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Future-Ready Educators: Assessing Digital Competence and Teaching Preparedness Among Prospective Teachers in the 21st Century

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Abstract

In the 21st century, it is critical for teachers to possess digital competence. This research aims at: (1) measuring prospective teachers' digital competence levels and (2) exploring their perceptions about teaching readiness in the 21st century. The participants consisted of 6 male and 29 female prospective teachers. The DigCompEdu self-reflection tool was used in this study, with a focus on 6 competencies—teaching, guidance, collaborative learning, self-regulated learning, assessment strategies, and feedback and planning—in combination with a questionnaire on teaching readiness in the 21st century. Data from close-ended questions were analyzed statistically, while data from open-ended questions were analyzed and coded using the NVivo 12 Plus application. The results showed that 6% of the participants were at level A1, 28% were at level A2, 46% were at level B1, 14% were at level B2, and 6% were at level C1 of digital competence, but no one was at level C2. In terms of teaching readiness in the 21st century, only some participants expressed their readiness to integrate a variety of digital technologies in the classroom. This research provides an overview of educational study programs that might be useful for developing prospective teachers' digital competence in the effort to prepare skillful teachers in the 21st century.

Keywords: digital competence for educator, 21st century education, teaching readiness

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1. Introduction

In the 21st century, information and communications technologies (ICT) have altered every aspect of society, from the way of interaction and work to the educational system. There have arisen significant changes due to technological advancements, globalization, institutional constraints, and social alterations (Sen et al., 2018). In the educational sphere, besides the factors above, changes are also

driven by technological innovations, hyper-competition, and advancements in education (Alpaydin & Demirli, 2022). Extensive developments of technology have propelled changes in education, as in the changing role of a teacher in the 21st century, who is expected to be more forward-thinking, curious, and flexible (Sulaiman & Ismail, 2020). The traditional teacher-centered approach, passive learning, and time-based, textbook-driven,

fragmented curriculum do not seem to cater to the learning needs of 21st century students (Reiter, 2017).

In the 21st century, learning involves a higher degree of collaboration and partnership between the teacher and students than learning in the traditional way, where the teacher acts as the primary decision-maker for the students (Syahputra, 2018; Indriastuti, 2022). Students now are more intelligent, independent, extremely capable, technologically savvy, and comfortable with global and intercultural communication (Strauss & Camins, 2015).

The challenge faced by prospective teachers in teaching students in 21st century education is about giving students the skills they need to succeed in this new world and helping them grow the confidence to practice those skills (Zamora & Zamora, 2022; Yusuf 2022). Teachers in the 21st century need to act as facilitators, guide students to learn and explore on their own (Strauss & Camins, 2015), maintain students' intrinsic and extrinsic motivation during lessons (Azzahro et al., 2021), guide students in understanding and utilizing digital resources wisely (Tarihoran, 2019), and master 21st century skills (Thornhill-Miller et al., 2023). Honing 21st century skills is essential to ensure that students are prepared for college, career, and civic life.

As teachers act as role-models and learning facilitators for their students, it is vital for them to be equipped with the digital competence necessary for all citizens to be able to adapt and actively participate in a digital society (Redecker & Punie, 2017; Asiyah, 2018) and to prepare them for future workforce (Tondeur et al., 2023). In addition to becoming digitally literate, teachers should also encourage their students' digital competence and take advantage of digital technologies' potential to improve and innovate teaching (Ghomi & Redecker, 2019). Teachers must maintain

their digital literacy to be able to search for information, gather it, and analyze it critically, and to create tools and use a range of web-based services (Muammar et al., 2023).

Digital competence for teachers refers to the collection of knowledge, skills, and attitudes that teachers must possess to be able to integrate and use technology appropriately and effectively to achieve their goals (Sen et al., 2018). It is an essential competence that teachers must master in today's society, as digital capabilities have become very important in the context of education (Baskaran et al., 2019). Digital competence for teachers is critical to the success of the education system, and it is important for initial and ongoing training for teachers to ensure that they have the necessary digital competence (Caena & Redecker, 2019; Shadiev & Wang, 2022), including the ability to create and edit digital content, ensuring digital security, and problem-solving skills (Chai & Kong, 2017; Maghfiroh et al, 2020; Niyazova et al., 2023).

Consequently, higher education, particularly faculties of education, needs to ensure that students as prospective teachers are equipped with the digital competence referred to earlier to participate in society, both personally and professionally (Astuti et al., 2019). Thus, it is critical to measure the level of digital competence of final semester students in the education department as prospective teachers in order to ascertain whether their digital competence meets the standards required for teaching in the 21st century. The results of this study will provide input for the study program regarding student needs for digital technology course materials so that students may gain sufficient competence to design and organize activities based on technology and to carry out cooperative learning in the classroom.

This study adopts the European Framework for the Digital Competence of Educators

(DigCompEdu) with a total of 22 competences designed to capture and describe educator-specific digital competences necessary to effectively use digital technologies for teaching (Redecker & Punie, 2017). The instrument consists of 22 items on professional engagement (4 questions), digital resources (3 questions), teaching and learning (4 questions), assessment (3 questions), empowerment of learners (3 questions), and facilitation of learners' digital competence (5 questions).

The entire instrument items are used by teachers to self-assess their individual strengths and learning needs (Ghomi & Redecker, 2019; Yang et al., 2022). However, in this study, the researchers focused only on 6 competences (teaching, guidance, collaborative learning, self-regulated learning, assessment strategies, and feedback and planning). For greater clarity, the 6 competencies examined in this study can be explained in Figure 1.

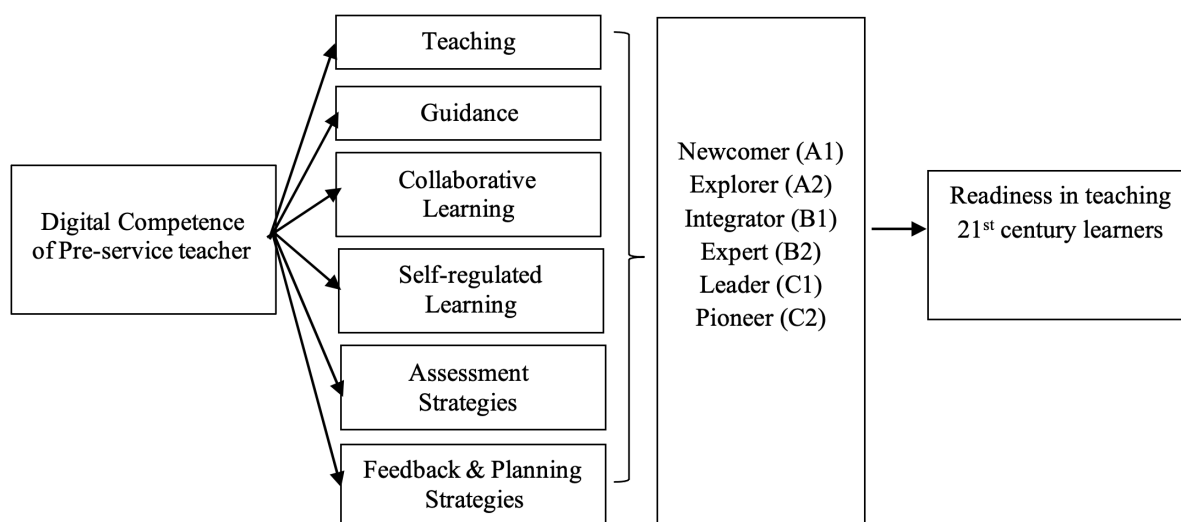


Figure 1. Research Framework

To sum up, this study aims to find out prospective teachers' digital competence levels, particularly on educator' pedagogic competence related to digital resources, and to explain how they perceived their teaching readiness in the 21st century. The research questions guiding the current research are as follows: (i) What is the digital competence level of prospective teachers? (ii) How ready are students to teach in the 21st century? This study will help the participants (prospective teachers) reflect on their strengths and weaknesses in using and integrating digital technology in the teaching and learning process. The results of this study will generate insights into prospective teachers' digital competence

in education and help design in-service teachers' instructional media courses.

2. Method

a. Research Design

This research used a mixed-methods approach which combined qualitative and quantitative research methods to produce comprehensive, valid, reliable, and objective data. Quantitative and qualitative research methods were employed simultaneously with different method portions, with the quantitative method being primary and the qualitative method being secondary. Quantitative data were obtained from participants' self-assessment of

digital competence using close-ended questions, while qualitative data were obtained from participants' answers to open-ended questions about their readiness to teach in the 21st century.

b. Participants and Settings

The participants of the research were aged 20 to 22 and were taking an English education program at one of three private universities in East Java province, Indonesia. They had previously taken instructional media and micro-teaching courses and/or a student internship program as teacher assistants at schools where they were conducting their teaching practice. The participants consisted of 6 male and 29 female prospective English teachers (sixth semester students).

c. Instruments and Data Collection

Two different types of questions were used in this study: close-ended and open-ended. The two types of questions will be discussed in the following sub-section. The close-ended questions were developed based on the DigCompEdu framework developed by [Redecker & Punie \(2017\)](#). A total of 22 competences are contained in the DigCompEdu framework, but the researchers only focused on 6 competences in this study: teaching,

guidance, collaborative learning, self-regulated learning competence, assessment strategies, and feedback and planning. These six competences were chosen because this research concerns itself with measuring prospective teachers' learning outcomes from instructional media courses after undertaking an internship program at school. The selected competences were basic competences related to teaching and learning, as well as assessment, that teachers must have.

d. Data Analysis Technique

In this study, the first data obtained from students' self-assessment were calculated statistically. The data were classified into six categories, namely Newcomer (A1), Explorer (A2), Integrator (B1), Expert (B2), Leader (C1), and Pioneer (C2). Each category represents a level of digital competence (Table 1).

The second part focused on the participants' perspectives on their level of digital competence in relation to their teaching readiness in the 21st century. The data gained from this part were analyzed using Miles and Huberman' (2008) model, which comprises data reduction, data display, and data verification. The NVivo 12 plus application was applied for data coding and ensuring the accuracy of the qualitative data.

Table 1. Proficiency level based on the Common European Framework of Reference for Languages (CEFR)

Levels	Explanation
Newcomer (A1)	Newcomers are aware of how digital technologies might improve professional and educational practices. However, they have relatively little exposure to digital technologies and mostly use such technologies for organizing communications within their organizations or for planning lessons. Newcomers require direction and support in order to broaden their skill set and use their current digital competency in the pedagogical setting.
Explorer (A2)	Explorers are interested in using digital technologies to improve educational and professional practices since they are aware of their potential. They have begun utilizing digital technologies in some areas of digital competency, but without adopting a thorough or consistent strategy. Explorers require support, wisdom, and inspiration, for instance, through the leadership and mentoring of peers, entrenched in a cooperative exchange of practices.

Levels	Explanation
Integrator (B1)	Digital technologies are used for a number of reasons and circumstances by integrators, who incorporate them into many of their processes. They creatively employ digital technologies to improve a variety of professional engagements. They are keen to diversify their set of exercises. However, they are still trying to figure out which tools are most effective in certain circumstances and how to adapt digital technologies to pedagogical tactics and procedures. To become Experts, Integrators just need more time for exploration and reflection, as well as group support and information sharing.
Expert (B2)	Experts skillfully, creatively, and critically employ a variety of digital tools to advance their professional endeavors. They carefully choose which digital technology to use in what circumstances, and they research the advantages and disadvantages of various digital tactics. Knowing there are many things they have yet to try, they are eager and receptive to new ideas. Their repertory of tactics is expanded, organized, and solidified via experimentation. Any educational organization's ability to innovate in practice depends on its experts.
Leader (C1)	Leaders use digital tools to improve pedagogical and professional activities in a comprehensive and consistent manner. They use a variety of digital tactics from which they are able to select the best one for every particular circumstance. They review and improve their procedures on a constant basis. Through peer exchanges, they stay informed of novel concepts and advances. They impart their knowledge to others, who they inspire by their experience.

3. Result and Discussion

a. Digital Competence Level

The data from the responses to the questionnaire on the digital competence of pre-service teachers are presented in figure 2. The data are detailed as follows: 2 participants (5.71%) were at level A1, 13 participants (37.1%) were at level A2, 7 participants (20%) were at level B1, 9 participants (25.7%) were at level B2, 1 participant (2.86%) was at level C1, and 3 participants

(8.57%) were at level C2. It shows that most of the respondents were making basic use of available digital technologies for instruction, integrating available digital technologies meaningfully into the teaching process, and using digital technologies purposefully to enhance pedagogic strategies. Very few of them were orchestrating, monitoring, and flexibly adapting the use of digital technologies to enhance pedagogic strategies and using digital technologies to innovate teaching strategies.

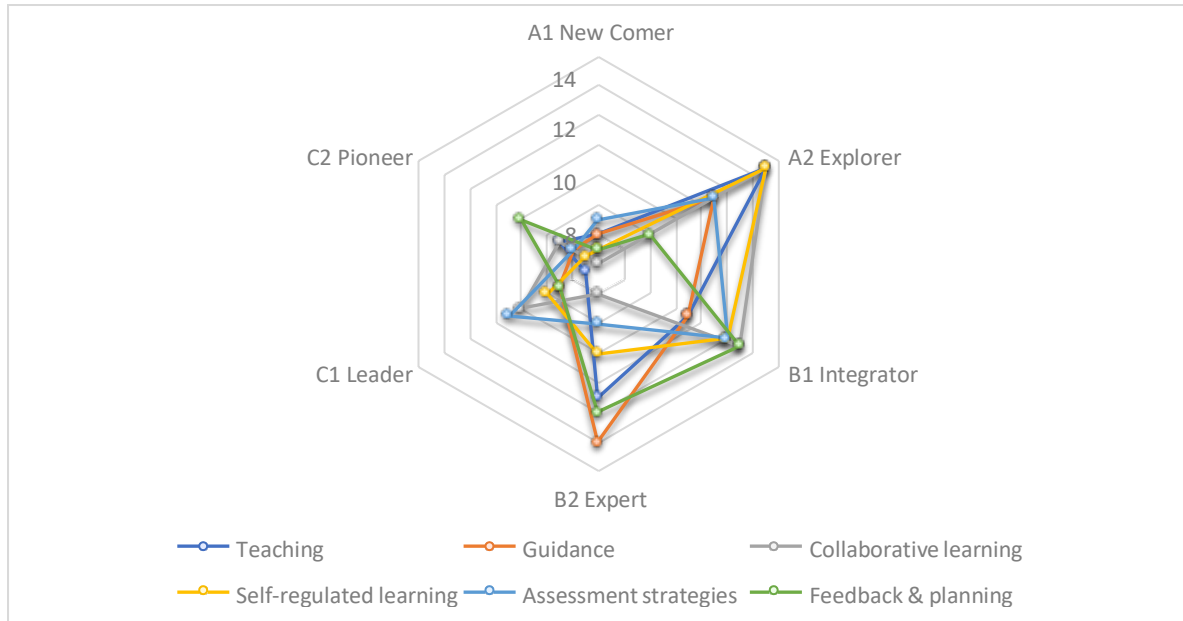


Figure 2. Digital Competence Level of Prospective teachers

The results for the guidance competence are as follows: 2 participants (5.71%) were at level A1, 9 participants (25.7%) were at level A2, 7 participants (20%) were at level B1, 12 participants (34.3%) were at level B2, 3 participants (8.57%) were at level C1, and 2 participants (5.71%) were at level C2. These results indicate that most of these prospective teachers were employing basic digital strategies to interact with learners, using digital technologies to enhance interaction with learners, and using digital technologies to enhance monitoring and guidance. Only a few of them were employing digital technologies strategically and purposefully to provide guidance and support and using digital technologies to innovate guidance provision.

The results for the collaborative learning competence are as follows: no participant (0%) was at level A1, 13 participants (37.1%) were at level A2, 11 participants (31.4%) were at level B1, 2 participants (5.7%) were at level B2, 6 participants (17.1%) were at level C1, and 3 participants (8.6%) were at level C2. These results show that the participants were encouraging learners to use digital technologies in their collaborative activities,

implementing digital technologies into the design of collaborative activities, and using digital environments for learners' collaborative knowledge generation and peer assessment. The fact that no one was at level A1 is a good thing, yet very few were at level B2 and level C2, meaning that not many of the participants were using digital environments to support collaborative learning and using digital technologies to innovate learner collaboration.

For the self-regulated learning competence, the results were as follows: 1 participant (2.9%) was at level A1, 13 participants (37.1%) were at level A2, 10 participants (28.6%) were at level B1, 6 participants (17%) were at level B2, 4 participants (11.4%) were at level C1, and 1 participant (2.9%) was at level with C2. Based on these results, the participants were encouraging learners to use digital technologies in self-regulated learning activities, implementing digital technologies into the design of self-regulated learning activities, and using digital environments to comprehensively support self-regulated learning.

For the assessment strategies competence, the results were as follows: 3 participants (8.6%) were at level A1, 9 participants (26%) were at level A2, 10 participants (23%) were at level B1, 4 participants (11%) were at level B2, 7 participants (20%) were at level C1, and 2 participants (5.7%) were at level C2. The data show that the participants mostly were integrating digital technologies into traditional assessment strategies, employing and modifying existing digital assessment tools and formats, and comprehensively and critically selecting, creating, and adapting digital assessment formats. Few of them were strategically using a range of digital assessment formats and developing innovative assessment formats using digital technologies.

For the feedback & planning competence, the results were as follows: 1 participant (2.9%) was at level A1, 4 participants (11%) were at level A2, 11 participants (31%) were at level B1, 10 participants (29%) were at level B2, 3 participants (8.%) were at level C1, and participants (17%) were at level C2. The last results indicate that mostly the participants were using digital technologies to inform and provide feedback, using digital data to enhance the effectiveness of feedback and support, and using digital data to evaluate and improve teaching. Very few of them were using digital technologies to personalize feedback and support.

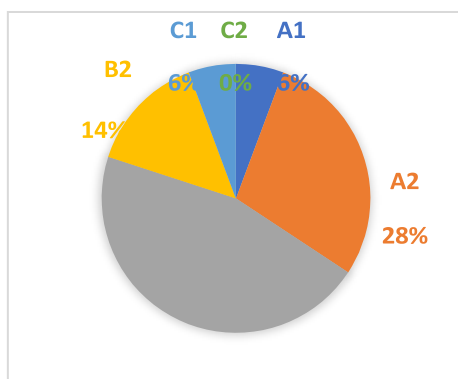


Figure 3. The Average of Prospective Teachers' Digital Competence Level

From the data of each category above, it can be concluded that generally the participants (prospective teachers) were at B1/Integrator level (46%), showing that they were eager to add new workouts to their repertoire (figure 3). However, the best tools to use in specific situations, as well as integration of digital technology with educational strategies and practices, still need working out. Integrators only require additional time for inquiry and reflection, as well as for group support and knowledge exchange, to advance to the status of Experts. In addition, 28% of the participants were at A2/Explorer level. Since they were aware of their potential, the participants were interested in adopting digital technologies to enhance professional and educational practice as explorers. They had started using digital technology in a few areas of digital competency, but they had yet to develop a comprehensive or consistent plan. The leadership and guidance of peers, rooted in a cooperative exchange of practices, could provide the support, knowledge, and inspiration that they needed.

b. Teaching Readiness in the 21st Century

The responses to the open-ended questions related to pre-service teachers' teaching readiness teaching in the 21st century were analyzed and coded using the NVivo 12 plus application. These responses were analyzed in three terms: (1) the importance of digital competence, (2) teaching readiness in the 21st century, and (3) efforts in increasing the digital competence (Figure 5).

particularly on integrating digital technology into assessment.

5: There is much to be improved, especially in designing and developing learning experiences and assessments in the digital era.

15: I learnt about technology related to student assessment, which is currently closely related to online tasks and online assessment.

Other participants realized that they had to adjust to the needs of their learners along with the ever-evolving technology. They also thought that technology integration could help students learn, nurture creativity, and derive enjoyment in learning.

8: I will re-learn about latest digital technology to suit my needs and targets.

25: I will try to provide assistance to students with up-to-date information and ideas that are relevant today.

20: I must learn continuously and develop broad insights using technology along with its positive and negative sides.

19: Collaborate in learning using digital technology or hands-on methods to help with students' understanding and development at school.

28: Setting up a creative and dynamic learning atmosphere.

32: I must master the use of technology-based media to make learning activities more varied and enjoyable.

In the current era of technological transformation, it is urgent for teachers to be able to adjust by integrating digital technology in classroom learning. The challenges posed by the digital era need to be addressed by both students and academics with expertise in various areas (Cabero-Almenara et al., 2021, 2022). Digital teaching competence refers to

the development of a certain set of abilities, knowledge, and attitudes that is necessary for the technical, pedagogical, and didactic integration of information and communications technologies (ICT) in educational environments (Lin et al., 2023).

On average, pre-service teachers were at B1/Integrator level (46%) of digital competence, which means that they were eager to add new workouts to their repertoire. They just required additional time for inquiry and reflection, as well as for group support and knowledge exchange, to advance to the status of Experts. This result supports the previous finding that teacher candidates have a high enough information and technology literacy skill (Arslangilay & Arslangilay, 2019). In addition, 28% of those pre-service teachers were at A2/Explorer level, which means that they were aware of their potential and interest in adopting digital technologies to enhance their professional and educational practice. They had started using digital technology in a few areas of digital competency, but they had yet to develop a comprehensive or consistent plan. The leadership and guidance of peers, rooted in a cooperative exchange of practices, could provide the support, knowledge, and inspiration that they needed as explorers (Redecker & Punie, 2017). This result is consistent with the finding of a previous study that EFL teachers were less confident in their TPACK (Wang, 2022).

However, it was also found that there was not a single participant who was at level C2, which means that the participants had yet to reach the Pioneer stage. Pioneers are motivated by a desire to innovate further in education and are concerned about the limitations or weaknesses of current approaches. Pioneers explore with advanced and complex digital technologies and/or create sophisticated instructional strategies. Level C2 is equivalent to the level of creating in Bloom's taxonomy, where individuals invent, design,

devise, and produce something. A previous study revealed that teacher candidates' scores of TPACK in the Remember, Understand, and Apply categories were higher than those in the Analyze, Evaluate, and Create categories (Wang, 2022; Sekar Pramesty et al., 2022).

The participants were able to tell the importance of integrating digital technology into their classroom practice, which will help students in many ways. It might be simpler than ever to see the value of ICT in education as a new generation of instructors grow more technologically savvy and reap its benefit. This is in accordance with the results of previous research by Lin et al. (2023). The findings of this study demonstrate that digital teaching competence not only serves as a direct predictor of student empowerment but also as a key mediator for ICT attitude, proficiency, and data literacy. This implies that enhancing instructors' digital teaching competence will encourage them to empower students.

Half of the participants clearly stated that they were confident of their ability to use digital technology and expressed their readiness in developing their teaching skills with a technology integration. Pozas & Letzel (2021) have previously stated that future instructors are confident of their ability to convey content in various digital formats and familiar with a wide range of digital tools.

Additionally, the participants also revealed their drawbacks and weaknesses related to the integration of technology in assessment, teacher-student interaction using technology, and giving feedback for students. They might see possible obstacles in relation to learner empowerment, particularly taking into account any digital issues that students might have when completing digital assignments, and they might not provide feedback in digital form (Muammar et al., 2023; Yuliawati et al., 2021). Introducing and pro-

moting a student-centered, constructivist pedagogical approach in teacher education positively influences the development of digital literacy (Wohlfart & Wagner, 2022).

It is extremely important that prospective teachers be aware of their weaknesses so that they can make a continuous improvement in their capacity in order to be adequately prepared and fit to teach in the 21st century. It is not only a matter of how they use and develop digital technology-based learning media (Indriastuti, 2019). It is important that their students be involved in creating and innovating with the help of digital technology to achieve learning goals (Permono et al., 2019). The improvement of the teaching and learning process is enabled by instructors' ICT self-efficacy (Rachman et al., 2021). ICT self-efficacy should focus on reorganizing the educational process and rethinking how students learn rather than just on specific ICT skills (Kaminskiené et al., 2022). Pre-service teachers also need to receive training in not only data protection and privacy but also authorship screening while searching for and utilizing Internet photos, using open-source software, respecting online communication norms and ethical and responsible technology use (Torres-Hernández & Gallego-Arrufat, 2022; Galerin et al., 2021). It is also crucial for them to recognize the benefits of integrating digital technology with classroom-based teaching as well as the barriers and challenges that can hinder successful implementation (Bralić & Divjak, 2018). These challenges include a cognitively challenging setting (Sulistyanto et al., 2022), technical issues (Listiaji et al., 2022), disruptions and distractions (Setyaningrum et al., 2023), and teachers' confidence issue (Al-Siyabi & Dimitriadi, 2020).

The results of this study indicate that all respondents had realized the importance of mastering all digital competences, as included in the DigCompEdu instrument (including professional engagement, digital resources,

teaching and learning, assessment, empowering learners, and facilitating learners' digital competence). However, based on their self-assessment, there was a gap between their teaching needs at school (from the teaching preparation process to the teaching implementation and assessment) and the conditions that they were under. The media instructional courses provided by education study programs were considered unable to close this gap. The results of this study may offer input to educational study programs in developing instructional media courses to meet the needs of prospective teachers to become skilled teachers in the 21st century. The learning outcomes of these instructional media courses are evident when prospective teachers demonstrate this digital competence while they are undergoing an internship program at school.

4. Conclusion

In the 21st century, digital competence becomes an important aspect to develop for prospective teachers. This study used a standardized questionnaire based on a validated DigCompEdu framework developed by Redecker & Punie. A total of 22 competencies are contained in the DigCompEdu framework, but the researchers only focused on 6 competencies in this study: teaching, guidance, collaborative learning, self-regulated learning competence, assessment strategies, and feedback and planning. The questionnaire was combined with several open-ended questions asking about prospective teachers' readiness to teach in the 21st century. This study involved prospective teachers' self-assessment of their own strengths and weaknesses in using digital technology in the teaching and learning process.

Additionally, this study measured learning outcomes from instructional media courses and internship programs. The study provides input for the study program for the

improvement of the courses and programs and for the development of prospective teachers' digital competence to prepare skilled teachers in the 21st century. The limitation of this study was that the number of respondents was too small to meet the researchers' need due to the very low response rate of the participants to the online questionnaires. A larger sample size would enable a deeper quantitative analysis and, therefore, a deeper qualitative analysis.

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