The impact of pedagogical and ICT training in teachers' approaches to online teaching and use of digital tools

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This study examines the relationship between teachers' pedagogical and ICT training, their approaches to online teaching and the use of digital tools. The participants were 265, teachers from the large multi-disciplinary university in Finland. The data was collected in May–June 2020 during the early stages of COVID-19 pandemic. The results showed that teachers used digital tools more for delivering information and less for activating students. The study revealed that pedagogical training enhanced teachers' learning-focused approach to online teaching and diverse use of digital tools. Contrary to expectations, teachers' ICT training was not related to the use of digital tools. Therefore, it is important to provide pedagogical training to support teachers in implementing teaching in diverse teaching-learning environments and enhance building an online teaching, in which digital tools are used to promote interaction in online environment.

KEYWORDS

pedagogical training, ICT training, approaches to online teaching, digital tools in teaching, higher education

Introduction

The current higher education teaching-learning environment is complex and blended. Teachers need to be able to implement versatile pedagogical practices and incorporate digital tools, applications and materials into their courses to support students in achieving the desired learning outcomes. The COVID-19 has had a broad impact on teaching and learning activities at different levels during lock down and after pandemic (Kovacs et al., 2021; Maity et al., 2021; Oliveira et al., 2021; Yau et al., 2022), increasing not only the number of online courses but also new kinds of hybrid teaching courses in which students are able to attend face-to-face teaching on campus and also participate in synchronous or asynchronous online teaching. This has required teachers to be aware of learning technologies and digital tools and above all, know how to make meaningful use of them to support student learning. It has been suggested that teacher-student interaction in online teaching is even more important for student learning than in face-to face teaching (Carter and Rukholm, 2008; Sun et al., 2022). Moreover, creating diverse interactive learning environments that support student learning requires pedagogical skills. However, studies show that university teachers are a very heterogeneous group in both their pedagogical and digital skills (e.g., Postareff and Lindblom-Ylänne, 2008; Scherer et al., 2021). Teachers with formal pedagogical training invest

more in aligning the design and implementation of their teaching and consider the impact of teaching and assessment methods on student learning (Postareff et al., 2007, 2008). There is evidence that pedagogical training may have an influence on teachers' views of teaching and enhance teachers' confidence as a teacher (Ödalen et al., 2019; Vilppu et al., 2019). While ICT training has been found to focus on familiarization with technologies, leaving behind pedagogical aspects (Røkenes and Krumsvik, 2014; Fernández-Batanero et al., 2022). Furthermore, teachers' approaches to teaching (i.e., whether teaching is seen as presenting factual knowledge and/or facilitating students' learning) reflect the use of teaching methods and the learning environment (Postareff and Lindblom-Ylänne, 2008). Previous studies have shown that university teachers' approaches to teaching vary in face-to-face contexts (e.g., Kember and Kwan, 2000; Postareff and Lindblom-Ylänne, 2008; Stes and Van Petegem, 2014), however, there is still little knowledge about how teachers' approaches to teaching vary in online teaching. Previous review study showed that earlier studies have not focused on the teachers' pedagogical training in online teaching (Farias-Gaytan et al., 2023). Therefore, it is important to explore the role of pedagogical and ICT training in approaches to online teaching and the use of digital tools. In this study we are focusing on role of pedagogical and technological training at the teachers pedagogical and technological skills in online teaching in May–June 2020 the early stages of COVID-19 from the large multi-disciplinary university in Finland.

Pedagogical training and ICT training

Voluntary pedagogical training is provided for university teachers in many countries (Ödalen et al., 2019; Vilppu et al., 2019). The content and extent of pedagogical training can vary between universities, however, the aim is to support university students' learning and teachers' pedagogical skills (e.g., European Commission, 2013). The positive effect of pedagogical training on teachers' conceptions, teaching practices, reflective skills and confidence has been shown in many studies (Ho et al., 2001; Postareff et al., 2007; Light and Calkins, 2008; Karm, 2010; Ödalen et al., 2019; Vilppu et al., 2019). However, there are also studies that show no differences in teaching practices between the teachers with pedagogical training and no training (Norton et al., 2005). In addition, there is contradictory evidence on the effects of pedagogical training of different lengths; some studies indicate that long periods of pedagogical training may be required (Gibbs and Coffey, 2004; Postareff et al., 2007) but a few studies show that even short training periods can have a positive influence on teachers' conceptions (Vilppu et al., 2019).

In addition to pedagogical training, it is important that teachers have an opportunity to be trained on the use of educational technology as the demand for online courses has grown, and adaptation for future society, e. g. working life requires equipping students with digital competence (Redecker and Punie, 2017; Kallunki et al., 2023). However, there is evidence teachers' technological training is insufficient and, it is problematic that the technological training usually lacks a pedagogical basis but focuses more on technological aspects (Fernández-Batanero et al., 2022; Kolil and Achuthan, 2022). Indeed, Gudmundsdottir and Hatlevik (2018) emphasizes the need to integrate ICT training into the pedagogical context but still doubts its transfer into actual teaching practices. Similarly, Røkenes and Krumsvik (2014) found that ICT training focused mostly on the organization and infrastructure of ICT training, rather than on how

ICT could be implemented in learning practices. Moreover, Esteve-Mon et al. (2020) concluded that technological skills seem to be generally higher than pedagogical skills and that pedagogical training was crucial for adequate digital teaching competence of higher education teachers. Therefore, there is a need for integrative training in which pedagogical and technological aspects are integrated (Pongsakdi et al., 2021).

Building on Shulman's (1987) work on pedagogical content knowledge, Mishra and Koehler (2006) presented a Technological Pedagogical Content Knowledge (TPACK) framework that integrated digital technology knowledge with pedagogical content knowledge. The model is widely applied in educational technology research is the TPACK that is used in diverse contexts (e.g., Almerich et al., 2016; Marcelo and Yot-Domínguez, 2019; Esteve-Mon et al., 2020; Scherer et al., 2021; Ortega-Sánchez, 2023). The TPACK distinguishes three types of teacher knowledge: content, pedagogical and technological knowledge (Mishra and Koehler, 2006). By integration of content, technology and pedagogy it represents the different skills that a university teacher needs to teach in diverse teaching-teaching learning environments (Koehler et al., 2013). The more the three areas overlap, and the more aware teachers are of the complex interactions between them, the more effective teaching becomes when using digital tools (Koehler and Mishra, 2009). Thus, Mishra and Koehler (2006) have claimed that knowing how to use technology does not ensure that one knows how to utilize it in teaching.

Some recent studies applying the TPACK framework show that different forms of training in digital pedagogy can enhance teachers' skills and confidence in digital teaching (Brinkley-Etzkorn, 2018; Koh, 2020; Pongsakdi et al., 2021; Diamah et al., 2022). However, research examining how teachers' skills in terms of TPACK are related to their training is scarce and mainly carried out among pre-service and in-service teachers and focused on the academic degree (e.g., Luik et al., 2018; Diamah et al., 2022; Ibrohim et al., 2022; Long et al., 2022; Ortega-Sánchez, 2023). In the studies focusing on higher education teachers, it seems that either age (Cubeles and Riu, 2018) or the academic degree (Castéra et al., 2020) are not linked to TPACK dimensions. Ortega-Sánchez (2023) also observed that among student teachers the scores of TPACK model's dimensions did not increase as their studies progressed. In particular, the relationship of voluntary pedagogical and ICT training to the TPACK model has not been studied much among higher education teachers.

Approaches to teaching in an online environment

Approaches to teaching refer to teaching intentions and strategies and reflect teachers' conceptions of teaching and learning (Trigwell et al., 1994). Studies have identified two approaches to teaching: a content-focused and a learning-focused approach. In a content-focused approach, the teacher focuses on content and sharing information students play a more or less passive role in their own learning (Kember and Kwan, 2000; Trigwell and Prosser, 2004; Postareff and Lindblom-Ylänne, 2008). Trigwell et al., 2005 also state that forward planning of teaching, management skills and the ability to use ICT are important aspects in content-focused teaching. In a learning-focused approach, teachers focus on students' learning and emphasize students' active role in the construction of their own knowledge by using a variety of active teaching methods and formative assessment to support student learning

(Kember and Kwan, 2000; Trigwell et al., 2005; Postareff et al., 2007; Postareff and Lindblom-Ylänne, 2008). The content is also important in a learning-focused teaching, but in the content is taught by activating students, not just sharing information. It should be noted that these two approaches to teaching should not be viewed as contrasting conceptions of teaching, but rather as a continuum in which teachers can adopt both approaches in their teaching and combine them (Postareff and Lindblom-Ylänne, 2011; Stes and Van Petegem, 2014). There is evidence that teachers' approaches to teaching have evolved toward a more learning-focused approach after pedagogical training, in other words, their thinking about teaching and the strategies they implement in teaching have developed or changed (Trigwell et al., 1994; Ho et al., 2001; Postareff et al., 2007; Ginns et al., 2008; Vilppu et al., 2019).

Approaches to teaching studies have been mostly explored in physical teaching and learning environment (e.g., Prosser and Trigwell, 2006; Postareff and Lindblom-Ylänne, 2008). Studies have shown that university teachers' approaches to teaching can vary in these contexts (e.g., Kember and Kwan, 2000; Postareff and Lindblom-Ylänne, 2008; Stes and Van Petegem, 2014). Moreover, it has been found that teachers are tended to change learning-focused approach to content-focused approach if the teaching environment is not favorable, for example, a teacher has very little control over how and what you teach or the support from the department is insufficient or the size of the class is experienced too large (Prosser and Trigwell, 1997). Furthermore, supportive environment has influenced positively to teachers' technology integration such as technical support, professional development possibilities and collaboration opportunities with colleagues (Glassett and Schrum, 2009; van der Rijst et al., 2019). Therefore, this phenomenon should also be explored in online environments as their use has increased (Jensen et al., 2020).

Only a few studies have focused on of approaches to teaching in an online environment and these approaches have similarities to above mentioned approaches that have found physical teaching and learning environments (e.g., Roberts, 2003; Ellis et al., 2006; Nevgi et al., 2010; González, 2011, 2013; Lameras et al., 2012; Badia et al., 2017; Jensen et al., 2020). For example González (2011, 2013) and Badia et al. (2017) have identified information transmission and content acquisition approaches that aim to transmit knowledge from teachers to students (e.g., provide easy access to course materials, offer up-to-date materials and provide administrative information to students); thus, they are similar to Prosser and Trigwell's (2006) content-focused approach to teaching. In addition, it has been identified two approaches namely communication and collaboration-knowledge building which focus on helping students to develop their own understanding and knowledge as well as support their active role in their own learning (González, 2011, 2013), and thus closely like learning-focused approach (Trigwell et al., 1994). Interestingly, Nevgi et al. (2010) found that content-focused approach to use ICT in teaching was related to use of digital tools whereas no relationship was found between a learning-focused approach and the use digital tools. On the other hand, it has been considered that a learning-focused approach is necessary for the successful integration of ICT in teaching (Glassett and Schrum, 2009).

The use of digital tools in teaching

Educational technology can be used for several purposes in fostering learning, such as supporting collaborative learning and knowledge building (Häkkinen and Hämäläinen, 2012; Deng and Tavares, 2013), providing feedback to students and monitoring their learning progress (Jääskelä et al., 2017). It can also be part of implementing online exams and learning assessments (Myyry and Joutsenvirta, 2015; Marcelo and Yot-Domínguez, 2019). In addition, educational technology can be used to enhance the design and use of student-centred learning environments that emphasize learners' active role in their own learning process and social interaction (Hannafin and Land, 1997; Ottenbreit-Leftwich et al., 2010; Reigeluth, 2014; Jensen et al., 2020).

Previous studies from different countries have shown that despite efforts to increase and improve digital teaching and learning in universities in different cultures, both teachers and students use of digital technology is rather limited (e.g., Bond et al., 2018; Amhag et al., 2019; Ferede et al., 2023; Söderlund et al., 2023). It is claimed that teachers' ICT training should take adequate time to learn and reflect upon new skills and knowledge, short-term training seems to be inefficient (Inamorato dos Santos et al., 2019). Research conducted during COVID-19 also shows that the pedagogical and didactic use of digital technologies to support students learning remains at a lower level among university teachers than in other aspects of use of ICT (e.g., Weidlich and Kalz, 2021; Sánchez-Caballé and Esteve-Mon, 2022). Further, it has been found that teachers have been replicating face-to-face lessons to online teaching environments and in doing so, the new pedagogical possibilities offered by ICT have possibly been lost (Casado-Aranda et al., 2021; Usher et al., 2021). To understand these discrepancies, it is important to examine how concepts related to teaching and learning, such as approaches to online teaching are related to the use of digital technologies in teaching. Teachers' pedagogical training, approaches to online teaching and the use of digital tools have been studied separately (e.g., Postareff and Lindblom-Ylänne, 2008; González, 2013; Bond et al., 2018; Scherer et al., 2021). Furthermore, as there is contradictory evidence of pedagogical and ICT training and only little research of approaches to online teaching, it is important to explore how the extent of pedagogical training is related to teachers' approaches to online teaching and the use of digital tools.

Aims and research questions

The aim of this study is to explore therelationship of pedagogical and ICT training in university teachers' approaches to online teaching and the use of digital tools.

Research questions:

1. How are teachers' pedagogical and ICT training related to their approaches to online teaching?
2. How are teachers' pedagogical and ICT training related to their usage of digital tools?

Context

Development of digital teaching and learning in a multidisciplinary university

In our study, we examine teachers' digital teaching at a large multidisciplinary university in Finland. The university is divided into 11 faculties on four campuses with an academic community of about

4,000 teachers and researchers and 35,000 students. The university has a Centre for University Teaching and Learning that offers university pedagogy courses that are not mandatory for teachers but are considered to add merit when they apply for academic positions. University pedagogy training consists of several five-ECTS (European Credit Transfer and Accumulation System) courses that can be completed for up to 60 credits; thus, a participant can achieve a broad, formal teacher qualification. The content and extent of pedagogical training is similar to that offered at other universities in Finland (Vilppu et al., 2019). Courses deal with learning and teaching in university, assessment, supervision, pedagogical leadership, curriculum development, and research-based development of one's own teaching. Digital tools such as Moodle learning platform and Flinga collaborative tool are used in the courses and thus teachers can learn how to utilise them in their own teaching. In addition, a few pedagogical courses have also organized in full online even before the Covid-19. Many academic staff members of the university under review have voluntarily completed pedagogical courses (Saari Frimodig, 2009), typically they complete 10–25 ECTS pedagogical courses.

In addition, teachers are offered ICT training and receive personal support in implementing online teaching and assessment from the Educational Technology Services. Technological training duration varies form 1 to 3 h and it has merely focused for the training of digital tools used by the university such as Moodle and Mooc including contents of interaction, feedback and assessment. In addition, self-study materials, e.g., from Zoom, Teams, Flinga (collaborative tool for co-creation) and Presemo (tool for questions and voting) are offered.

Between 2017 and 2020, online learning was seen as one of the strategic goals of the University. However, in most courses before the COVID-19, teachers used the Moodle online learning environment. The extent to which it was used to support student learning varied considerably from mere distribution of digital learning materials to the utilization of ICT training (e.g., applying student activation functionalities) as a significant part of the course activities. Still, prior to the COVID-19, almost all courses were implemented as face-to-face instruction, with digitalisation being used as a complementary element of the course.

Methods

Participants

A total of 273 higher education teachers from the large multi-disciplinary university in Finland responded to the online survey from 19th of May to 2nd of June in 2020 at the beginning of the COVID-19. The questionnaire was sent to teaching and research staff in seven faculties divided into three groups of academic fields: humanities and social sciences (teachers in the faculties of arts, education, law and theology: 47%), health sciences (teachers in the faculties of medicine and pharmacy: 26%) and natural sciences (teachers in the faculty of science: 27%). The faculties were chosen because they represent different academic fields, both humanistic and natural sciences, and versatile teaching methods (lectures, seminars, exercises, laboratory work, field courses, workshops and practical training). Eight of the respondents did not consent to the

use of their answers in the study so the final sample size was 265. The exact response rate was difficult to estimate because the link to the questionnaire was sent to all teaching and research staff members in the target faculties. According to the university statistics on teaching and research staff, the invitation to participate was sent to about 1,920 staff members and the approximate response rate was 14%.

Most of the participants were university lecturers or clinical teachers (44%, $n = 117$). In addition, respondents included professors (25%, $n = 65$); postdoctoral researchers (10%, $n = 26$); university teachers (6%, $n = 16$) and doctoral students (5%, $n = 14$). Of the participants, 137 (53%) were female, 113 male (44%), and 10 reported gender as other and five responses were missing a gender classification. Most of the participants were from the faculties of arts (33%), science (27%), and medicine (19%). In addition, respondents came from faculties of pharmacy (6%), theology 6%, law (5%), and education (3%).

More than one-third of the respondents had more than 20 years of teaching experience (34%, $n = 89$); 29% had 11–20 years, 29% had 4–10 years and 8% had 3 years or less of teaching experience. Most of the teachers had pedagogical training. More precisely, 19% ($n = 50$) of the participants had no pedagogical training, 22% ($n = 58$) had 1–10 credits, 26% ($n = 69$) had 11–24 credits and 33% ($n = 87$) had 25 or more credits. Of the participants, 28% had a teacher qualification. Most of the teachers (48%, $n = 126$) had participated in ICT training one to three times, 20% ($n = 53$) more than three times and 32% ($n = 84$) had not participated in ICT training.

Design and procedure

The research design was cross-sectional (Matthews and Ross, 2010). A link to the questionnaire was sent via email and was followed by one reminder. Participation was voluntary and no compensation was provided. Ethical review and approval were not required for the study on human participants in accordance with the local legislation and institutional requirements (Finnish National Board on Research Integrity, 2019: https://tenk.fi/en/ethical-review). The questionnaire included a section asking respondents for consent to use the answers for research purposes.

The questionnaire consisted of questions about how and what purposes the participants had used digital tools in teaching and their beliefs about the use of digital tools in teaching over the last 2 years (2018–2020) and questions about their participation in pedagogical and ICT training and demographic questions. The questionnaire also included other questions about.

how respondents assessed their use of digital tools in teaching during the lockdown in spring of 2020 which are not addressed in this paper. It took about 20 min to complete the survey.

Measures

Pedagogical training and ICT training were measured by asking the respondents about participation in pedagogical and ICT training. They were asked the number of ECTS they had completed in pedagogical training and the number of ICT training courses they had participated in during the past three years.

Approaches to online teaching were measured by a modified version of the Approaches to online teaching scale by Nevgi et al. (2010), which originally was adopted from the Approaches to Teaching Inventory (ATI) (Trigwell and Prosser, 2004). There were six items measured on a five-point scale (1 = fully disagree; 5 = fully agree). Three items measured content-focused approach (alpha 0.77): ("I use digital technologies to deliver information and materials to students."); finally, three items measured a learning-focused approach (alpha 0.82): ("I use digital technologies in order to encourage my students to discuss the topic").

Use of digital tools for teaching were enquired by nine items measuring how and for what purpose the participants had used digital tools in teaching. This part of the survey was developed on the basis of previous studies (Häkkinen and Hämäläinen, 2012; Deng and Tavares, 2013; Myyry and Joutsenvirta, 2015) and has been used and validated in our prior study (Myyry et al., 2022). Participants were asked to rate statements on a five-point Likert-scale (1 = never; 5 = all the time). The items consisted of three factors: using digital tools for sharing/delivering information "I inform students about the course/studying" (three items, alpha = 0.81); using digital tools for activating students "My students produce collaborative learning outcomes" (four items, alpha = 0.62); and using digital tools for assessment or following progress "I give feedback and assess students' assignments or use for peer feedback and assessment" (two items, alpha = 0.77) (Myyry et al., 2022).

Data analysis

First, we conducted exploratory factor analysis (principal axis factoring with varimax rotation) for the items of approaches to online teaching. Explorative analysis of the items measuring approaches to online teaching indicated that a two-factor solution was the clearest: content-focused and learning-focused approach. Factor loadings and Cronbach's alphas are presented in Table 1. The

factor structure of the items measuring the use of digital tools has been analysed and validated in our previous study (Myyry et al., 2022). The relationships between approaches to online teaching and the use of digital tools were analysed by Pearson's correlations. The relations between pedagogical and ICT training and approaches to online teaching, and the use of digital tools were analysed by using One-Way ANOVA with the Bonferroni's post-hoc test. The effect sizes were calculated using eta squared values Statistical analyses were conducted using SPSS 25.

Results

Before the main analyses, descriptive statistics and correlations were explored. The results showed that teachers used digital tools mostly for information delivery and assessment. Respondents received the lowest scores for student activation, the highest scores for the content-focused approach and relatively high scores for the learning-focused approach. Table 2 shows the means and standard deviations of approaches to online teaching and the use of digital tools.

Pearson's correlations showed that approaches to online teaching correlated to the use of digital tools (Table 3). More precisely, the content-focused approach had the highest correlation with information delivery, whereas the learning-focused approach correlated with student activation.

Main aim was to explore how the extent of pedagogical training and ICT training are related to teachers' approaches to online teaching (Table 4). The results showed that the pedagogical training was related to the learning-focused approach. Bonferroni's *post hoc* test revealed that teachers who had more than 25 study credits of pedagogical training received statistically significantly higher scores on the learning-focused approach than teachers without pedagogical training. Similarly, ICT training was related to a learning-focused approach. Teachers who had participated in ICT training more than three times had higher scores on the learning-focused approach than teachers who had not participated in ICT training. A content-focused approach was not related to pedagogical or ICT training. However, in both cases, the effect sizes were quite small (0.034–0.029).

Then, the results showed that pedagogical training had statistically significant relations to the use of digital tools

TABLE 1 Factor loadings of the items measuring approaches to teaching.

Approaches to teaching in online context scales	Factor loading
Content-focused approach, a = 0.69	
I use technology in my teaching so that students have access to all relevant information.	0.769
I think that an important reason for using technology in teaching is to share good materials to students.	0.734
I use digital technologies to deliver information and materials to students.	0.584
Learning-focused approach a = 0.69	
I use digital technologies to encourage my students to discuss the topic.	0.807
I prefer to use technology in my teaching so that students have the opportunity to present their own ideas.	0.769
I help students develop their own understanding of the topic they are studying.	0.642

TABLE 2 Means and standard deviations of use of digital tools and approaches to teaching.

	Mean	Standard deviation
Use of digital tools		
Information delivery	3.45	0.83
Student activation	1.74	0.98
Assessment	2.15	1.27
Approaches to online teaching		
Content-focused approach	4.19	0.69
Learning-focused approach	3.53	0.85

TABLE 3 Pearson's correlations among the use of digital tools and approaches to online teaching.

	1	2	3	4	5
Information delivery	1				
Student activation	0.473	1			
Assessment	0.459	0.449	1		
Content-focused approach	0.411	0.227	0.277	1	
Learning-focused approach	0.358	0.485	0.349	0.512	1

**All the correlations are significant at the 0.001 level.

TABLE 4 Means and standard deviations of approaches to online teaching in relation to pedagogical and ICT training.

Pedagogical and ICT training	Content-focused approach		Learning-focused approach	
	Mean	SD	Mean	SD
Pedagogical training				
No pedagogical training ($n = 50$)	4.07	0.71	3.23	0.88
1–10 cr ($n = 58$)	4.30	0.56	3.62	0.64
11–25 cr ($n = 69$)	4.26	0.60	3.56	0.73
more than 25 cr ($n = 87$)	4.14	0.82	3.65	0.99
F	1.33	$p > 0.05$	3.00	$p < 0.05$
η^2	0.015		0.034	
ICT training				
No ICT training ($n = 84$)	4.07	0.85	3.34	0.90
1–3 training sessions ($n = 126$)	4.28	0.58	3.62	0.79
more than three training sessions ($n = 53$)	4.18	0.67	3.69	0.85
F	2.20	$P > 0.05$	3.93	$p < 0.05$
η^2	0.017		0.029	

TABLE 5 The relationships between the use of digital tools and pedagogical training and ICT training.

Use of digital tools	Information delivery		Student activation		Assessment	
	Mean	SD	Mean	SD	Mean	SD
Pedagogical training						
No pedagogical training ($n = 50$)	3.11	1.11	1.49	0.95	1.99	1.26
1–10 cr ($n = 58$)	3.52	0.64	1.56	0.89	1.94	1.23
11–25 cr ($n = 69$)	3.46	0.74	1.82	1.00	2.16	1.31
more than 25 cr ($n = 87$)	3.58	0.74	1.95	0.99	2.40	1.23
F	3.82	$p < 0.05$	3.40	$p < 0.05$	1.95	$p > 0.05$
η^2	0.042		0.038		0.022	
ICT training						
No ICT training ($n = 84$)	3.31	1.01	1.64	0.97	2.18	1.23
1–3 training sessions ($n = 126$)	3.49	0.71	1.79	1.01	2.06	1.35
more than three training sessions ($n = 53$)	3.56	0.77	1.80	0.91	2.33	1.07
F	1.89	$p > 0.05$	0.71	$p > 0.05$	0.88	$p > 0.05$
η^2	0.014		0.005		0.007	

(Table 5). Regarding the use of digital tools for information delivery, teachers who had no pedagogical training had significantly lower scores on information delivery than teachers who had more than 25 credits of pedagogical training. In terms of the use of digital tools for student activation, teachers who had no pedagogical training had statistically significantly lower scores than teachers who had more than 25 credits. The effect sizes were relatively small (0.042–0.038). In assessment, there were no differences between the teachers with different amounts of pedagogical training. The results also revealed that ICT training was not related to the use of digital tools.

Discussion

The present study provides new insights into teachers' pedagogical and ICT training in online teaching in higher education. In addition, it enhances knowledge about the approaches to online teaching and how teachers use digital tools in their teaching. The study showed that pedagogical and ICT training enhanced teachers' ability to apply a learning-focused approach in an online environment. The learning-focused approach is necessary for the successful integration of ICT in teaching (Glassett and Schrum, 2009). Previous studies have shown that a relatively large amount of university pedagogical training (more than 25 ECTS) is needed to influence approaches to teaching (Gibbs and Coffey, 2004; Postareff et al., 2007). This was confirmed in our study in online context. The present study also showed that teachers with an extensive amount of university pedagogical training used digital tools significantly more for student activation as well as information delivery than teachers without pedagogical training. Furthermore, the results of the present study indicate that the learning-focused approach was determinant factor for a more diverse

and interactive use of digital tools which is contradictory with a previous study (Nevgi et al., 2010).

The surprising finding of our study was that teachers' ICT training was not related to the use of digital tools, although ICT training could be expected to support the use of digital tools and the development of digital skills as studies applying the TPACK framework suggest (Brinkley-Etzkorn, 2018; Koh, 2020; Pongsakdi et al., 2021; Diamah et al., 2022). It may be that in ICT training the pedagogical content is more superficial and the training is shorter, above all, focusing on familiarization with technology, including student activation tools and technical skills. This short and formal ICT training can explain why teachers in our study used digital tools mostly for information delivery and assessment, rather than to activate students through collaborative learning tasks and discussions. It is plausible that teachers who have participated in ICT training were aware of the online tools that activate students, but they had not internalized the importance of interaction and activation for student learning. Hence, the result is in line with Inamorato dos Santos et al.'s (2019) report that highlighted the need for long-term ICT training for teachers. As such, the studies have found that the use of digital tools is rather limited, primally to organized teaching (e.g., Bond et al., 2018; Amhag et al., 2019; Weidlich and Kalz, 2021). However, the use of teaching methods that support the student's active learning such as collaborative activities in an online environment requires a sufficient pedagogical understanding of learning processes (Englund et al., 2017). On the other hand, previous studies using the TPACK framework (Mishra and Koehler, 2006; Koehler et al., 2013) showed that teachers' technological competence might exceed their pedagogical competence in online teaching (Almerich et al., 2016; Esteve-Mon et al., 2020).

The results of the present study suggest that in pedagogical training teachers enhance not only their understanding of the importance of students' active role, but they also learn to apply diverse pedagogical practices and use digital tools in multiple ways to support student learning. Our study also confirms Mishra and Koehler's (2006) claim that integration of pedagogical and technological knowledge is essential for effective teaching.

Limitations

A low response rate (14%) raises concerns about the generalisability of our results, although a low response rate is a common phenomenon in e-mail surveys, and e-mail surveys on average have a 20% lower response rate than do mail surveys (Shih and Fan, 2009). Nevertheless, the sample represented the teachers at the target university sufficiently with respect to gender, age and by the career stage. The representativeness of the sample is a more important criterion for evaluating the validity of a study than the response rate (Cook et al., 2000). Our sample consisted of respondents from several faculties with varying amounts of teaching experience as well as pedagogical and ICT training, corresponding to the distribution of teachers at the university under scrutiny, which in turn increases the validity of research. The responses to each question also varied among respondents, suggesting that our data represented a larger spectrum of teachers' use of digital tools, approaches to online teaching, rather than reflecting the ideas of a particular sub-group. The survey was carried out in the early stages of the Covid-19, when the transition to online teaching had taken place only a few weeks

earlier. The Covid-19 situation and the sudden change to remote teaching in the spring 2020 may have affected the response rate, considering that the teaching staff was busy with organizing remote teaching and examinations. It also may be highlighted in participants' responses, despite that the self-evaluation questionnaire we used was designed before the Covid-19 to measure teachers' use of digital tools over the past 2 years, not just the transition to remote teaching due to the Covid-19. This explorative study was conducted at one university, where the scope of one pedagogical course is a minimum of five ECTS and completing the course includes tasks that reflect on one's own teaching, observation of teaching and teaching practice. However, there can be differences between the HE organizations in the content and implementation of pedagogical training. The impact of voluntary pedagogical training and pedagogical professional development on applying digital teaching should be scrutinized in future studies.

Practical implications

The present study has several practical implications. First, to ensure relevant pedagogical training, it is important that pedagogical and technological aspects can no longer be separated in the context of higher education as learning environments have become more diverse. Thus, both aspects should be integrated in teachers' trainings. The TPACK model can provide a useful framework on curriculum development for integrating pedagogical and technological contents and practices. Teachers also need support to develop their online teaching toward a learning-focused approach and to promote student-centred pedagogical strategies such as solving real-life problems, interaction with peers and teachers and providing social support. Therefore, in pedagogical training, it would be important to integrate views and practices on how to support students' active learning in online courses. Furthermore, this study showed that the use of digital assessment tools was not very familiar to teachers; thus, assessment, especially formative assessment with constructive feedback, should be developed in the future to support students' learning processes. Further research should focus on the use and applicability of digital assessment tools in an online environment. The present study highlights the need for long-term pedagogical training as it showed that teachers who had 25 or more credits differed from the teachers who had no pedagogical training. Finally, teachers need institutional support for developing their pedagogical and digital competence (Zhao et al., 2021). It would be also useful to arrange collaborative group work for teachers where they possibility to learn with colleagues. Because approaches to teaching seem to be at least to some extent context specific and to be influenced by the teaching and learning environment, such as curriculum design (Kember and Kwan, 2000), it is also important that educational institutions emphasize and support a learning-focused approach. In this study, online teaching is thought to be implemented either as blended teaching or fully online course, in which teacher has a close connection with the students during the course. However, when massive open online courses are becoming would be interesting to expand the context to include MOOCs, where the presence of the teacher during the course is usually low. It would be interesting to study, for example, how teachers whose teaching is more learning-focused implement MOOCs.

In summary, the present study showed that pedagogical training plays a key role in how teachers approach their teaching and use digital tools in an online environment. It seems that pedagogical training helps teachers to cope with the changes in the learning environment and organize learning-focused teaching also in an online context, which has become one of the key learning environments. During the post-pandemic time, universities struggle to adapt to new ways of teaching, based on the lessons learned from the Covid-19 lockdown. Blended or hybrid remote teaching, as well as pure online courses such as MOOCs, are claimed to be more typical in the future (Guppy et al., 2022), which increases the need for pedagogical and ICT teacher training. The challenge today is to integrate pedagogical and technological training so that both pedagogical and technological aspects of teaching in theory and practice are better addressed.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The requirement of the studies were involving humans and the ethical approval was waived by the Finnish National Board on Research Integrity, 2019: https://tenk.fi/en/ethical-review. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

Acknowledgments

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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