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Impact of Emergency Online Teaching on Teachers' Professional Digital Competence: Experiences from the Nordic Higher Education Institutions

Completed Research Paper

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Abstract

During the COVID-19 pandemic, Nordic higher education institutions (HEIs) as any other learning providers had to abruptly switch from onsite in-person delivery strategies to a more 'pandemic-friendly' online mode. To manage these emergent transformations of learning environments successfully, development of teachers' digital competence became pivotal. This study investigates the experiences of teachers and students from HEIs in the Nordic countries of the impact of the transition to online teaching during the pandemic crisis on teachers' professional digital competence (TPDC). The findings indicate that the pandemic promoted teachers' creativity and innovation, enabling individual initiatives, openness, and decentralization that demonstrates the Nordic HEIs readiness to mobilize relevant digital infrastructure and exert academic freedom in times of crises. The study further broadens the concept of TPDC involving aspects of well-being and physical environment as additional indicators, to ensure equality, inclusion, and sustainability in the future of online education in higher education.

Keywords: Higher education, COVID-19, teachers' digital competence, online pedagogy

Introduction

Digitalization is constantly transforming our society with technology as an integral part of our lives, affecting how we as citizens work, study, consume and maintain social contacts. This technological progress allowed people to carry on with their lives during the COVID-19 pandemic, even as physical lockdowns and social distancing were enforced. In numerous countries, working remotely from home and online learning became the predominant methods of operation (McFadden et al. 2021; Muthuprasad et al. 2021). Higher education institutions (HEIs) as any other learning providers were required to rethink on-campus physical delivery strategies to other more 'pandemic-friendly' formats such as online, blended or hybrid learning (LeBlanc 2020). The collective experiences highlight a changed perception of the role of technology from ancillary support to that of an enabler of work and learning (Peters et al. 2022). While there are reports on European HEIs successful transition and adaptation of teaching and overall positive student experiences (Cone et al. 2022), studies also reveal intensifying inequities as a result of the differing access to and experiences of networked digital communications (Peters et al. 2022).

The COVID-19 pandemic is furthermore perceived as a catalyst for educational change and with increased online presence a boost of digital competence (Rapanta et al. 2020). The traditional conception of teaching and learning as on-site, in-person, and co-located (pre-pandemic), due to "the large-scale, wide-spread planning, development, and delivery of alternative learning environments" (Nørgård 2021, p. 1711) is discussed in research as a reconceptualization of the learning space (Hilli et al. 2019) modifying the whole educational ecosystem (Pischetola 2022). The emergent learning spaces of online, blended, and hybrid formats motivate a dissolvement of the dichotomy between digital and non-digital and the sharp polarizations of 'digital vs real', 'online vs face-to-face', 'artificial vs natural worlds', and 'human vs technological' (Goodyear 2022; Nørgård 2021). The post-digital way to understand these hybrid learning spaces embraces "the blurring of boundaries between physical and virtual spaces, private and public spaces, personal and professional life and embodied and rational experiences" (Pischetola 2022, p. 71).

To date, only a handful of studies have examined the experiences of Nordic HEIs of COVID-19 pandemic. In Denmark, the transitions undermined the confidence of HE teachers, and limited their academic freedom (Tomej et al. 2022) compromising their social identity continuity at work (Krug et al. 2021). Finnish university teachers from different disciplines experienced enhanced competence in distance teaching (Myyry et al. 2022) but also increased workload and challenges with time management, and colleague interactions that limited their well-being and agency, especially during the pandemic's first year (Mäkelä et al. 2022). Studies in Sweden report also on more stress and experiences of losing contact with students and lower quality of teaching (Hietanen and Svedholm-Häkkinen 2023). For many teachers in Sweden the learning management system (LMS) was also quite new as many universities migrated to a new system at that time. Other studies report on faculty experiences of holding more pedagogical discussions with teachers emerging as more reflective practitioners (Lundberg and Stigmar 2022). Further, while a plethora of studies show how the global pandemic speeded up the development of online education, few studies explore how the pandemic contributed to developing teachers' professional digital competence.

To this end, this study aims at uncovering the impact of the transition to online teaching during the pandemic crisis on university teachers' professional digital competence by investigating the experiences of HE teachers and students in Denmark, Finland, and Sweden. We pose the following research question:

How has the COVID-19 pandemic contributed to the development of university teachers' professional digital competence?

The remainder of the paper is structured as follows. The next section presents previous research on teaching in times of crisis, online education and frameworks addressing teachers' professional digital competence. Then, an overview of the materials and methods for the study is provided, followed by the findings section. The final three sections of the paper consist of a discussion, concluding remarks and notes on limitations of the study.

Previous Research

Research on Emergent Changes in HEIs during the Pandemic

Changes in society give rise to new learning environments and challenge educators on multiple levels, requiring not only new pedagogies but also new beliefs about what represents relevant education, what should be taught, and how (Fullan 2007; Nieveen and Plomp 2018). The sudden and unforeseen developments during the global pandemic have significantly altered our ways of living, learning, and working resulting in remote and online modes as the "new normal" method of communication (Khalili 2020). HEIs faced difficulties in handling the evolving changes in educational settings (Carvalho et al. 2021) They also encountered time constraints during stages of panic and survival, as observed by Nørgård (2021). The abrupt lockdown policies that limited physical presence and in-person gathering turned to online education including live-streamed and pre-recorded lectures, discussion and collaboration platforms, and simulation tools to ensure educational continuity. In this emergency online teaching, faculty have rapidly moved entire curricula online in simple pedagogical approaches (Hodges and Fowler 2020) transforming onsite face-to-face instruction to online formats, and rearranging students in smaller groups (Rose 2020). In many cases, face-to-face classes were replaced by synchronous, video-mediated lecturing (Bond et al. 2021). 'Zooming' became a universal term for video conferencing as the most used method to connect with students and colleagues (Singh 2021). Instructors delivered lectures from home, many of them with limited (or no) training and lacking the pedagogical content knowledge for online teaching and learning (Hodges and Fowler 2020). Many teachers also faced a lack of access to software and limited online infrastructure (Singh 2021).

According to Goodyear (2022), changes to educational infrastructure during the pandemic revealed the fragility and speeded up expectations for social and technical solutions, raising questions about "how to think about the infrastructure required (social, material, digital, hybrid)" (p.35). Before the global pandemic, a specific and limited number of digital tools were in use in HEIs, mostly to share course material and organize teaching (Svensson et al. 2020) and to a lesser extent for pedagogical goals promoting learning, displaying e.g., lower competence in assessment activities (Muñoz Carril et al. 2013; Rapanta et al. 2020) and students self-organizing peer support (Lillejord et al. 2018). Chatterjee and Chakraborty (2021) demonstrate the increase in use of online collaboration tools and social media (e.g., Facebook groups, WhatsApp, Instagram live), promoting student participation, opportunities for mentoring and collaboration. Video conferencing tools enabled access to practical training for e.g., surgical education, teacher education, being effective in discussing cases and research literature, sharing pre-recorded lectures, and activating interactions with students asking questions live, in a chat or using audience response tools.

Students and academic staff appreciated the flexibility in the online formats, availability of teaching materials such as video lectures (Muthuprasad et al. 2021), and opportunities to enhance digital skills (Mishra et al. 2020). On the other hand, studies report about students and staff facing increased workload, decrease in academic performance as well as learning challenges (Farnell et al. 2021). There were concerns about student engagement and motivation (Aristovnik et al. 2020; Oittinen et al. 2022), limited social interaction and teacher-student contact (Karalis and Raikou 2020), well-being (Holzer et al. 2021; Mäkelä et al. 2022; Sarasjärvi et al. 2022) and technical difficulties with online tools (Adnan and Anwar 2020). Research reports also about students struggling with access to the internet and online communication tools as well as their level of digital skills (Farnell et al. 2021). Drawbacks to moving online were reported to be even more severe for the programs with practical skill training which require physical presence, e.g., medical and dental students reported a decline in quality in clinical learning (Chakladar et al. 2022; Cheng et al. 2021; Farrokhi et al. 2021). International students especially experienced exclusion and loneliness being by themselves in the host society (Weng et al. 2021).

Defining and Theorizing Teachers' Professional Digital Competence

Technological advancements continue to emerge making digital competence vital to every citizen to adequately prepare for the challenges and demands of today's society. Digital competence is among the most highly sought-after skills, encompassing the utilization of technological, informational, multimedia, and communication skills and knowledge (Esteve-Mon et al. 2020). Turning specifically to the educational context, the growing political focus on digitalization in education has also expanded the agenda of what

contemporary teachers' professional digital competence (TPDC) entails (Selwyn and Facer 2013; Søby 2015). Although the concept of digital competence is frequently mentioned in research literature, well-defined conceptualizations are rarely included (Pettersson 2018; Skantz-Åberg et al. 2022). The main reason is that the concept is complex and has a multidisciplinary character (Erstad et al. 2021; Godhe 2019) which as such has diverse connotations in different educational contexts (Spante et al. 2018). Several frameworks figurate and vary in definitions also in teachers' professional practice integrating technical skills with didactical/pedagogical application, professional development, and the ability to develop the digital competences of students (Esteve-Mon et al. 2020). These frameworks are both policy-driven and research-based. The European Framework for the Digital Competence of Educators (DigCompEdu) (Redecker and Punie 2017) integrates educators' pedagogical competence in facilitating learners' digital skills with their professional engagement (i.e., communication and collaboration with colleagues, administration, competence development, etc.). The well-known research-based Technological Pedagogical and Content Knowledge-framework (TPACK) (Mishra and Koehler 2006) addresses and integrates these three knowledge areas. TPACK represents, however, only a part of the knowledge and skills teachers need in their profession. Providing high-quality instruction in HEIs where instruction is increasingly digitalized and student populations are changing, new dimensions of teachers' *pedagogical* digital competence are defined as "the ability to consistently apply the attitudes, knowledge, and skills required to plan and conduct, and to evaluate and revise on an ongoing basis, ICT-supported teaching, based on theory, current research and proven experience with a view to supporting students' learning in the best possible way" (From 2017, p. 43).

In a recent review of TPDC characteristics in research literature between 2010 and 2019, Skantz-Åberg et al. (2022) reveal seven recurring aspects: 1) technological competence, 2) content knowledge, 3) attitudes to technology use, 4) pedagogical competence, 5) cultural awareness, 6) critical approach, 7) professional engagement. *Technological competence,* the most frequently approached dimension of TPDC, pertains to educators' capability to successfully utilize digital tools for educational objectives and troubleshoot technical issues. *Pedagogical competence* encompasses educators' understanding of when and how to incorporate digitalization in the situated educational context to enhance students' learning. It also involves their ability to effectively integrate digital technology to support students' social and cognitive needs, as well as their learning goals. Turning to *content knowledge, it* implies the inclusion and incorporation of digital perspectives on a subject area. Teachers' *attitudes to technology use* are recognized to include their attitudes towards technology and their level of self-confidence in its application "how and to what extent they use their digital competence in the classroom to support students' learning" (Skantz-Åberg et al. 2022, p.11). *Awareness of culture* in teaching and learning refers to teachers' understanding of students' identity development across digitalized contexts, which encompasses the impact of social conditions and technological development on learning processes. *Critical approach* concerns a deliberate perspective and consciousness regarding technology within the realm of education and society. This encompasses the careful selection, assessment, and judgement of digital tools in communication with others, as well as introspective reflection on one's own teaching methods. Finally, *professional engagement* pertains to teachers' involvement in administrative and communicative tasks, collegial discussions, and competence development, which includes the ability to recognize their own professional needs. The authors also emphasize that the development of TPDC is a complex process, requiring the efforts of both individual teachers and their organizations, as well as strategic leadership. Teachers also need access to digital technologies in the workplace to learn how to use them effectively.

Digitalization in higher education is complex and challenged by the lack of critical perspectives and relevant policies and strategies (Roumbanis Viberg et al. 2023). Knowledge regarding in what ways the emergency online teaching strategies during the global pandemic have influenced TPDC in higher education is still scarce. This study addresses this research gap in the context of Nordic higher education.

Materials and Methods

This section presents the selected HEIs, data material and approach in the analysis.

Data Collection

Between May-August 2022, the authors gathered secondary data materials (reports) from selected HEIs in Denmark (1), Finland (1), and Sweden (2). The four HEIs are state universities, interdisciplinary, with large

international networks and a well-developed digital infrastructure. The number of students enrolled varies between 6.000 to 50.000 students. As Denmark and Finland experienced stronger restrictions during the COVID-19 pandemic, their universities switched to online mode earlier than the Swedish HEIs. The Danish university switched to online mode on March 11th, 2020, and the Finnish one on March 14th, 2020. The Swedish universities switched to exclusively online teaching and remote work mode from March 18th, 2020. The authors contacted relevant actors, such as faculty members, education managers, and study counsellors regarding if any investigations were conducted with a focus on teachers' and students' experiences of online teaching during the pandemic. The quest resulted in nine reports based on surveys or interview data.

For the present study, questions concerning the switch to online teaching, including students' views on teachers' performance and digital competence, have been included in the analysis.

Report	University	Time collected	Based on type of data (No)	Respondents	No. of respondents
1	Denmark	Autumn 2020	focus group (1) focus groups (2)	teachers students	15 7
2	Finland	Spring 2020 Autumn 2020	survey survey	teachers teachers	296 246
3	Finland	Spring 2021	written reflections interview	students students	28 9
4	Sweden 1	Spring 2020	survey	students	1907
5	Sweden 1	Spring 2020	survey	teachers	203
6	Sweden 1	Autumn 2020	survey	students	1 770
7	Sweden 1	Spring 2021	focus groups (2)	teachers	9
8	Sweden 2	Autumn 2020	survey	teachers	174
9	Sweden 2	Spring 2021	focus groups (3) focus group (1)	teachers students	13 5

Table 1. Data Overview

The data from the Danish university (DK) is based on interview data from two focus groups with a total of 15 lecturers and 7 students. Each focus group interview included a mix of lecturers and students and had a duration of approximately one hour each involving participants distributed across four faculties (Social Sciences and Humanities, Engineering and Science, Medicine, IT and Design). The interviews were carried out in autumn 2020 and covered the second lockdown period of the university and shift to online teaching and learning from spring 2020 to autumn 2020. The two focus groups had different focal points: (1) Well-being, motivation, and identity, focusing on digital well-being, student involvement, and future perspectives, and (2) Digitally supported teaching and problem-based learning (PBL) with a focus on the moving from physical to digital teaching, student engagement online, digital knowledge sharing, and hybrid future.

The data from the Finnish university (FI) consists of an internal report on two teacher surveys and data of students' written reflections and interviews. A survey was conducted twice among academic staff in 2020 to investigate teaching and supervision practices across the university's disciplines and faculties during the pandemic. Further aims were to identify the needs of the teaching staff and to provide support for their work. The findings were shared with the staff members on the university's internal pages and presented to the university's management and to the Education Council in 2021. Furthermore, to investigate students' experiences in video-mediated synchronous lectures, data was collected in the form of students' written reflections (n=28) and interviews (n=9) during the spring term of 2021.

The data from the larger Swedish university (SW1) includes in total four reports, two reports based on survey data, targeting students (spring and fall 2020) and one to teachers (spring 2020) at the Faculty of Social Sciences. In addition, one report based on focus group interview data with teachers from spring 2021 from the same faculty was selected. The surveys focused on concerns about the teachers' and students' experiences pandemic, how social life has been affected by the abrupt transition to online education, how information and measures taken by universities and other authorities were perceived, etc. The surveys included both open-ended and multiple-choice questions. The focus group interviews with teachers were primarily focused on their learnings from the pandemic and best practices, and ideas for developing and implementing digital technologies in post-covid teaching.

The data from the smaller Swedish university (SW2) consist of an internal report on a teacher survey and interviews with teachers and students. The survey was sent out to all teachers at the university at the end of November 2020 with a response rate of 174 teachers, targeting experiences of digital teaching and remote work and the possible effect this experience had on their digital competence development. The focus group interviews were all carried out and recorded online in Microsoft Teams during spring 2021 after receiving informed consent from the participants and transcribed verbatim. Three of the interviews were conducted with a total of 13 teachers from all four faculties of the university (Business, Education and Social Sciences, Health, and Information Technology). There were 3-4 teachers in each focus group and each interview lasted for approximately 1-1,5 hours. The interviews focused on the teachers' experience of remote teaching during the pandemic and digital competence development. The fourth focus group interview involved 5 students (also with representatives from all four faculties) to capture their experience of remote teaching and learning during the pandemic.

Though the collected reports are heterogeneous, based on different types of data, all of them were conducted on faculty levels and considered to be the main investigations in the selected HEIs concerning teaching and learning in times of the pandemic. The data was available in the languages of the respective countries, i.e., Danish, Finnish, and Swedish. First, the researchers worked on their data sets individually. Second, all researchers jointly discussed the findings during interactive workshops and translated the data into English.

Data Analysis

The data were analyzed using a qualitative thematic content analysis as a method of identifying, analyzing, and reporting patterns within the data without imposing theoretical perspectives or preconceived categories (Braun and Clarke 2012). The study thus does not adhere to the quantitative information in survey data presented in the respective reports since the overarching interest is qualitative, i.e., to explore teachers' and students' perceptions. The first step of the thematic analysis (Braun & Clarke, 2012) was to get familiar with the data reading and rereading the reports several times and transcribing the interviews independently, also to establish initial impressions. Thereafter, episodes in the reports and quotes in the interviews were highlighted to systematically note and identify interesting and representative features in relation to the study aim. Next, data was arranged relevant to codes and shared between the authors. The different codes were organized into potential themes, that is, all data relevant to the theme were gathered in search of the themes. The coding categories and emergent themes were discussed again among the authors to achieve a mutual understanding and enhance cross-coder reliability (Cohen et al. 2017). Finally, the themes were named to reflect the content of each theme. These themes, together with representative quotes are presented in the Findings section below and are further developed in the discussion section.

Findings

In the thematic analysis of the data, we discerned seven themes, which are presented and discussed below.

Theme 1. Coping with Technological Challenges at the Expense of Quality of Teaching

At all four universities, the abrupt switch to online education caused teachers experiencing challenges in relation to access to technological equipment, especially in the initial stages of the pandemic. Though in general, the academic staff had access to laptops, microphones, and cameras, some of them were of inferior quality, which according to the students' opinions influenced teaching quality:

> *Technical competence development for the teachers is essential … the university should provide technology and aids, for example camera and microphone so that sound and image work well. (Student, SW1)*

While the pandemic caused a marked increase in the use of primarily videoconferencing tools (such as Zoom, MS Teams), video production, and Cloud services, the teachers also experienced challenges in learning to use them. Implementing new videoconferencing software, e.g., creating breakout rooms, saving chat messages, recording online lectures, formatting them, and sharing them via learning platforms was a challenge, especially at the initial stages of the pandemic, when IT support was limited:

> *It took time to learn how to record and transfer recorded material and understand the technology. It is difficult to learn only via online manuals. (Lecturer, SW1)*

For the teachers, the abruptness of the switch to online teaching felt stressful because they had to learn to handle these new teaching technologies and practices in a short time. Many of them had to redesign their courses, which needed time and energy. This led to students experiencing delays in communication, for example, in responding to e-mail messages:

> *All the lectures were suddenly cancelled and we were just given assignments to do on our own with no way to really ask questions except for email, of course, but the teachers might take some time to answer so there was no way to immediately get answers for questions. (Student, FI)*

Though students showed awareness of the teacher's changed work situation, appreciating their teachers doing their best of the situation, they also expressed concerns about a varied teaching quality. In all four universities, students raised criticism about such issues as teachers' lack of skills in handling e.g., security issues with Zoom, film quality and formatting, publishing links on the LMS, etc.

While the teachers generally perceived that their confidence in operating the digital tools increased, they also faced challenges to comply with students' expectations which increased during the pandemic, in terms of requiring pre-recorded lectures and materials to be available to them. For some teachers, the transition to online teaching generally worked well, as they had already had such elements in their teaching in recent years, while for other teachers it meant several challenges. Many had to gradually learn how to handle and become accustomed to digital tools and other forms of online teaching:

> *… the thing about that it is not just a matter of moving from one platform to the other, in fact the course has to be redone, because it is not the same, and you cannot do it in the same way. And it is not the same content that you can use, and it is not the same structure, so we had to constantly redo the course, and I think that has been the most frustrating thing about it. And what has pushed people the most is that we had to constantly rethink our teaching. (Lecturer, DK)*

The IT services of the participating HEIs explored different ways to support the development of teachers' technological competence for online teaching, particularly in areas such as teacher-student interaction and interaction between students. For instance, the IT-support of the FI university organized webinars to share good practices of online teaching, and also acquired new digital tools and licenses. In the SW1, SW2 and DK universities, the pedagogical and IT-services conducted online seminars to support academic staff learn to work with videoconferencing and other digital tools. Unfortunately, the transition to remote teaching implied in general extra work, stress, and time pressure, which impeded teachers from taking full advantage of the support offered by the HEIs to the extent they would have liked:

> *Changing teaching from campus to distance in one day without allowing time for adjustment created a lot of extra work. You don't have time to reflect, analyze, and think through what works well. (Lecturer, SW2)*

The teachers also perceived that learning digital tools took time at the cost of teaching activities:

> *There is no room to do 'that little bit extra' because digitization takes so much more time than the actual teaching time we get. (Lecturer, SW2)*

Theme 2. Managing Student Involvement and Active Participation

Student involvement in online courses was a common challenge perceived as impeding teacher-student and student-student interaction. The teachers found it challenging to maintain contact with students in online teaching. This could concern everything from students being able to ask (spontaneous) questions during online lectures to 'catching' students who are having a hard time with their studies. Further difficulties raised concerns about being able to assess whether students were following along and understanding the material during online lectures. The absence of visual cues and the inability to observe students' reactions when cameras were switched off could make it difficult for teachers to gauge how well students were engaging with the material. Teachers experienced that even though their students attended online teaching sessions, they were not always actively participating and could often be doing other things simultaneously:

> *There were several [students] who said, 'I will work while I am listening to it [the online lecture], I will do something else, hanging up laundry'... So, it was very difficult to make it work. (Lecturer, DK)*

It is worth mentioning some prominent disparities identified in the data. For instance, at SW2 mostly first-year-students (over 60 percent) state that their studies worked worse during the first period of the pandemic, whereas half of the students in years 4 and 5 report that there was no change. The students at DK had different stances experiencing that most teaching was pre-recorded during the first period of the lockdown (spring 2020) not promoting active participation in the lectures, but merely something to passively watch. When teaching was gradually transferred to videoconferencing, the students reported becoming more committed, in particular, when interactive exercises were introduced:

> *The current semester has changed because we have more Zoom classes now. Last semester it was pre-recorded, and it was problematic because you just postponed it when you had to watch it. Live Zoom lessons provide more commitment, presentations well integrated with exercises. (Student, DK)*

The pandemic made teachers aware of the pros and cons of using asynchronous and synchronous modes of online teaching, live online lectures and pre-recorded materials, and different ways of combining them to activate students in their online courses. Concerning asynchronous mode, the teachers recognized the benefits of using flipped classroom model by preparing the content knowledge in pre-recorded videos and slides, which could be accessed before the lecture via the university's LMS and devoting online live time to the students with active discussions and interactive exercises. It provided flexibility for students in terms of following the content at their own pace, going back and repeating things. It was perceived especially positively by the students with families, full time workers and students with special needs:

> *Videos are wonderful because then you can do other things in that time. (Student, SW2)*

> *As a person with a recognized anxiety disorder, my performance is unilaterally worse in a crowd and my focus is impacted. This applies to lectures and exams both. (Student, SW1)*

Many students also commented on expecting their teachers to record the live lectures and publish them after the lecture for the students to be able to re-watch them or for those who missed the lecture to get the information:

> *I think having the option of watching lectures online and having them recorded to be watched later is a huge benefit. (Student, SW1)*

Theme 3. Enhancing Teaching Creativity and Innovation

The teachers realized early that it is not optimal to transfer existing materials (as it is planned for campus teaching) to digital materials, also recognizing the required need for competence development around the possibilities of online digital tools, as well as time to apply new knowledge and develop the teaching:

> *The transition to digital forms of teaching therefore does not just mean transferring existing content material into digital form but presupposes that we can develop and invent new forms of teaching that we have not previously explored. (Lecturer, SW2)*

The teachers reported becoming more creative in their teaching practices, commenting on opening for new ideas and acquiring new digital tools which they integrated into their online courses. Some of the ideas mentioned are playing music at the beginning of lectures to create an atmosphere while students are dropping in and assigning a 'socially responsible person' to create topics for social interactions and reflections after lectures. Another example of innovative combinations of different digital tools and guidelines is creating a space where teachers could engage with their students. At DK, a teacher who was responsible for a course of 120 students mentioned creating a roadmap for the students that included videos, podcasts, and a book written by the lecturer, presenting the steps that the students should take to get the most out of the course. The roadmap was provided in a good time before the course started, encouraging reflections and defining expectations. The lecturer experienced that this preparation helped to create an active online learning environment despite the large group of students. Another example was the integration of social media into teaching practice. For instance, a teacher in art courses at DK used Instagram for students to upload physical products as part of the teaching (e.g., mock-ups and prototypes). Other examples of application of different digital tools concerned an increased use of podcasts.

The teachers also commented on creating innovative ways of connecting their online courses to 'outside world.' While before the pandemic invited speakers commonly attended lectures on campus and had to travel (sometimes long distances), during the pandemic, online visits from companies, webinars with invited authors of papers included in the course literature lists became increasingly common. The teachers perceived this development as extremely positive and mentioned aiming at continuing using online mode for invited speakers even after the pandemic for climate and sustainability reasons.

Theme 4. Ensuring Examination Quality

One of the biggest challenges arose around examination procedures. In Sweden, the change to digital teaching took place in the middle of the exam period, and the teachers experienced a lack of knowledge, time, and skills to transform the on-site exams to online mode in the best way. The teachers mentioned spending a lot of extra time on developing the forms for online examinations at the expense of quality:

> *We need to work more with examination forms, now they are only 'good enough.' (Lecturer, SW2)*

It was especially relevant in transforming the exams with practical elements, e.g., within medical education, into a digital form. The teachers lacked knowledge of how to do it, which caused dissatisfaction among students:

> *The university must take responsibility and adapt practical elements, and examinations so that they can be implemented digitally in a way that benefits our learning. This is what you [the teachers] have completely failed with! (Student, SW1).*

Teachers in all four universities expressed concerns regarding the growing chances of students cheating by using internet resources. A common strategy for preventing cheating was shortening examination time, and minimizing opportunities for googling online resources, which also resulted in students not having enough time to demonstrate their abilities and knowledge.

Other challenges concerned the anonymity of online exams, which was not always possible to achieve, and its potential impact on grading. The teachers were concerned about the lack of common guidelines in their universities about allowing students to have cameras on or off during oral exams. As some students 'could hide behind the black screen' and the teachers had no time to "check so that they have cameras on and don't cheat" (Lecturer, SW1), it resulted in many 'free riders,' causing dissatisfaction from the students who diligently participated in the exams. Some teachers mentioned that they would rather offer a classic home exam than a regular classroom exam online to avoid these hurdles.

Attitudes to and experiences of online exams also depended on the discipline and the subject content that was examined. For instance, the SW1 students taking programming courses appreciated the opportunity to

program on a computer in a quiet home environment, compared to writing compliable code directly on paper in an examination hall, with no real way to check that you don't make small syntax errors.

Theme 5. Struggling with Students' Motivation

In all four universities, the teachers experienced decrease in the students' motivation affected by the change from on-campus education and physical group work to sitting alone and collaborating online with peer students:

> *I also saw that a lot of those students complained that they have a much harder time getting motivated … they just miss the kind of social pressure from their peers to get something going and to get out of bed and start working. And that makes it, I guess, also, even for the students working alone, it's more difficult because otherwise they would usually be at the university. You have some people to go to lunch or talk to and, you know, it makes things easier. Working alone from home is kind of a very isolating experience, for many students in the spring. (Lecturer, DK)*

The teachers were challenged to develop engaging and motivating ways of teaching under the new circumstances, which some students pointed out lacked variety:

> *Some lessons have been just that the teachers speak like only they speak, and everyone has their cameras on and only a few times we use the chat box and then (this) the lesson is over, and we leave. (Student, FI)*

Or even that online lectures were perceived by some students as having the same monotonous design:

> *The teacher has a slide show that you go through first and then there will be a task and then you will be divided into groups and need to discuss that task and come back again to the main room and let's go through them a little bit (…) They're pretty much the same formula they are. (Student, FI)*

Especially challenging was to adjust activities in online groups that would suit to every student, which led to more individualized work lacking the necessary communication and feedback:

> *I have experienced an increasing individualization of the work. So, a project group, for example, where they sit separately and have divided the tasks /…/ but the dialogue that has followed, around the working papers that have been made by individual group members, has not been very good in this process. (Lecturer, DK).*

Theme 6. Recognizing Aspects of Clarity and Spontaneous Dialogue in Online Teaching

Overall, online education was considered to be a largely solitary experience, characterized by lack of communication among course managers, fellow students as well as teachers and students:

> *Nowadays it's very much a solitary experience because after the session you just leave the meeting room and that's it. You're back in your own space and your own place basically and usually in face-to-face lectures you maybe talk to people after the lecture, or you go to lunch together. (Student, FI)*

The need for students to receive information and clear instructions was highlighted as well as opportunities for interaction associated with lectures, such as spontaneous conversations and discussions between students and teacher, as well as between students. Here we observe significant variations between and at the same universities. For instance, at SW2, there was a great variation in how the students perceived the contact with teachers, from completely lacking information to having a good dialogue and experiencing responsiveness from the teachers, even better possibility of contact with the teachers compared to before. Also, the teachers confirm more requests for information and clarity from the students:

> *Received more positive feedback on the practice sessions, that you are available more as a teacher for questions - to compensate for them sitting by themselves and watching clips. (Lecturer, SW2)*

Teachers at SW1 booked videoconferencing meetings to enable their students to ask questions and were responsive to suggestions for improvement, which was perceived positively by the students:

> *The teachers really tried to do their best in this strange situation, and I have learned a lot, despite these strange times and new study methods. (Student, SW1)*

At FI lack of opportunities to chat with teachers and ask for clarifications created uncertainty among students. They felt they didn't get enough information and perceived it challenging to 'bombard' their teachers with emails on specific questions.

Some teachers also arranged office hours/open office via Zoom where the students could come and "hang out", ask questions, get to talk undisturbed with their teachers and fellow students. Zoom cafés and joint reflection times were also scheduled for discussions with teachers, and informal talks.

Theme 7. Considering the Impact of Home Environment

The working/home environment was in general mentioned in connection with difficulty with concentration and stress due to housing, e.g., children at home, also blurring the boundaries of work and free time:

> *But for my own part, there has been a 7-year-old and an 8-year-old at home, where the demand from their schools has been that we should be able to handle teaching tasks, as being a teacher for them. What corresponds to six hours a day, at the same time as having to lecture and guide and, in addition, also see if you can find time for research during this period. I also know of colleagues where this situation of being confined at home with the children and having to take on this role have come down with stress. For my own part, it has meant a complete fusion of work and free time, where I can hardly mention a single day when I have not worked at the weekend and in the evenings during the shutdown. (Lecturer, DK)*

The teachers revealed that students experienced more peace and flexibility studying from home, which reduced stress and gave them more time for studies. Many of them appreciated the opportunity of combining work with full-time online studies, saving time and money for traveling. In Sweden, taking this opportunity led in the long run to prioritizing work over studies and introducing a more relaxed attitude to online teaching:

> *If the lecture is during lunchtime, I usually eat my lunch here at the desk again. (Student, FI)*

At the same time, many students across countries also mentioned the boundaries between studying and private life becoming blurred, which caused stress and feelings of being 'constantly connected':

> *It's very important to have a schedule and good time management because it's easy to blend work with spare time when you are studying online because it's so flexible. You have to plan and think ahead in a different way than on campus. But also use the flexibility to adjust the studying more to your own preferences. (Student, SW1)*

Discussion

The abrupt shift to online education during the COVID-19 crisis restrictions forced HEIs to reconsider perspectives on teaching and learning practices in higher education. Drawing from thematic analysis conducted on reports from four higher education institutions (HEIs) in the Nordic region, which encompassed survey responses and interviews with teachers and students about their experiences of the abrupt transition to online education, we uncover the impact of the pandemic on HE teachers' professional digital competence (TPDC). Seven themes have been discerned, which are discussed here in relation to previous research findings on aspects of TPDC (Skantz-Åberg et al. 2022) including technological

competence, content knowledge, attitudes to technology use, pedagogical competence, cultural awareness, critical approach, and professional engagement.

The findings indicate the complexity and interrelatedness of the aspects of TPDC and the rise of new conceptualizations brought to the fore during the pandemic. In the initial stages of the pandemic, there were clear indications of both insufficient access to adequate digital infrastructure as well as teachers lacking both *technological and pedagogical knowledge* and skills to manage online education (Rapanta et al. 2020) Though our sample consists of data from highly technologically developed countries, academic staff in the studied Nordic universities still witness some equipment being of lower quality, which influenced online teaching to work well at the beginning of the pandemic. Although these challenges were handled relatively fast, this highlights the importance of ensuring that teachers have access to reliable and high-quality technology when delivering online instruction (Chatterjee and Chakraborty 2021; Singh 2021). Goodyear (2022) highlights these issues of fragility in digital infrastructure revealed during the pandemic related to enhancement of technological competence and quality development in HE.

Teachers had varying experiences of the transition to online teaching, and many of them had to gradually learn and adapt. Learning and redesigning with new technologies was time and energy-consuming leading to varied teaching quality and delays in communication with students. Online teaching also posed a challenge for teachers in terms of understanding students' engagement and participation, which led to the development of online teaching strategies aimed at enhancing interaction and active learning. In this shift from a content-centric to an activity-based approach, teachers had to get involved in designing for learning tasks relevant to facilitating students' activities (Beetham & Sharpe, 2013). The teachers explored different modes of online teaching and recognized the benefits and drawbacks of using both synchronous and asynchronous approaches. They found the flipped classroom model effective in promoting flexibility and engagement among students, allowing them to access content at their own pace and participating in active discussions and exercises during live sessions. The teachers' adoption of new teaching strategies in online teaching thus demonstrates an increased awareness and development of *pedagogical knowledge* as a consequence of the pandemic.

Furthermore, while video conferencing technologies have been widely used as "one size fits all" tools for online teaching through the pandemic (Singh 2021), some teachers in our study attempted to integrate other tools such as podcasts and social media into their teaching to meet the subject-specific needs in their online courses. This indicates a tendency to develop *technological pedagogical content knowledge* (Mishra and Koehler 2006) for online teaching and learning towards awareness of *content approaches* (Hodges and Fowler 2020).

Our findings also indicate that the conditions of the forced educational change during the pandemic made the HE teachers develop more advanced teaching practices pre-recording parts of lessons, planning for group interactions, and other teaching strategies to engage students in active learning which was beyond utilizing the basic functionalities of structuring and sharing course material with students characterizing the pre-pandemic digital teaching practices (Svensson et al. 2020). Also, their competence to design online assessment increased highlighting the necessity of common guidelines in HEIs regarding students' use of cameras during exams to avoid risks of cheating and ensure anonymity (Rapanta et al. 2020; Muñoz Carril et al. 2013). In this endeavor, the teachers demonstrated their *professional engagement*, being aware of and able to formulate their own needs for professional competence development. At the same time, the immense time pressure academic staff experienced outweighed the HEIs mobilization of diverse initiatives to support collegial competence development and similar. Students' voices provided valuable insights into the development of *technological knowledge* of their teachers in terms of handling software, e.g., learn how to record lectures, manage video files, and share them in a suitable format (Singh 2021). Our findings show that it is important for teachers to receive adequate training and ongoing professional development and support in using new technologies to ensure that they can effectively incorporate them into their teaching practice while maintaining high-quality instruction and timely communication with their students. Incorporating student feedback into teacher training could help to identify areas of support and improvement of teachers' *technological pedagogical knowledge* (Mishra and Koehler 2006; Skantz-Åberg et al. 2022) to enhance the quality of online teaching.

Further, our findings clearly demonstrate the initial lack of knowledge and skills of online *pedagogical approaches* in using a newly acquired technology and applying it on-campus teaching to online courses. In this period of experimenting with online pedagogies, some turned out to be successful whereas others

needed more development. This is shown in our data where the turn to video recording lectures and flipped classroom models was not particularly favored, as it resulted in lack of teacher-student interactions, requiring the development of elements of live and active learning approaches. Additionally, considering online work and study as more physically and psychologically exhaustive, planning for shorter lectures with more interactive activities and integrating short breaks became an essential part of teachers' digital competence, not mentioned among the TPDC aspects (Skantz-Åberg et al. 2022). Here, the educators could test in authentic teaching situations their different teaching designs, which is an essential part of the development of *technological pedagogical knowledge* (Mishra and Koehler 2006), *critical approaches* in the selection and judgment of digital tools, *attitudes to technology use*, as well as reflection on own teaching practice.

Also, empowering learners and fostering their active involvement are essential elements of *pedagogical competence,* where versatile teaching methods and interactive class design has a positive impact on students' online engagement (Oittinen et al. 2022). This is demonstrated in our data by promoting the importance of students' presence and active participation online, commitment to studies, concerns about grading related to unequal contributions to group work and suspicions of cheating on exams. Our analysis demonstrates that while some teachers considered it to be their role to include students, ensuring active participation and involvement, others accepted some students being passive participants, indicating it being "their own choice." This raises the issue concerning equal and inclusive treatment of students, which is one of the cornerstones of Nordic academic culture (Mittal et al. 2020) related to the *culture awareness* aspect of TPDC.

Apart from considering well-being as an aspect of TPDC in higher education, the thematic analysis of data also reveals the need for consideration of students' study environment, as an aspect expanding this conceptualization and adheres to teachers' digital competence. While Skantz-Åberg et al. (2022) discuss how the social conditions within a local school setting influence the thinking and actions that take place in the digitalized classroom, our study indicates the impact of such *socio-economic factors* as students' home environment, ergonomics, and access to technology on students' possibilities to manage their online education. Compared to on-campus studies in pre-pandemic times, when students had equal opportunities in terms of access to lecture halls, study areas and libraries, the pandemic brought out the differences among students in terms of study environment and access to technology, enhancing inequalities. As the online mode is here to stay, addressing this issue is pivotal for providing all students with opportunities to get their education.

Concluding remarks

Dealing with emergent crises puts new and challenging demands on higher education. The global pandemic, apart from bringing stress and anxiety, accelerated digitalization of higher education, drawing an increased interest to teachers' professional digital competence. This cross-Nordic study signals that being a student and a teacher has been impacted by the pandemic crisis in terms of enhancing knowledge, developing skills, and changing attitudes towards digital teaching and learning. Our findings indicate that the pandemic has fostered teachers' pursuit of creativity and innovation, empowering them with the ability to take individual initiatives, promoting openness, and decentralization. This has ultimately granted teachers greater autonomy to shape and design their courses to align with their students' needs and teaching objectives. It has also encouraged them to explore, adapt, and incorporate new, unconventional tools in their teaching methods, such as podcasts, social media, online discussions, and more. The study thus demonstrates the Nordic HEIs readiness to mobilize relevant digital infrastructure and exert academic freedom in times of crises.

To conclude, the study shows the importance of raising awareness of well-being and physical environment/study conditions, as additional indicators of TPDC in higher education, to ensure equality, inclusion, and sustainability in remote teaching. Our study highlights that TPDC is a much broader concept and that pinpointing digital competences to be addressed is challenging but pivotal for ensuring the future of online education.

Future research and development should strive to enhance academic teaching practices in a sustainable balance between online and on-site teaching incorporating identified good practices and guidelines of relevance for HE teachers from several disciplines.

Limitations

The study is delimited to the Nordic context based on a complementary combination of quantified and descriptive data distributed among the four HEIs. The authors have had access to the sources of the secondary data tailored specifically to the goals of this article, which we consider to be trustworthy despite not being authentically collected.

Statements and declarations

The authors have no competing interests to declare. The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

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