous, asynchronous, and hybrid situations. Fourth, teacher’s pedagogical skills include planning students’ work and identifying various working methods that affect teaching, learning, assessment, and reflection. However, during the analysis, it became apparent that the framework lacked a digital competence dimension. The results of the reflections on the empirical study (Korte et al., 2023) guided the authors to the next phase, in which three different models regarding teachers’ competence were examined. This resulted in the development of the model of Digital Competence for Future Teachers (DCF_T, figure 2), so that the prerequisites for dynamic digitalization are firmly embedded in future teacher education programs and education policies. In this research phase, which focused on progress in digital knowledge areas through the meta-analysis of the models, we developed a holistic view of teachers’ skills that concern technology use in online and classroom teaching. The starting point of the theoretical model is the teacher’s knowledge base for teaching and learning (cf. the MAP model), their technological-pedagogical-content knowledge (TPACK) and their knowledge of the interconnected dimensions of pedagogical aspects, ethical aspects, attitudinal aspects and technical aspects (PEAT).

For university professors, offering high-quality instruction and adjusting to the requirements of shifting student populations have become new problems as a result of the increasing digitalization of the education delivered by higher education institutions. Teachers now need to acquire a new set of pedagogical competencies that we have named “Pedagogical Digital Competence”(PDC) because of how much digitalization has changed teaching. This article seeks to discuss and characterise this new dimension using texts and ideas from related fields. We do not do a thorough literature review because our goal is to define a notion; instead, the conversation is theoretical in

nature. As a consequence of the discussion, the term "PDC" is defined as follows: "Pedagogical Digital Competence refers to the capacity to consistently use the attitudes. (Jorgen, 2017.)

A model for the digital competence of future teachers (DCFT)

Future-oriented teacher education and studies that support teachers' competence should be constructed so that they form the basis for a teacher's lifelong learning in a digital transformation context. As the study by Korte et al. (2023) revealed, teachers perceived practical and contextual knowledge of digitalized teaching and learning as problematic. Whether this relates to online learning or a general change in learning toward digitalization, teacher education should develop new culturally responsive competencies for future teachers. The competence of the teacher of the future is built on digital knowledge, skills and experiences with cultural dimensions, due to learners' diversity. Cultural competence can be looked at from the perspective of culture which refers to the contextual background and from the perspective of competence which refers to the required abilities of the teachers. Furthermore, the ability to successfully live and work in culturally diverse situations and to uphold a commitment to equality and inclusion is characterized by the Cultural Competence for Equity and Inclusion (CCEI) framework (Goodman, 2020), which is important in today's diverse classrooms. Cultural competence gives people the skills and situational awareness that supports their constructive engagement with others from various socio-cultural backgrounds (Goodman, 2020). The CCEI framework by Goodman (2020) incorporates five interconnected core components; self-awareness, understanding and valuing others, knowledge of societal inequities, interpersonal skills to effectively engage across differences in different contexts, and skills to foster transformation towards equity and inclusion. As dimensions of culture, our research identified four types of digital knowledge-based competencies necessary for holistic education; *techno-cultural, self-cultural, micro-cultural and intercultural*—that are explained in the model in Figure 2.

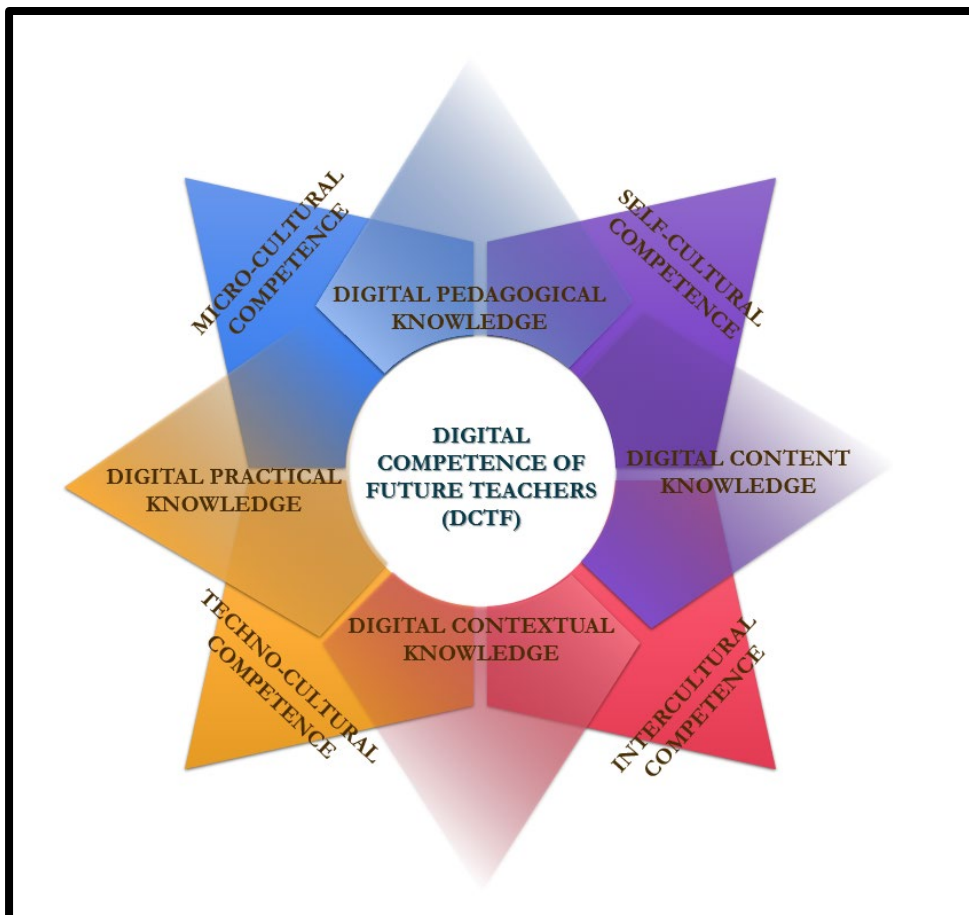


Figure 2. A model for the digital competence of future teachers (DCFT).

Firstly, *techno-cultural competence* includes digital practical knowledge and digital contextual knowledge. The digital practical knowledge is part of technological competence, and in order for teachers to acquire this knowledge, teacher education must include systematic practice of digital skills as part of curriculum. Digital contextual knowledge, in turn, involves the development of an effective digital culture in teaching and learning, which has implications for schools' ability to manage technological change. This is influenced by the school's resources to collaborate in the digitalisation of teaching and learning. In order to successfully manage the digitalisation of teaching and learning, future teachers need to acquire knowledge both at the school level and at the wider societal level.

Secondly, self-cultural or self-contextual means that future teachers need self-awareness and awareness of their social identities and cultural influences to be competent in context-aware digital culture and content production (Goodman, 2020). Development in teachers' digital pedagogical competence with a focus on *self-cultural competence* will create teachers of the future with knowledge on how to combine the potential of technology with their own pedagogical expertise in learning and teaching. However, for this to be achieved one needs to be aware of one's own culture and conscious of one's self-identity, and have the ability to self-reflect. To understand other cultures, teachers need to first understand their own culture and how one interacts with one's own surroundings.

Thirdly, corollary to self-cultural competence, one needs also to be aware of others' perspectives, cultural backgrounds and social identities (Goodman, 2020). Hence, *micro-cultural competence* means that for teachers to be digitally and pedagogically competent, they need firstly knowledge of the social identities of the learners of their classroom, how their cultural influences intersect and how the societal inequalities appear in this context (Goodman, 2020). Then, this is combined with practical knowledge of how to guide and support pupils using a variety of digital applications. This competence encompasses the ability and competence to guide the social and psychological process of learning, taking into account the diversity of the learners and picking up nuances within the learner group, and informal interpersonal relationships.

Fourthly, future educators need to have *intercultural competence* which includes skills to engage and communicate across individual, cultural and societal differences (Goodman, 2020), and contextual and content knowledge to facilitate the digital competence required for technology-mediated teaching. Future teachers need contextual and situational knowledge to enable them to adapt the digital content delivery according to the needs of the learners. With the growing cultural diversity of student populations, providing intercultural learning opportunities develops appreciation and understanding of one's own cultural heritage as well as those of others. Subsequently, the learners develop cultural sensitivity and become more confident in cross-cultural encounters and intercultural communication.

The above mentioned four competencies have the power to foster transformation towards equity and inclusion (Goodman, 2020) also in the classroom. The competencies relate to how the teacher manages the classroom and creates the group's learning culture, or learning environment, where micro-cultures and individual diversity co-exist. The teacher is responsible for creating the general learning environment, but also many small learning environments according to the subject or topic of learning, whether it is in a classroom or online, whether it is physical or digital. All in all, the recent shift towards use of digital tools in teaching and learning has necessitated to acquire the new digital skills relating to managing the four culture-related competencies mentioned in DCFT.

Discussion and Conclusion

We developed the DCFT model based on the MAP, TPACK and PEAT models, CCEI framework and an empirical study. We acknowledge that this model, although comprehensive, is limited in many ways. Because only three former frameworks were used as a theoretical basis, some relevant aspects of teachers' digital competence may be missing. A broader use of the theoretical literature could have led to a different model (cf. McDonagh et al., 2021). From previous models MAP highlights the significance of practice and reflection, whereas TPACK and PEAT attribute different digital competencies, which guided the authors to look for a framework that takes into account the diversity of individuals. This was achieved in CCEI, which, in turn guided the authors to propose the Techno-cultural, Intercultural, Self-cultural and Micro-cultural competencies proposed in the DCFT model. Dockett and Perry (2023) highlight the need to recognise the distinctive language and culture, local communities, demographic changes, and educational policies affecting the provision of education in the north. These distinctive features require a distinctive set of competencies identified within the model. The DCFT model introduces a new way of approaching teachers' digital competence as cultural competence, highlighting that teachers' competence does not mean mixing different knowledge and skills but dealing with a wider digital culture.

Furthermore, strengthening digital skills of teachers impacts positively also on the quality of distance and online education and thereby on the digital competence of learners. The COVID-19 pandemic has changed education delivery permanently because many practices learnt during the lockdown will continue to be utilized in face-to-face teaching. We now know that using the digital competence developed during the pandemic permitted many young people to take responsibility for their own learning (Hattie, 2009); this is especially important in small rural schools that may be alleviated by the affordances provided by digital provision. In the long run, distance and online education can contribute to educational equity through use of information technology and communication to mitigate some of the drawbacks that rural schools face (Howley et al., 2011). Examples include for young people the opportunity to learn Indigenous and minority heritage languages in culturally responsive ways (Helander et al., 2023).

Development of education in rural areas is negatively impacted by the slowed inclusion of technology and the lower average levels of education and skills in rural areas. In this area, general policies ignore particular local requirements. Contrarily, rural areas are the least connected and included, despite having the greatest need for increased digital connectivity to make up for their isolation. Therefore, to create "customised policies" for underdeveloped and digitally excluded rural populations, future research should concentrate on specific locations and communities, merging connectivity and inclusion challenges (Salemink et al., 2017.)

This article may be of interest and use to other Higher Education Institutes, particularly those that provide teacher education. In consideration of the distinctive nature of the North in this article, we recognize within national and international educational environments that the findings can be applied to the development of teacher education as well as policy. Despite the study's emphasis on the circumpolar North, there are worldwide ramifications, such as decolonizing teacher education and education in general. Future teachers should be prepared to teach in culturally responsive ways which require that dimensions of the DCFT model are considered and applied both in pre-service and in-service teacher education. Furthermore, the findings of this article have implications that can be of significance for teacher education particularly focusing in rural education delivery. With the help of the DCFT model it is possible to contribute to teacher education that provides future teachers the competency to teach in ways that addresses the

structural and geographical challenges, such as long distances, for education in the Circumpolar North (Bain et al., 2017; Óskarsdóttir and Wozniczka, 2023).

New research could enrich and widen the areas of teachers' digital competencies. The DCFT model could be used as a basis for new survey instruments and other data-collection procedures that could focus on testing the DCFT model to study teachers' digital competence in both pre-service and in-service contexts in different national settings. The next phase of developing the DCFT model should include a deeper reading of existing theoretical frameworks to capture the complex nature of teachers' digital competence. Moreover, there is a need to closely examine relationships between different components of the DCFT model because even though its various aspects are interconnected, they may define teacher competence in different ways. It is also recommended to collaborate with other Higher Education Institutes in similar contexts in order to share and strengthen the knowledge about their strengths and weaknesses, share good practices, and find solutions to their common challenges. Besides digital competence it is essential to also study teachers' forms of enacting this competence in various educational contexts because no model can describe how teachers apply their knowledge and skills, and thus, ready-made models cannot reach the complexities of teacher everyday work. This kind of socio-cultural perspective brings teacher agency to the front, highlighting that teachers have an ability, through negotiations, to enact different practices and activities in their working contexts and through that perform and 'do' their digital competence (see also Brynildsen & Haugsbakken, 2023). In its current form, the DCFT model is theoretical, and it might be difficult for educators to apply it to practise. Therefore, further development of the model includes piloting the framework and collecting data from practitioners and teacher educators, so that practical recommendations and guiding questions on how to consider the dimensions of the model in daily work as teachers can be offered.

In this article, the authors draw on findings from the comparative multiple-case study and consider these findings in addition to analysing previously presented models in relation to the specific needs of educators in rural areas in the Circumpolar North. The article has taken into consideration the ecological understanding (Karlberg-Granlund, 2019: 294) and social and cultural (Schafft & Jackson, 2010: 11) aspects of education in rural schools. By exploring what teaching and teacher competencies with a specific focus on the digital domain are required to work in rural schools in the Circumpolar North, the experience of the rapid shift to online teaching prompted by the COVID-19 pandemic created an opportunity to truly continue developing educational practices and benefit from lessons learnt from the pandemic. We support continued research in rural and Arctic teacher education that builds on the complexities of the cultures and locations, fostering understanding of the contexts and drawing links throughout the continuum of teacher learning in studies on rural teacher education.

Acknowledgements

This research was supported by an international cooperative project – DistARCTIC: Distance Teaching and Learning in the Arctic Communities – financed by the Danish Agency for Higher Education and Science; eLapland - Digital solutions - financed by the European Social Fund (ESF) and Programme for Sustainable Growth and Work Centre for Economic Development, Transport and the Environment, Northern Ostrobothnia; Eudaimonia Institute, University of Oulu, Finland.

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