# Pathway Analysis of the Dynamics of Teacher Educators' Professional Digital Competence

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**Abstract.** Institutions offering teacher education have generally been criticized for giving pre-service teachers an insufficient education regarding the pedagogical use of digital technology. In this study we investigate the dynamics of professional digital competence (PDC) among teacher educators (in primary, secondary and early childhood teacher education programmes) in Norway, Slovenia, and Portugal. A survey was constructed based on the understanding of digital competence consisting of an individual's knowledge, skills, and attitudes. Three constructed variables from the survey (Attitudes, Knowledge and skills, and Use, regarding digital technology in higher education) were analysed, and we found small differences in mean scores between the three countries. However, a pathway analysis via regressions revealed markedly different dynamics of PDC, and we discuss implications of our findings on teacher educators' use of digital technology.

**Keywords:** Digital Competence · Attitudes · Skills · Knowledge · Teacher Education · Teacher Educators · Higher Education

## 1 Introduction

The European Commission defines digital competence as a key competence for lifelong learning [1], but digital competence within teacher education is complex. Teacher educators need sufficient digital competence to teach in a digitized era, whilst at the same time they are to facilitate pre-service teachers' own development of professional digital competence (PDC) [2]. The teacher educators' PDC therefore contains several levels of competencies, including their own didactical understanding of using technology as well as content for facilitating pre-service teachers' development of PDC for other levels of the educational system. Teacher education has across nations been criticized for not preparing pre-service teachers regarding a sufficient level of PDC [3–5]. Our study aims to contribute to knowledge on what factors influence the development of PDC amongst teacher educators. More specifically, we investigate the dynamics of digital competence, building on the established understanding of digital competence as


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consisting of an individual's knowledge, skills, and attitudes [6–9]. Our study is based on survey responses from teacher educators from higher education institutions in Norway, Slovenia, and Portugal.

Research question: What are the dynamics of teacher educators' professional digital competence, and how is this related to their application of digital technology in educational practices?

## 2 Background

### 2.1 Conceptual Understanding of PDC

There are several frameworks developed trying to grasp the complexity of PDC, such as the TPACK model [10], the professional digital competence framework for teachers [11] and DigCompEdu [12]. Digital competence has developed into a complex concept, and Erstad et al. [13] discuss how this is related to a lack of conceptual clarity. What is common for the above-mentioned frameworks is that they to some extent build on the notion of competence as consisting of skills, knowledge, and attitudes (Fig. 1). This understanding is also widely used when talking about digital competence. Ferrari [6] did a review of 15 frameworks, and merged and summarized a common definition of digital competence:

> Digital Competence is the set of knowledge, skills, attitudes, abilities, strategies, and awareness that are required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning, and socialising.

The understanding of knowledge, skills, and attitudes as central for digital competence is also evident in recent studies and newer formal frameworks [1, 7, 8, 12, 14].

### 2.2 Governmental Approaches to Digital Competence in Education and Lifelong Learning for Norway, Slovenia and Portugal

The European Commission defines digital competence as a key competence for lifelong learning [1]. This understanding of competencies is globally used and is also found in policies for Norway, Slovenia, and Portugal. The same understanding of the concept is for instance described in official Norwegian reports, such as NOU 2014:7 [15] and NOU 2018:2 [16], which are formal policy documents guiding the governing of education. The same notion of digital competence is also found in Slovenian policy and documents [17] and other documents related to education [18]. Slovenia focuses intensively on the digital transformation of society, the state, local communities, and the economy to improve the quality of life of the Slovenian population. The digital transformation of the society is regarded as a key strategy to manage the future in a sustainable way [17]. The establishment of the Slovenian Ministry for Digital Transformation, the adoption of

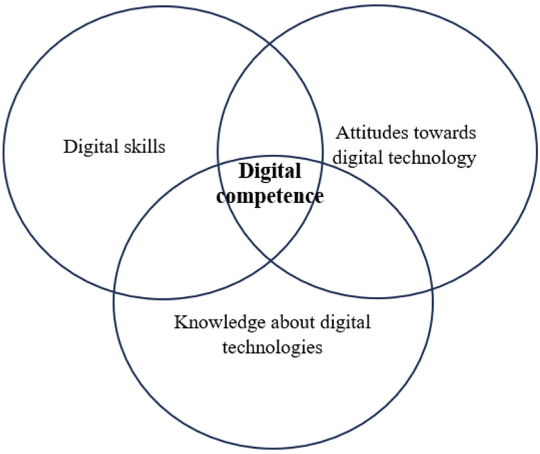


**Fig. 1.** Digital competence as a combination of knowledge, skills, and attitudes [1, 7].

the Digital Slovenia 2030 strategy [17] and sectoral strategies and action plans such as the Slovenian Action Plan for Digital Education [18] have laid the foundations for this process.

The Portuguese Ministry of Education has placed a lot of emphasis on digital skills in education. To this adds the "National Digital Skills Initiative e.2030, Portugal INCoDe.2030" [19]. This is a public policy initiative, launched in 2017, which aims to promote digital skills. For the Portuguese Ministry of Education, digital skills are essential for the full exercise of citizenship, also acting as a facilitator of employability, as they respond to the demands of the growing digitalization of the labor market: a more qualified active population gives rise to new forms of work, new professions, innovative markets and products and, therefore, more robust and competitive economic activities. The Digital Education Action Plan-Portugal (DETP, 2021–2027) [20] was initiated by the European Commission to promote the effective use of digital technologies in schools by supporting innovation in teaching and learning practices.

Even though several European frameworks are building on the same notion of digital competence, there are differences in the educational contexts and cultures in countries across Europe. This is evident when looking at national reports and policies from the three nations included in our study.

### 2.3 Norwegian Higher Education and Digital Technology

In 2021 the Norwegian ministry of education and research launched a strategy for all higher education institutions in Norway, applicable for 2021–2025 [21]. The strategy builds on the notion that there is a great unused potential regarding the application of digital technology in higher education. This strategy highlights the structure and content of education. Higher education needs to be made available through decentralized and flexible programs, as well as programs that contribute to develop students' need for specific PDC. Policy reviews of teacher programs for early childhood education show that

implementation of PDC in local curricula is limited compared to expectations expressed in national frameworks. The level of implementation also varies across institutions [22].

One challenge in meeting these goals is that educators have not developed their digital practices sufficiently. Pedagogical and didactical aspects related to applying technology in education are described to not sufficiently align with the content and the intention to facilitate students' learning processes. Educators need training in how to transform traditional education to education with, as well as through the means of, digital technology [21]. In a national report about pedagogical use of digital technology in higher education, it is clearly stated that digital technology itself does not contribute to higher pedagogical quality [23]. On the other hand, the prevailing discourse in Norwegian higher education is that digital technology can and should be applied in ways that adds value to teaching. Other legitimate reasons for applying digital technology are to offer flexible study programs to reach students in rural and remote districts in Norway. The Norwegian education system's use of technology is therefore not necessarily pedagogically motivated. The same report concludes that the biggest challenge regarding pedagogical use of digital technology in higher education is a lack of relevant and sufficient PDC among educators [23].

### 2.4 Slovenian Higher Education and Digital Technology

The use of digital technologies in Slovenian higher education is evolving, with a growing emphasis on digital competence among educators. While progress has been made, ongoing efforts are needed to ensure that all educators possess the necessary digital skills and pedagogical knowledge to effectively integrate technology into their teaching practices [24].

The Slovenian National Assembly, in March 2022, adopted a resolution on the national program of higher education until 2030 [25]. This resolution aims to improve the quality, attractiveness, and responsiveness of higher education to society. The document sets out strategic objectives in the following areas: (i) linking the higher education system to social development; (ii) improving legislation and increasing funding; (iii) enhancing quality; (iv) promoting internationalization; and (v) advancing digitalization [26]. The resolution underscores the significance of digital competencies and skills for successful operation in modern society and emphasizes the need to adapt higher education programs and processes to digital trends. It also proposes measures to enhance digital infrastructure, support, and inclusion in higher education. Furthermore, the document highlights the connection between digitalization and the green transition, which are key priorities of the EU and Slovenia. It asserts that higher education must contribute to addressing the challenges posed by digital and green transformations while promoting sustainable development and innovation in these areas. It is predicted in the document that digital internationalization will become an integral part of the higher education system, facilitating increased mobility, collaboration, and knowledge exchange among higher education institutions, students, and employees in Slovenia and abroad [26].

### 2.5 Portuguese Higher Education and Digital Technology

Higher education in Portugal does not have a specific policy regarding the development of digital skills. However, the European Digital Competence Framework for Educators (DigCompEdu) [12] is launched in Portuguese, a document aimed at teachers, from pre-school education to secondary education and higher education, but also towards adults, including general and professional training, special education, and non-formal learning contexts [27]. The Digital Education Action Plan-Portugal (DETP, 2021–2027) [18] was initiated by the European Commission to promote the effective use of digital technologies in schools by supporting innovation in teaching and learning practices. Based on European Union policy initiatives, the Portuguese Ministry of Education has implemented measures in all education cycles, from pre-school to higher education. To this end, the Ministry of Education has created the Action Plan for Digital Education, transversal to all study cycles in Portugal. It is suggested that teachers carry out an Action Plan for Digital School Development [28]. This Plan aims at the efficient use of digital technologies in teaching and learning and must be implemented by the Digital Development Team of each institution. Through the Digital Education Action Plan, it is intended that educational institutions have a common vision of high-quality, inclusive, and accessible digital education, with the aim of supporting the adaptation of education and training systems to the digital era.

## 3 Methods

This study is based on a survey conducted at institutions providing teacher education in Norway, Slovenia, and Portugal (Table 1). The target group for the study was teacher educators at teacher programs for early childhood education, and primary and secondary education. The sample from Norway included two institutions: UiT the Arctic University of Norway, with campuses in Tromsø and Alta, and NLA University College, with campuses in Oslo and Bergen. The Slovenian sample was from the University of Primorska, and the Portuguese sample was from the Catholic University of Portugal. These three countries were included in the survey because they differ with regards to context; national strategies, infrastructures, and teacher education systems (see Sect. 2.2–2.5. For more detailed context description, see Janes et al. 2023 [29] and Madsen et al. 2023 [30].

**Table 1.** Number of participants.

| Nation | Participants (n) | Response rate |
|---|---|---|
| Norway | 175 | 76.42% |
| Slovenia | 39 | 67.24% |
| Portugal | 37 | 78.72% |

An online questionnaire was used, with five-point Likert-type scales (from 1: Strongly disagree, to 5: Strongly agree). Based on the questionnaire three main constructs were established: 1. Attitudes towards digital technology in higher education (8

items), 2. Skills and knowledges regarding digital technology in higher education (8 items), and 3. Use of digital tools when teaching (16 items). For construct details see Appendix. The survey was translated to the different native languages and distributed by email through an online survey tool (Nettskjema) to all teacher educators associated with the range of teacher education at each institution. Data was gathered late 2021 and during the first half of 2022.

### 3.1 Ethical Considerations

The survey was anonymous, and participation was voluntary. We did not collect personal data or sensitive information; therefore, ethical approval was not formally needed.

### 3.2 Analysis

A simple pathway modelling and exploration was conducted via regression analysis. The dependent and independent variables were interchanged to find the best model fit. Data were analysed in SPSS (Version 29.0, IBM, Armonk, NY, USA). We calculated mean scores for the different constructs, and report mean scores for each of these. For reliability we calculated Cronbach's alpha for a measure of internal consistency, with satisfying results (Table 2). Following this, multiple linear regression analysis was conducted, and effect sizes were estimated by the standardized beta coefficients, with conventions: 0–0.1 = weak effect, 0.1–0.3 = modest effect, 0.3–0.5 = moderate effect, and >0.5 = strong effect [31, p. 749]. A goodness of fit was determined from the adjusted R-square (i.e. explanatory power): 0–0.1 = poor fit, 0.1–0.3 = modest fit, 0.3–0.5 = moderate fit, and >0.5 = strong fit [31, p. 804]. When presenting the results, explanatory power is shown as percentage based on the adjusted R-square.

The results from the regression analyses are presented in tables based on the different models and individual analyses were conducted for each nation (Table 3, 4 and 5). The statistically significant standardized regression coefficients for each nation in Tables 3, 4 and 5 are further visualized in three models of the dynamics of digital competence (Figs. 2, 3 and 4). As the elements within digital competence are mutually affecting each other we conducted regression analyses without assuming a one-way relationship between attitudes, skills, and knowledges. Neither are we assuming that there is a one-way relationship between competencies and use of technology, as using technology will also affect educators' level of knowledge, skills, and attitudes.

### 3.3 Limitations

The study has several limitations that could affect the validity of the results and needs to be addressed. The study includes small sample sizes for some of the nations, which makes the results less reliable. Due to the small sample sizes and the fact that data is collected at only one university for some nations, we have no intention of generalizing the finding to a larger national context. Nevertheless, we have no indication that the universities included in the study stand out in comparison to other universities.

Results regarding comparison between nations must be read with reservations, as the survey response scales are constructed with vague quantifiers. For instance, what is understood as "often" in one national context could differ from another national context.

When conducting research within our own workplaces there is always a risk of researcher bias. As this is a quantitative study with limited elements of subjective interpretations, we assess this risk as limited. There is a risk during the discussion that we are affected by preconceptions associated with our positions within the field we are researching.

## 4 Results

Teacher educators in all three countries showed a similar pattern in their answers (Table 2). The construct "use of digital tools when teaching" indicate that they occasionally utilised digital tools (Table 2). The mean scores for Norway show a tendency towards answering "rarely". On the construct "attitudes toward digital technology" the mean score indicated answers in the range from neutral to "agree", which can be interpreted as relatively positive attitudes, but with some restraints (Table 2). On this construct the variation around the mean (standard deviation) was highest among the constructs for Norway and Slovenia, indicating a higher variation in answers when it came to attitudes than the two other constructs. On the questions about knowledge and skills related to technology, the teacher educators evaluated themselves quite positively (Table 2). The Norwegian and Portuguese teacher educators mostly agreed on statements describing different aspects of their skills and knowledge, whereas the teacher educators from Slovenia scored slightly lower on this variable.

**Table 2.** Mean scores (SD). 1–5 (See Appendix for details).

| Multi item constructs | Norway | Slovenia | Portugal |
|---|---|---|---|
| Use of digital tools when teaching (16 items, alpha = 0,775) | 2.89 (0.53) | 3.06 (0.65) | 3.00 (0.49) |
| Attitudes towards digital technology in higher education (8 items, alpha = 0,811) | 3.21 (0.74) | 3.54 (0.73) | 3.67 (0.56) |
| Knowledge and skills related to technology in higher education (8 items, alpha = 0,775) | 4.00 (0.57) | 3.65 (0.67) | 3.99 (0.60) |

### 4.1 Norway

When looking at the pathway-analysis based on the Norwegian sample, there were significant and reciprocal relations between Use and Knowledge & skills, and between Knowledge & skills and Attitude (Fig. 2, Table 3, 4 and 5). The effect sizes of the significant predictors were all within the modest effect interval (for intervals see Sect. 3.2). No significant relations were found between the variables Attitude and Use (Fig. 2, Table 5).

**Table 3.** Regression analysis with Use as the dependent variable, and Attitude, and Knowledge & skills as predictors.

| Nation | Predictors | Beta (standardized) | P-value | R-square |
|---|---|---|---|---|
| Norway | Knowledge and skills | **.362*** ** | <.001 | .16 |
| | Attitude | .103 | .187 | |
| Slovenia | Knowledge and skills | **.591** ** | .013 | .15 |
| | Attitude | −.232 | .312 | |
| Portugal | Knowledge and skills | .410 | .080 | .09 |
| | Attitude | −.365 | .117 | |

**Table 4.** Regression analysis with Knowledge and skills as the dependent variable, and Use, and Attitude as predictors.

| Nation | Predictors | Beta (standardized) | P-value | R-square |
|---|---|---|---|---|
| Norway | Use | **.308*** ** | <.001 | .29 |
| | Attitude | **.376*** ** | <.001 | |
| Slovenia | Use | **.270*** | .013 | .61 |
| | Attitude | **.693*** ** | <.001 | |
| Portugal | Use | .214 | .080 | .49 |
| | Attitude | **.711*** ** | <.001 | |

**Table 5.** Regression analysis with Attitude as the dependent variable, and Use, and Knowledge & skills as predictors.

| Nation | Predictors | Beta (standardized) | P-value | R-square |
|---|---|---|---|---|
| Norway | Knowledge and skills | **.419*** ** | <.001 | .21 |
| | Use | .098 | .187 | |
| Slovenia | Knowledge and skills | −.122 | .312 | .55 |
| | Use | **.802*** ** | <.001 | |
| Portugal | Knowledge and skills | **.724*** ** | <.001 | .49 |
| | Use | −.194 | .117 | |

Attitude was thus not a predictor for teacher educators' use of technology, and neither was their use of technology predicting their attitude. Knowledge and skills on the other hand seemed to be a central element for both use and attitude. However, the variation explained in either of the three regressions were modest (Table 3, 4 and 5, see Sect. 3.2 for intervals of explanatory power).

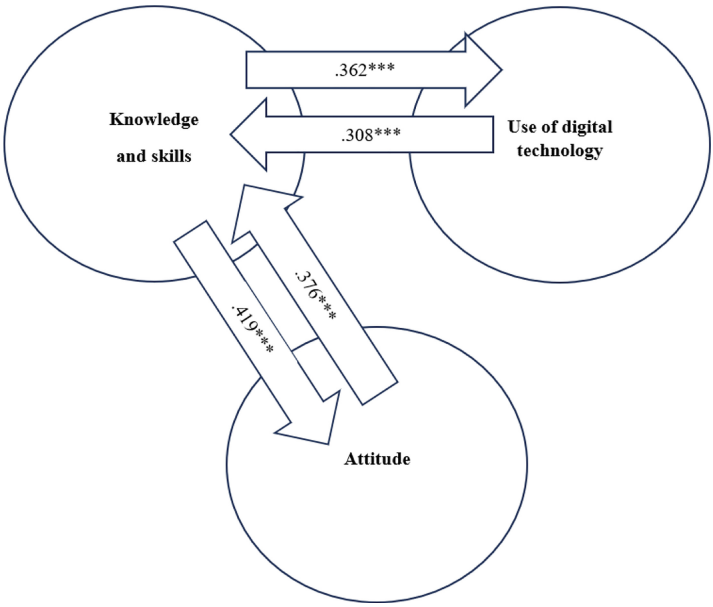


**Fig. 2.** Dynamics between elements of digital competence and the use of digital technology in Norwegian teacher education (significant standardized coefficients in the arrows). Arrows point from predictors to dependent variables.

### 4.2 Slovenia

The results from the Slovenian dataset (Fig. 3) showed that the variables Use and Knowledge & skills were mutually affecting each other; Use was a significant predictor of Knowledge & skills and vice versa. The teacher educators' knowledge and skills could be predicted by both Use and Attitude (Table 4). This model had strong explanatory power (0.61 = strong fit, see Sect. 3.2 for intervals of explanatory power). The effect of attitude was more than double the effect of Use on Knowledge & skills. Following the pathway, we see that Attitude influenced Knowledge & skills, Knowledge & skills had an impact on Use, and Use was a significant predictor of Attitude. There was thus a circuit of indirectly related variables.

### 4.3 Portugal

For the Portuguese sample there was a distinct mutual relationship between Knowledge & skills and Attitude (Fig. 3). The knowledge & skills of the teacher educators in Portugal could explain almost 50% of the variation in their attitudes and vice versa ($R^2$ in Table 4 and 5). There were no significant relationships between Use and Attitude, or between Use and Knowledge & skills.

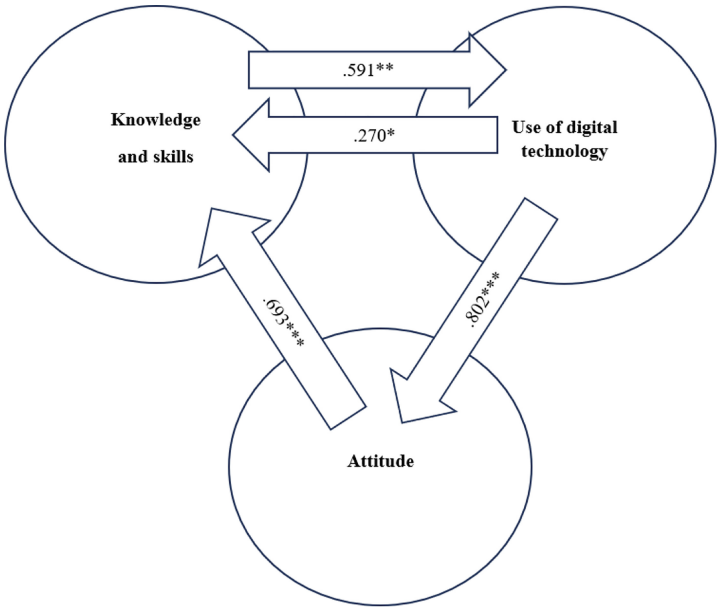


**Fig. 3.** Dynamics between elements of digital competence and the use of digital technology in Slovenian teacher education (significant standardized coefficients in the arrows). Arrows point from predictors to dependent variables.

## 5 Discussion

Teacher educators in the three countries included in our study (Norway, Slovenia, and Portugal) had quite similar use of digital technology in pedagogical settings, which was also the case for knowledge and skills, and attitudes towards the use of digital technology. However, the dynamics of the relationships between these factors were distinctly different between the countries. One consistent finding though, was that the use of digital technology could not be predicted by the teacher educators' attitudes in any of the countries.

Provided that the goal of the governmental processes described in the Sects. 2.2 to 2.5, is to improve and increase the use of digital technology in teaching, our results indicate that processes aiming to influence the attitudes of teacher educators will not necessarily lead to success. This contrasts previous studies where attitudes were found to have the strongest effect on technology use [32]. We found, on the other hand, that attitude was a significant predictor for teacher educators' knowledge and skills, and that knowledge and skills could partly explain the use of digital technology in their teaching. Based on our results it may seem like the educational systems are still in their empirical phase, i.e. experience with digital technology is gained prior to established attitudes regarding the matter. Attitude thus seemed to be a factor that indirectly affected teacher educators' use of digital technology, while the actual use of digital technology and gained skills and knowledge seemed to be the basis for developed attitudes in the current phase of the digital transformation of education.

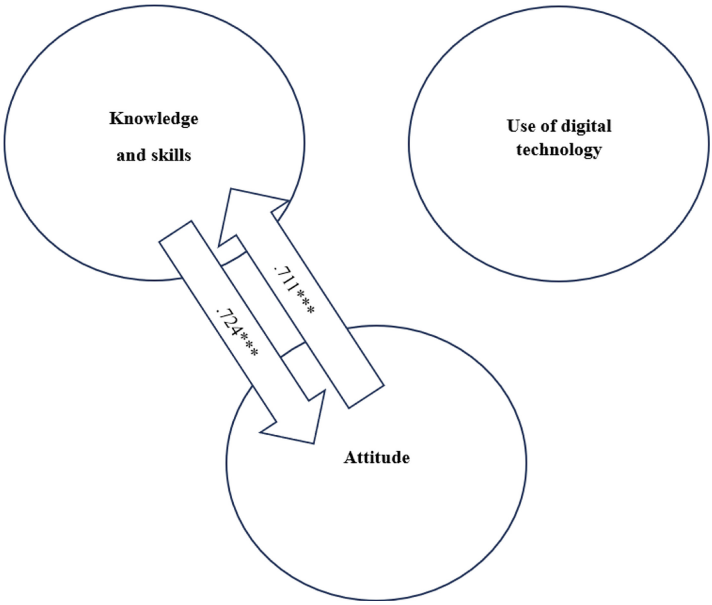


**Fig. 4.** Dynamics between elements of digital competence and the use of digital technology in Portuguese teacher education (significant standardized coefficients in the arrows). Arrows point from predictors to dependent variables.

The actual use of digital technology in the teacher educators' pedagogical work is likely to be influenced by factors that we have not measured, such as curriculum content, expectations and technical-pedagogical support provided by leaders, structure of the study programmes, responses from students, or access to equipment and software in the lecture rooms [2, 33–36]. These are possible explanations to why we found that knowledge and skills, or attitudes towards digital technology, to a limited extent could explain the teacher educators' use of digital technology in our study. In fact, these constructs could not explain the use of digital technology amongst Portuguese teacher educators at all. Furthermore, we deal with self-reported data, in which there is a risk that they are overrated (see e.g. [7, 37]. This could influence the measured relationship between the extent of teacher educators' use of digital technology, their attitudes and knowledges and skills. In general, conclusions based on our findings should be drawn with some caution. For instance, the results from the Norwegian sample differ from previous results based on the same survey tool conducted prior to the pandemic. A comparative study of teacher educators from Norway and New Zealand concluded that the professional use of digital tools was dominated by professional attitude [38].

The Covid-19 pandemic and the recent introduction of AI could be relevant setbacks or changes in the development of PDC amongst teacher educators. The imposed and extensive use of distant education during Covid-19 changed pre-service teachers' attitudes towards education [39]. Teacher educators are also expressing concerns regarding students' in-depth learning and development of critical thinking skills when learning is influenced by digital technology [40]. Times are challenging for teacher educators as

the context is developing fast, and there is an ongoing need to adapt to these challenges [41]. For instance, ChatGPT set a record for the fastest-growing consumer application in history when launched in November 2022. The tool is estimated to have reached 100 million monthly active users within two months after launch [42]. The implication of an educational transformation like this, where we are in the process of finding out artificial intelligence's impact on education, is that teacher educators must proactively seek to educate themselves and their students [43]. Indeed, in our study we have found that knowledge and skills may influence the teacher educators' use of digital technology. Our findings thus underline the importance of teacher educational institutions to facilitate further development of educators' knowledge and skills to achieve competent use of digital technology in education.

## 6 Conclusion

The conducted pathway analyses show that for the contexts we have investigated, knowledge and skills is a significant predictor of teacher educators' pedagogical use of digital technology for two of the three countries included in our study. Attitude does not significantly predict teacher educators' use of technology when teaching but has an indirect relation to teacher educators' use of technology, as attitude is a predictor for knowledge and skills. What sems to be a disruption within teacher educators' PDC is argued to be related to the ongoing educational transformation, inducing educators to rapidly develop new knowledges and skills.

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**Availability of Data and Materials.** The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

**Competing Interests.** The authors declare that they have no competing interests.

## Appendix: DigiCross Survey Items Used in This Study

**Use of Technology When Teaching**
Which digital tools and work methods have you used in your own teaching in the past year?

The following variables have the alternatives: 1 Never, 2 Rarely, 3 Occasionally, 4 Often, 5 Extensively

1. Digital tools for testing with multiple choice questions
2. Platforms like Moodle or Fronter (Learning management systems).
3. Digital tools for presentations (like Powerpoint or Prezi)

4. Word processor
5. Spreadsheets (like Excel)
6. Use of video
7. Production of film/video/animation
8. Online discussions
9. Online meetings (like Lync, Adobe Connect or Skype)
10. Production of Wiki (website which allows collaborative modification)
11. Screen capture (like Camtasia or Mediasite)
12. Programs for scientific analyses (like SPSS)
13. Student response systems, Online questions answered by phone or computers (like Kahoot og Socrative
14. Tools for collaborative writing (like Google docs)
15. Social media (like Facebook or Twitter)
16. The internet as a source of knowledge

**Digital Skills and Knowledge About Technology in Teacher Education**
The following variables have the alternatives: 1 Strongly disagree, 2 Disagree, 3 Neutral, 4 Agree and 5 Strongly agree.

1. I am familiar with digital tools that can help diversify teaching.
2. I am, in general, confident when using digital tools.
3. I find it easy to become familiar with new digital tools.
4. I can use digital tools which are appropriate for the subjects I am teaching.
5. It is difficult to use digital tools as an educational resource within my subject (reversed).
6. When I am using digital tools it is difficult to adjust the content to the individual student's needs (reversed).
7. I have no clear idea of learning outcome when using digital tools in my teaching (reversed).
8. I use digital tools when giving feedback to students.

**Attitudes Towards Technology in Teacher Education**
The following variables have the alternatives: 1 Strongly disagree, 2 Disagree, 3 Neutral, 4 Agree and 5 Strongly agree.

1. When I use digital tools in my teaching, I find it adds value.
2. The use of digital tools is essential for good teaching.
3. Society's expectations of the impact of digital tools are exaggerated (reversed).
4. Expectations related to the use of digital tools in education frustrates me (reversed).
5. In professional debates at my university, the expectations of the impact of digital tools are exaggerated (reversed).
6. The use of digital tools is disruptive for the relationship between student and educator (reversed).
7. Digital tools can make the students more interested in the subject I am teaching.
8. I like testing new digital tools in my teaching.

## References


1. European Commission, Directorate-General for Education, Youth, Sport and Culture: Key competences for lifelong learning. Publications Office (2019). https://data.europa.eu/doi/10.2766/569540
2. Nagel, I., Guðmundsdóttir, G.B., Afdal, H.W.: Teacher educators' professional agency in facilitating professional digital competence. Teach. Teach. Educ. **132** (2023). https://doi.org/10.1016/j.tate.2023.104238
3. Gudmundsdottir, G.B., Hatlevik, O.E.: Newly qualified teachers' professional digital competence: implications for teacher education. Eur. J. Teach. Educ. **41**(2), 214–231 (2018). https://doi.org/10.1080/02619768.2017.1416085
4. Napal Fraile, M., Peñalva-Vélez, A., Mendióroz Lacambra, A.M.: Development of digital competence in secondary education teachers' training. Educ. Sci. **8**(3) (2018). https://doi.org/10.3390/educsci8030104
5. Nelson, M.J., Voithofer, R., Cheng, S.-L.: Mediating factors that influence the technology integration practices of teacher educators. Comput. Educ. **128**, 330–344 (2019)
6. Ferrari, A.: Digital Competence in Practice: An Analysis of Frameworks. Publications Office of the European Union, Luxembourg (2012)
7. Hämäläinen, R., Nissinen, K., Mannonen, J., Lämsä, J., Leino, K., Taajamo, M.: Understanding teaching professionals' digital competence: what do PIAAC and TALIS reveal about technology-related skills, attitudes, and knowledge? Comput. Hum. Behav. **117**, 106672 (2021)
8. Spiteri, M., Chang Rundgren, S.-N.: Literature review on the factors affecting primary teachers' use of digital technology. Technol. Knowl. Learn. **25**, 115–128 (2020)
9. Vuorikari, R., Kluzer, S., Punie, Y.: DigComp 2.2: The Digital Competence Framework for Citizens—With New Examples of Knowledge, Skills and Attitudes; Publications Office of the European Union, Luxembourg (2022). https://publications.jrc.ec.europa.eu/repository/handle/JRC128415. Accessed 25 Mar 2024
10. Koehler, M.J., Mishra, P.: What is technological pedagogical content knowledge? Contemp. Issues Technol. Teach. Educ. **9**, 60–70 (2009)
11. Kelentric, M., Helland, K., Arstorp, A.-T.: Professional Digital Competence Framework for Teachers (2017). https://www.udir.no/globalassets/filer/in-english/pfdk_framework_en_low2.pdf. Accessed 25 Mar 2024
12. Redecker, C., Punie, Y.: European Framework for the Digital Competence of Educators: DigCompEdu. Publications Office of the European Union, Luxembourg (2017). https://doi.org/10.2760/178382
13. Erstad, O., Kjällander, S., Järvelä, S.: Facing the challenges of 'digital competence'. Nord. J. Digit. Literacy **16**(2), 77–87 (2021). https://doi.org/10.18261/issn.1891-943x-2021-02-0
14. European Commission: Digital Education Action Plan (2021–2027). Resetting Education and Training for the Digital Age; European Union: Maastricht, The Netherlands (2020). https://ec.europa.eu/education/sites/default/files/document-library-docs/deap-communication-sept2020_en.pdf. Accessed 1 June 2023
15. NOU 2014:7. Elevenes læring i fremtidens skole – Et kunnskapsgrunnlag [Students learning in future schools – a knowledge foundation] (2014). https://www.regjeringen.no/no/dokumenter/NOU-2014-7/id766593/. Accessed 25 Mar 2024
16. NOU 2018:2. Fremtidens kompetansebehov I – Kunnskapsgrunnlaget [Future needs of competencies I – a knowledge foundation] (2018). https://www.regjeringen.no/no/dokumenter/nou-2018-2/id2588070/. Accessed 25 Mar 2024
17. Government of the Republic of Slovenia: Digital Slovenia 2030 – An Overarching Strategy for Slovenia's Digital Transformation by 2030 (DSI 2030). https://nio.gov.si/nio/asset/strategija+digitalna+slovenija+2030?lang=en. Accessed 21 Jan 2024

18. Ministry of Education of the Republic of Slovenia: Digital Education Action Plan (ANDI) 2021–2027. https://www.gov.si/assets/ministrstva/MVI/SDIG/SI-Digital-Education-Action-Plan-EN-web.pdf. Accessed 25 Nov 2023
19. INCoDe, Iniciativa Integrada de política pública dedicada ao reforço de com-petências digitais. https://www.incode2030.gov.pt/incode-2030/. Accessed 02 Jan 2024
20. European Commission, Digital Education Action Plan (2021–2027). https://education.ec.europa.eu/focus-topics/digital-education/action-plan. Accessed 02 Jan 2024
21. Norwegian Ministry of education and research: Strategi for digital omstilling i universitets- og høyskolesektoren, 2021–2025 (2021). https://www.regjeringen.no/contentassets/c151afba427f446b8aa44aa1a673e6d6/no/pdfs/kd-strategi-digital-omstilling.pdf
22. Madsen, S.S., Unstad, T., Tveiterås, N.C., Dardanou, M., Habbestad, H., Kosner, L.: Planverkets blindsone? En analyse av profesjonsfaglig digital kompetanse i emneplanbeskrivelser for barnehagelærerutdanning. Nordisk barnehageforskning **20**(4), 103–128 (2023). https://doi.org/10.23865/nbf.v20.531
23. Korsberg, L., Svartefoss, S.M., Bergene, A.C., Hovdhaugen, E.: Pedagogisk bruk av digital teknologi i høyere utdanning. Rapport 2022:1. NIFU (2022)
24. Čampelj, B., Jereb, E.: Report on smart education in the Republic of Slovenia. In: Zhuang, R., et al. (eds.) Smart Education in China and Central & Eastern European Countries. LNCS, pp. 293–319. Springer, Singapore (2023). https://doi.org/10.1007/978-981-19-7319-2_12
25. Resolucija o nacionalnem programu visokega šolstva do 2030 (ReNPVŠ30), Uradni list RS, št. 49/22 (2022). http://www.pisrs.si/Pis.web/pregledPredpisa?id=RESO139
26. European Commission, Directorate-General for Education, Youth, Sport and Culture: Education and Training Monitor 2022 – Country Analysis: Slovenia (2022). https://op.europa.eu/webpub/eac/education-and-training-monitor-2022/en/country-reports/slovenia.html#6-higher-education. Accessed 01 June 2023
27. Lucas, M., Moreira, A.: DigCompEdu: quadro europeu de competência digital para educadores. Universidade de Aveiro (2018)
28. SELFIE PTK (N/D). O que é o Plano de Ação para o Desenvolvimento Digital da Escola (PADDE) baseado na SELFIE? [What is the School Digital Development Action Plan (PADDE) based on SELFIE?]. https://education.ec.europa.eu/focus-topics/digital-education/action-plan. Accessed 2 Jan 2024
29. Janeš, A., et al.: Preliminary results from Norway, Slovenia, Portugal, Turkey, Ukraine, and Jordan: investigating pre-service teachers' expected use of digital technology when becoming teachers. Educ. Sci. **13** (2023). https://doi.org/10.3390/educsci13080783
30. Madsen, S.S., et al.: International perspectives on the dynamics of pre-service early childhood teachers' digital competences. Educ. Sci. **13** (2023). https://doi.org/10.3390/educsci13070633
31. Cohen, L., Manion, L., Morrison, K.: Research Methods in Education, 8th edn. Routledge, Washington (2018)
32. Blackwell, C.K., Lauricella, A.R., Wartella, E.: Factors influencing digital technology use in early childhood education. Comput. Educ. **77**, 82–90 (2014). https://doi.org/10.1016/j.compedu.2014.04.013
33. Røkenes, F.M., et al.: Teacher educators' professional digital competence in primary and lower secondary school teacher education. Nordic J. Digit. Lit. **1**, 46–60 (2022)
34. Lindfors, M., Pettersson, F., Olofsson, A.D.: Conditions for professional digital competence: the teacher educators' view. Educ. Inquiry **12**(4), 390–409 (2021). https://doi.org/10.1080/20004508.2021.1890936
35. Amhag, L., Hellström, L., Stigmar, M.: Teacher educators' use of digital tools and needs for digital competence in higher education. J. Digit. Learn. Teach. Educ. **35**(4), 203–220 (2019). https://doi.org/10.1080/21532974.2019.1646169

36. Carpenter, J.P., Rosenberg, J.M., Kessler, A., Romero-Hall, E., Fischer, C.: The importance of context in teacher educators' professional digital competence. Teach. Teach. (2024). https://doi.org/10.1080/13540602.2024.2320155
37. Merritt, K., Smith, D., Renzo, J.C.D.: An investigation of self-reported computer literacy: is it reliable? Issues Inf. Syst. **6**(1), 289–295 (2005)
38. Madsen, S.S., Thorvaldsen, S., Archard, S.: Teacher educators' perceptions of working with-digital technologies. Nord. J. Digit. Literacy **13**(3), 177–196 (2018). https://doi.org/10.18261/issn.1891-943x-2018-03-04
39. Madsen, S.S., Thorvaldsen, S.: Implications of the imposed and extensive use of online education in an early childhood education program. Nordisk barnehageforskning **19**(1) (2022). https://doi.org/10.23865/nbf.v19.258
40. Madsen, S.S., Thorvaldsen, S., Sollied, S.: Are teacher students' deep learning and critical thinking at risk of being limited in digital learning environments? IntechOpen (2021). https://doi.org/10.5772/intechopen.96151
41. Nagel, I.: Digital competence in teacher education curricula: what should teacher educators know, be aware of and prepare students for? Nord. J. Comp. Int. Educ. **5**(4), 104–122 (2021)
42. Hu, K.: CHATGPT sets record for fastest-growing user base - analyst note. Reuters (2023). https://www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/#:~:text=The%20report%2C%20citing%20data%20from,analysts%20wrote%20in%20the%20note
43. Trust, T., Whalen, J., Mouza, C.: Editorial: ChatGPT: challenges, opportunities, and implications for teacher education. Contemp. Issues Technol. Teach. Educ. **23**(1), 1–23 (2023)