Teachers' Technology-Enhanced Remote Teaching Competency in an Arctic Ubiquitous Pedagogical Context

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ABSTRACT

This article presents the findings of a survey (N = 35) conducted among teachers working above the Arctic Circle in Northern Finland, specifically in the Sámi Domicile Area educational institutions (the Utsjoki, Enontekiö, Inari, and Sodankylä municipalities). The survey's goal was to determine what types of premises instructors worked in when working in online environments, as well as what types of developmental needs they indicated. The survey was designed around a technology integration framework that focuses on and combines technological, pedagogical, and content knowledge, and technological-pedagogical content knowledge (TPACK) by Mishra and Koehler for the effective and meaningful integration of technology in teaching and learning activities. The findings suggest that digital education is still being implemented at a variety of levels in Northern schools and that greater efforts should be made to ensure that appropriate techniques and equal learning opportunities are available to all students.

KEYWORDS

Arctic Educational Context, Remote Teaching, Teacher Competency, Technology-Enhanced Pedagogy

INTRODUCTION

This article presents the findings of a survey conducted by the Arctic Pedagogy II project (2019–2021), which aimed to strengthen educators' technology-related teaching skills. The Arctic Pedagogy II project was hosted by the Sámi Education Institute, Inari, Finland, with collaborators from the University of Lapland and primary and vocational schools in the Sámi Domicile Area in Northern Finland covering the Utsjoki, Enontekiö, Inari, and Sodankylä municipalities. The project was timely, as the COVID-19 pandemic broke out in 2020 when the project was halfway through its activities. The project covered three Sámi languages spoken in Finland: North, Inari, and Skolt, all of which are endangered according to the UNESCO criteria. The Sámi Education Institute has developed Sámi language distance education for decades and actively promotes the use of Sámi languages by providing

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support and education in digital pedagogical solutions and platforms for teaching through different kinds of projects and activities to ensure that any person who wants to learn Sámi can do so regardless of their geographical location. In the academic year 2020 to 2021 in Finland in the Sámi Domicile Area, the number of children attending basic education in Sámi language classroom teaching (L1) was 185, and 254 children took it as a second language (L2). Outside of the Sámi Domicile Area, 222 students study the Sámi language as an extracurricular activity (Sámediggi, 2020). Sámi education is an Indigenous educational science that seeks to enhance knowledge of Indigenous languages, content, knowledge, and methods within both formal and non-formal educational systems (Keskitalo et al., 2013; see also Keskitalo et al., 2019, 2020).

The aim of the Arctic Pedagogy II project was to determine the development needs of Sámi teaching personnel regarding their digital pedagogical competencies in the Sámi Domicile Area in the Arctic in the context of long distances that create certain concerns and challenges in culturally and linguistically diverse educational contexts. The project created a survey in which the situation of teaching personnel could be investigated to guide the planning of forthcoming supplementary courses and innovative activities involving digital technologies in a pedagogically meaningful and deliberate way. This article presents this survey's findings, which are unique, as similar surveys have not been conducted on such a large scale in the small community of Sámi people in Finland. This study is an important opportunity for the development of Sámi online teaching and learning for the revitalization of endangered Sámi languages, particularly in the four countries in which Sámi people live: Finland, Sweden, Norway, and the Kola Peninsula in the Russian Federation. Furthermore, the findings of this study will serve as useful pointers for improving the online teaching and learning practices of any Indigenous or endangered languages around the globe.

The project started in the first stages of the COVID-19 pandemic, so it was in a key position to support schools at the beginning of school closures by providing in-service teachers with supplementary education on digital tool use and digital pedagogy. Education was provided and designed according to educational needs and fitted into the working life that considers lifelong learning with different backgrounds of learners regardless of their age, education, and living area. The project created support measures for teachers so that they could provide education for their students through different kinds of platforms in different studies and education levels in primary, basic, and vocational education.

The Arctic Pedagogy II project was a continuum to the first project that aimed to educate teachers to build a permanent network for them to work in the Sámi Domicile Area. The aim of the survey was to determine the state of technological tool use and technological pedagogy in Sámi teachers' work and how to proceed based on the survey findings. The survey was conducted in the Sámi Domicile Area, which has a special role in Sámi language education in Finland. The schools located in this area need to provide most of their teaching to Sámi-speaking children in the Sámi language. Outside of this area, regulations are different, as Sámi language teaching is provided for only a few hours weekly as an extracurricular online activity. This is problematic on many levels, as resources, competent teachers, and support are lacking (Arola, 2020).

This study sought to provide insights into in-service teachers' technological and technological–pedagogical competency and their development needs in relation to technology-enhanced teaching and learning through the following research questions:

1. How do teachers in the northernmost areas of Finland assess their technological knowledge (TK) skills?
2. How do teachers in the northernmost areas of Finland assess their students' TK skills?
3. How do teachers in the northernmost areas of Finland assess their technological–pedagogical knowledge (TPK) skills?

The study aimed to provide knowledge on what technological–pedagogical issues should be highlighted in diverse linguistic settings in education and what kinds of gaps exist.

THEORETICAL FRAMEWORK

In this paper, technology-enhanced education has been researched from the teacher's perspective. The technological–pedagogical content knowledge (TPACK) framework provides a holistic view of the skills that a teacher needs for effective technology integration in educational settings by combining TK, pedagogical knowledge (PK), and content knowledge (CK) (Koehler & Mishra, 2009; Mishra & Koehler, 2006), providing a fitting framework for this study. The three knowledge areas overlap, producing further knowledge areas that integrate two of the areas in the following way: TPK combining technological content knowledge (TCK) and pedagogical content knowledge (PCK). At the very core of the framework, all three basic knowledge areas are combined into TPACK. CK is knowledge about the content of a topic being taught, what the topic is, and the extent to which it is covered. CK defines what kind of competence is expected of a teacher and, for example, the extent of technology integration. PK includes knowledge and experience of teaching and learning processes. PCK is information related to the subject being taught, pedagogical information about teaching the subject, and the methods best suited to teach the subject. Both PK and PCK consider the students' existing levels of knowledge and skills, as well as the curriculum objectives. TK refers to information related to the use of technological equipment. It is the ability to use digital tools and apply them in one's work when the use of technology contributes to the achievement of teaching goals. TCK is information about the use of technological devices, programs, and applications in the teaching of a particular subject. The teacher should be able to evaluate which technologies best support teaching and learning in the subject area and how technology enhances or limits learning. TPK refers to knowledge and understanding of the opportunities that technology offers for teaching and learning and the limitations it brings, such as information about the technological tools and pedagogical models suitable for teaching the chosen subject (Koehler & Mishra, 2009; Mishra & Koehler, 2006).

The TPACK model has been used especially in research and development related to the technological–pedagogical competence of teacher students and its development, as well as in research on the competence and competence development of in-service teachers. Previous TPACK studies have focused on the model, its testing, and its conceptualization (Chai et al., 2016; Sointu et al., 2016). Some studies have focused on measuring study participants' various TPACK competences (Lee & Tsai, 2010), whereas others have focused on developing interventions with the objective of enhancing teachers' competences (Koh et al., 2017; Kyllönen, 2020). Research has also been conducted on contextual, such as multicultural, factors related to the TPACK model (Kelly, 2007). This study was interested first in teachers' TK to establish teachers' situations with digital tools in their work and second, particularly in their TPK, with the objective of investigating teachers' abilities to take advantage of digital tools to support their pedagogical practices and provide meaningful technology-enhanced teaching. Through this knowledge, the ultimate aim is to design targeted solutions that take advantage of technology-enhanced pedagogies.

METHODOLOGY

Study Context and Respondents

The online survey was conducted in three Sámi languages and in Finnish, and sent to all Sámi Domicile Area teachers. Responses were received from 35 individuals in Sámi education, of whom 51% work in Inari, 23% in Enontekiö, 14% in Utsjoki, and 12% in other municipalities. Considering the number of learners, the number of responses was good. Recent similar studies were not found for comparison. The respondents work as teachers in early childhood education (11%), primary education (54%), secondary education (26%), upper secondary or vocational education (25%), and mixed groups at various education levels (34%), or a combination of these. Additionally, the respondents were encouraged to send the link to the online questionnaire to any Sámi teachers who had not received the invitation. Furthermore, a link was sent to the Sámi Parliament's Educational

Office so that they could distribute the link to the questionnaire to Sámi teachers outside of the Sámi Domicile Area. The teaching language was Finnish for 74%, Northern Sámi for 43%, Skolt Sámi for 9%, and another language for 6% of the respondents. Forty percent of the respondents speak Northern Sámi at least fluently, 26% speak Inari Sámi at least at an intermediate level, and 11% speak some Skolt Sámi. Half (51%) of the respondents had completed a degree or studies in the Sámi language, most typically (25%) over 60 credits, while one-fifth (17%) had completed 15–60 credits, and 10% had completed 1–15 credits.

Almost one-third of the respondents (29%) had been working for less than 5 years, almost one-third (29%) for 6–10 years, a fifth (20%) for 11–20 years, and almost a quarter (23%) for over 20 years. A majority (66%) were working under permanent employment contracts, while 34% had fixed-term contracts.

Method

The data were collected through an online questionnaire since the Sámi teachers are few, live mostly in remote areas, and provide lessons to students who may be over 1000 kilometers away. The questionnaire was provided in Finnish and the Northern Sámi, Skolt Sámi, and Inari Sámi languages, so that the participants could respond in the language that was most comfortable for them to use and the researchers would receive as much information as possible. Participation in the study was voluntary, and the participants were informed that the information would be used for research and development purposes. The questionnaire focused on the participants' TK and TPK skills with questions using a 5-point Likert scale (1 = totally disagree and 5 = totally agree) and multiple-choice and open-ended questions. TK skills were investigated using 9 Likert-scale questions, 2 multiple-choice questions, and 8 open-ended questions. TPK skills were determined with 7 Likert-scale questions, 1 multiple-choice question, and 18 open-ended questions. The analysis of the quantitative survey data was conducted using the Statistical Package for the Social Sciences (SPSS); however, deeper analysis of correlations was not meaningful due to the small amount of data, nor was it possible to make statistically significant or generalizable conclusions. Hence, only the distribution of the answers was examined. In the analysis of the qualitative responses, we used theoretical framework-driven analysis themed according to TK and TPK aspects; questions related to the knowledge of using technology were considered to belong to the themes of TK, and questions related to the knowledge of pedagogical use of technology were considered under the themes of TPK.

FINDINGS

RQ1: How do Teachers in the Northernmost Areas of Finland Assess Their TK Skills?

Overall, the findings indicated that teachers felt proficient in general computer and program usage. Slightly more than half (54%) of the respondents reported having good or excellent information and communication technology (ICT) skills (Figure 1). Some 9% reported having weak skills. A more detailed question regarding specific skills (see Figure 1) revealed that nearly all respondents regarded their information search (97%), email (97%), and Microsoft Office applications (85%) skills as at least intermediate.

In contrast, a third of the respondents (Figure 1) reported a lack of skills in touch typing, learning applications, and mobile-mediated learning. Programming was the weakest among the investigated skills (54% of respondents reported weak or no skills).

Most of the respondents reported having a solid knowledge of the Windows environment and the use of smartphones as educational tools in lesson planning (Figure 2). The respondents were divided in terms of their social media skills: 45% had good knowledge of the integration of social media in

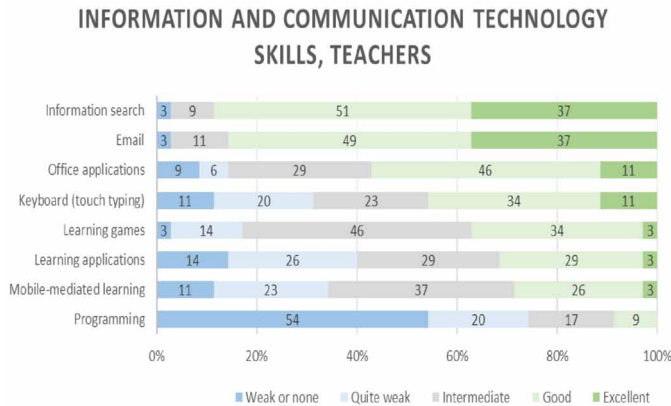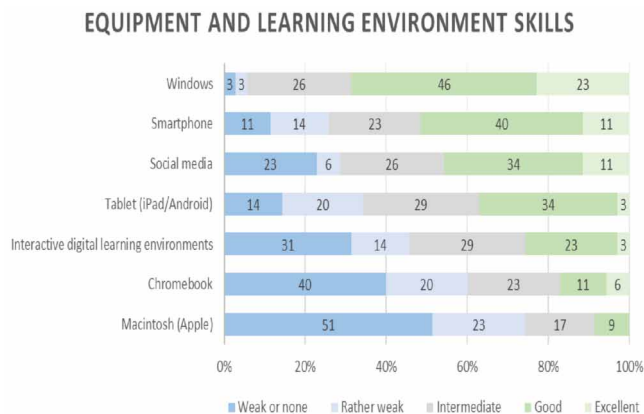Figure 1. Teachers' information and communication technology skills

Figure 2. Equipment and learning environment skills

teaching, while a third (29%) of the respondents reported having weak or no skills in the area. The respondents were less familiar with the ChromeBook and Apple environments.

Regarding teaching applications, the respondents mentioned Google Earth, Quizizz, Quizlet, iMovie, StopMotion, Green Screen, Bee-bot, ThingLink, Trello, Mojikello, Vektor, and Ekapeli, as well as Google services. Tablets were mentioned as effective, especially with small children. The utilization of mobile technology had been challenging because not all students had smartphones. The respondents also reported challenges with Adobe Connect, services provided by publishers and online learning platforms, and Chromebooks (because of a lack of Flash support). Only one respondent reported experience with virtual reality (VR), augmented reality (AR), or mixed reality (MR) in the workplace, while most respondents did not know what they were.

The respondents reported their experiences with equipment and electronic learning materials as follows:

"Teams and OneNote together make up an excellent digital staffroom (an electronic staffroom)."
"Information and communication technology makes teaching more versatile. It may help students to remember things when they are presented with information in many different ways, such as sounds,

pictures, games, text, video, etc. It is also a way to make teaching more interesting when it is not just books."

"Positive. Usually, it is a way to get students excited, even about something more boring."

Negative experiences were also reported:

"Good and bad. There is always an issue with the technology and the settings, and it takes a lot of time to figure that out for a student. The limited number of tools and the fact that the students can't use them at home or when they're out on the fell, where there's no Internet."

Regarding cloud services, 60% of the respondents typically used them in their teaching for giving assignments, working online, and submitting assignments (e.g., Google Drive). The respondents' educational institutions typically used Google Drive, Peda.net, Microsoft 365 services, and learning games (see Table 1). The advantages of cloud services are as follows:

"... Students submit assignments to a Drive folder, work together on projects on Drive, etc.

I use it every day. Giving assignments, working online, sharing. Instructions with pictures at first. Inspiringly brief—it is easy to get students practicing."

"Google Drive, file sharing, messages, presentations, submitting essays, cooperation in group/ research projects."

"I often use, e.g., Google Docs with my students, where we can work on a text simultaneously. I find it useful that I can save files there and share them as links to absentees, for example. That way, everyone is able to follow lessons, even on their home sofa, with a smartphone."

Cloud services were regarded as useful and necessary almost without exception, although practical problems had also been observed. The most typical problems concerned situations where students did not have a user account or access to a computer, had lost their sign-in information, or had experienced other technical problems.

Table 1. Cloud services and learning games used in educational institutions

Google Drive	86%
Peda.net	74%
Microsoft 365 services (Onedrive, Teams, OneNote)	69%
Learning games (Seppo.io, Quizlet, Kahoot, and others)	69%
Google Classroom	11%
Thinglink	9%
Google My Maps	9%
Google Education	3%
Kartta.nyt	3%
360 images + VR images via mobile devices	0%

RQ2: How do Teachers in the Northernmost Areas of Finland Assess Students' TK Skills?

According to the teachers' evaluations, the students' skills were strongest in learning games, information searches, learning applications, and mobile-mediated learning (Figure 3). However, according to the teachers' evaluations, the students seemed to vary significantly in terms of their basic computer skills, since nearly half of the teachers evaluated the students' skills with email and Microsoft Office applications as weak.

About a third (37%) of the teachers believed that they knew how students used information and communication technology. The teachers felt that the students needed more instruction in basic computer skills and writing on a computer, use of Microsoft Office applications, searching for the right information, programming, and online etiquette.

RQ3: How do Teachers in the Northernmost Areas of Finland Assess their TPK Skills?

Generally, teachers expressed their desire and need for more training and tutoring, provided particularly in Sámi languages, in technology-enhanced pedagogy and more advanced digital solutions, as technical concerns continued to be a challenge. Regarding the pedagogical use of technology, nearly all the respondents (95%) regarded the use of information and communication technology in teaching as essential, although a third (37%) regarded it as time-consuming.

A clear majority (89%) of the respondents used information or communication technology applications or software in their teaching to support learning. The most commonly used tools were Kahoot (9 mentions), Google tools (7), Microsoft tools (7), learning games (5), and e-learning services (6). The respondents also mentioned Quizlet (3) and Ekapeli (2), as well as video (2) and note-taking (3) tools.

A significant number of the respondents (83%) sought to expand their skills in information and communication technology use in teaching and learning in their free time. Most often, they requested help from others (69%), actively experimented with various digital applications (46%), participated in courses or training (38%), were members of a community or social media group related to the area (35%), or actively sought information in other ways (23%). Less than 10% of the respondents had completed studies in digital and multimedia learning materials. A third of the respondents felt that they were able to pedagogically utilize information and communication technology in phenomenon-based learning under the National Core Curriculum (Opetushallitus, 2014).

Figure 3. Students' information and communication technology skills
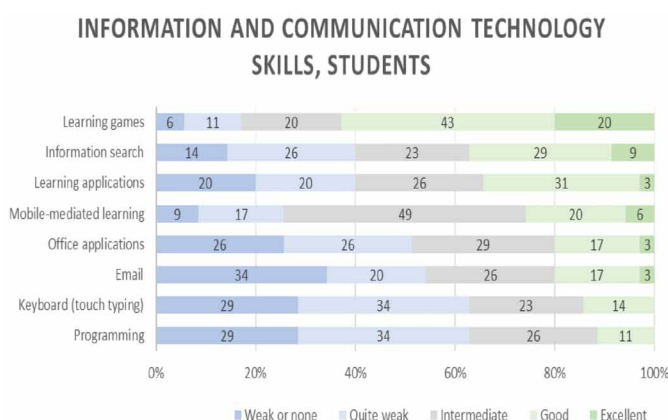
Slightly less than half (43%) of the respondents had been able to participate in all the training in which they wished to participate. Training is typically organized by the employer, by the Regional State Administrative Agency, or by development projects. The employers of 71% of the respondents supported their participation in training. According to more than half of the respondents, no training had been offered in programming. The respondents reported a need for additional training in programming and in using and creating learning games and applications.

Almost one in four (23%) respondents had a digital tutor in their educational institution or municipality. One in three (28%) respondents did not, and almost half did not know whether they had one (49%). Half (51%) of the respondents expressed a need for a digital tutor.

The digital tutor's expertise had been utilized in teaching by asking for help and support when needed. However, the respondents were relatively unfamiliar with tutoring and were unable to say much about its practical implementation. If a digital tutor were available to them, the respondents stated that they would request more support with the acquisition and use of equipment, identifying usage opportunities together, individual guidance, learning software, programming, and having up-to-date information. According to the respondents, digital tutoring should be improved to make sure that help would be available, that the tutors would offer teachers training on how to use new materials, that they would provide tips on practical implementation, and that the tutors would act as co-teachers in class. The respondents felt that they often had to familiarize themselves with new applications and tools alone in their free time if they wanted to use them in their work.

Slightly less than a third (29%) of the respondents said that they covered programming in their teaching, even though it has been integrated into the Finnish Core Curriculum since 2014 from the first grade (Opeushallitus, 2014). In some cases, programming had been taught at the primary (30%) and secondary levels (25%) by another teacher, student, tutor, or digital officer. Most typically, programming had been included in mathematics (17%). Finnish and physical education (PE) were also mentioned. Gamification, meaning playful learning activities that have certain rules to enhance engagement, was included in the teaching of more than 60% of the respondents.

As the most important area of improvement, the respondents mentioned training teachers, sharing information and tips, and drafting clear plans. Useful practices for teaching programming were described as follows:

"Programming daily activities with pictures and easy exercises with small students."

"Systematically covering the area of programming, from programmatic thinking through icon-based applications to programming languages, regardless of the age of the students." "Working with robots and creating exercises/problems that students must solve."

"Practicing causality and following instructions."

Furthermore, the respondents expressed their need for supplementary training in Sámi languages for the pedagogical use of digital tools, particularly in teaching those languages. At the same time, the respondents expressed the lack of and dire need for applications that are intended for learning Sámi languages, as they needed to translate and produce most of the teaching materials themselves.

DISCUSSION

Teachers in the Sámi Domicile Area in northernmost Finland felt that their information and communication technology skills were strongest in the basic use of computers and equipment, Microsoft Office applications, and email. According to the teachers' evaluations, these were the areas where the students were weakest and in need of support. At the same time, in the teachers' view,

the students were most skilled with learning games, learning applications, information searches, and mobile-mediated learning. The teachers used a wide range of information and communication technology solutions in their teaching, including cloud services. They expressed a need for support and training, especially regarding learning games, learning applications, and programming.

Programming has been included in the National Core Curriculum since 2014 for all grades; however, less than one-third of the respondents covered it somehow in their teaching, pointing to the urgent need for targeted training on how to integrate programming into all subjects for all grades. Technical issues also created challenges. Digital tutoring was seen as making help and support available to better utilize information and communication technology in teaching practice. Nearly all the respondents regarded the pedagogical use of information and communication technology in teaching as a necessity; however, only one-third of the respondents felt that they could pedagogically utilize information and communication technology in phenomenon-based learning in accordance with the National Core Curriculum (Opetushallitus, 2014), which uncovers yet another area in need of supplementary training.

CONCLUSION

This study has several shortcomings, one of which is that it concentrated only on TK and TPK assessed by the teachers themselves. Furthermore, the sample size was small, even if it was large in the Sámi community context. Perhaps these areas should be addressed in future research by examining all aspects of TPACK in a wider global Indigenous language context. With a larger sample size, particularly from different Indigenous language contexts, more sophisticated and comparative methods could be used. However, this study provides completely new information on digital tool use, which is important for the development of education in the Sámi context. Reflecting and comparing the findings of this study to earlier studies is rather difficult, since similar studies have not been conducted in the Sámi context before, making it apparent that more research is needed for the development of solutions that can help Indigenous people and the revitalization of endangered languages globally and nationally. Linguistically and culturally diverse and demanding educational contexts may benefit from digipedagogical solutions and the ability to use these possibilities. It is important to continue conducting participatory action research in minoritized language contexts.

In this article, we sought to determine what ideas teaching personnel have about technology-enhanced pedagogy and what practical matters they face in their everyday work, with the objective of developing and providing in-service teachers with supplementary education about digital tools and digital pedagogy. This article presents the key findings of a survey conducted in 2020 when the COVID-19 pandemic started, and it extends the current research on TPACK by investigating it in the Indigenous Sámi context and proposing practical supplementary digital pedagogical training in Sámi languages for teachers' skills development, as well as time for familiarization with new digital applications and tools.

The results reveal great variation in the teachers' TK and TPK competencies. Furthermore, the findings highlight the teachers' need for supplementary training provided in their own language, particularly on the pedagogical use of learning games and programming, while, according to the teachers, students need help with basic computer use. Our findings are in line with earlier studies on digitalization of learning environments and the ability of teachers to use them in their working life in the Finnish and Swedish contexts (Mannila et al., 2018; Olofsson et al., 2021; Tanhua-Piiroinen et al., 2016, 2020). At the same time, the findings raise the question of educational equality (see also Olofsson et al., 2019). In the Sámi context, this is particularly significant, as language is a significant pillar in the maintenance of Indigenous culture and society (see also Aikio-Puoskari, 2018; Smed Olsen et al., 2020), pointing to the importance of revitalization of endangered languages so that educational equality can be achieved (Nijdam, 2021; Outakoski, 2021; Raheja, 2017; Sam et al., 2021).

In conclusion, these mixed findings suggest consideration of the following: first, the implementation of targeted practical digital pedagogical training so that in-service teachers can stay up to date on rapidly developing information and communication technology use in teaching and learning and provide not only motivating and meaningful lessons to their students on any subject, but also provide the students with education on the basic use of computers that they need. Second, we recommend the development of teacher education programs that ensure that future teachers have the necessary technological competence and technological–pedagogical competence to function as representatives of lifelong learning in future classrooms. Third, teachers need time to familiarize themselves with new digital tools and applications (alone or with a tutor) so that they can comfortably use them in their lessons; hence, such time should be provided for teachers.

The findings of this study can guide the development of technology-enhanced pedagogies and targeted supplementary education for teachers provided in Sámi languages for the creation of better opportunities for the revitalization of endangered languages through high-quality online teaching and learning. Although strategies emphasize that digitalization should also be involved in teaching in nuanced forms, challenges and gaps remain. More efforts to review these gaps should be conducted during preservice teachers' education.

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COMPETING INTERESTS

The authors of this publication declare there are no competing interests.

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