



Challenges and Opportunities in Preparing Prospective Teachers in the Digital Era: A Critical Study Based on Digital Literacy Profile

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ARTICLE INFO

Keywords:

Challenges and Opportunities
Preparing Prospective Teachers
Digital Era
Digital Literacy Profile

ABSTRACT

Purpose—The preparation period for prospective teachers at the Teacher Training Institute begins with preparing them to navigate the digital era. Digital literacy is a crucial competency that needs to be effectively developed during this period. This study aimed to evaluate the opportunities and obstacles associated with preparing prospective teachers for the digital era by examining their digital literacy profiles.

Methodology—This research employed a quantitative descriptive research design involving 250 students from the Faculty of Teacher Training and Education at Timor University. We conducted the research in three stages: preparation, implementation, and final. The research data, obtained through a digital literacy questionnaire, underwent quantitative descriptive analysis.

Findings - The study's results indicated that prospective teachers' average digital literacy score was 73.86, with 60% of respondents falling into the "good" category. However, only 13.6% of respondents exhibited digital literacy in the "outstanding" category. We classified 26.4% of respondents as "fairly good," "bad," and "very bad." This variation suggests a gap that must be rectified by optimizing internal factors, such as student self-awareness, and external factors, such as technology-based training and increased access to digital devices. The curriculum for prospective teacher education should prioritize the enhancement of digital literacy.

Significance—Consequently, to establish an environment that motivates the enhancement of digital literacy, it is imperative that educational institutions, the government, and the private sector collaborate. Internally, Teacher Training Institutions must ensure the development and implementation of project-based curricula that effectively integrate technology to prepare prospective teachers for digital literacy and 21st-century skills.

Received 8 January 2024; Received in revised form 15 January 2025; Accepted 26 April 2025

Jurnal Eduscience (JES) Volume 12 No. 2 (2025)

Available online xx April 2025

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INTRODUCTION

Education is a critical component of life that is a top priority in national development. Its role is highly strategic, as it serves as the foundation for the development of a generation capable of positively impacting society and educating the nation's lives. Quality education is intended to cultivate students' potential in knowledge, attitudes, and skills, thereby preparing them to meet the challenges of a constantly evolving world. Students can be developed into individuals capable of addressing a variety of life challenges and possess critical and creative thinking skills through implementing optimal education. Furthermore, education enhances students' capacity to adjust to various changes, particularly in the digital era, which is characterized by the rapid advancement of science and technology. The development of a competitive and elite generation depends on this future-focused education (Amadi, 2023; Zamhari et al., 2023).

As previously stated, the performance of various parties, particularly teachers, significantly influences the achievement of positive contributions to the implementation of education. Teachers' contributions significantly influence the education process. Teachers are expected to be capable of adapting to the changing times, mastering educational technology, and incorporating a variety of innovations into the teaching and learning process in the ever-evolving digital era. It is anticipated that teachers will continue enhancing their professional competencies by engaging in ongoing learning and training as change agents (Farisia & Syafi'i, 2024; Fitria & Suminah, 2020). Therefore, educators are not only facilitators of learning but also serve as the driving force behind educational transformation, ensuring that students grow into adaptive, creative, and critical individuals who can confront the challenges of the digital age.

The preparation period for prospective teachers is where teacher readiness in the digital era begins, in addition to the coaching and training that occurs during their term of office (Keshavarz & Ghoneim, 2021). The Teacher Training Institution is primarily responsible for this process, which plays a strategic role in developing prospective teachers who are competent and relevant to the current needs. The Teacher Training Institution prepares prospective teachers effectively to implement digital learning using information and communication technology (ICT). Prospective teachers need to be equipped with knowledge related to digital devices and skills in using these digital devices to develop interactive, innovative, and effective learning. This knowledge and skills are a long-term investment because prospective teachers have the capital to become competent future teachers, digitally literate and able to face the demands of digital learning. Prospective teachers can become future teachers who are adaptive to the needs of the increasingly complex world of education, along with rapid global developments (Durak, 2021).

The Teacher Training Institution can make a real effort to empower prospective teachers' digital literacy skills. As one of the 21st-century skills, digital literacy can be interpreted as the ability to utilize digital technology effectively and efficiently. Digital literacy is not only limited to the technical ability to operate digital devices but is related to the ability to access, evaluate, and utilize digital information wisely. With good quality digital literacy, teachers can access information from various digital sources, evaluate and select this information, and use valid and reliable information to enrich teaching materials. Digital literacy can also have a positive impact on increasing teacher creativity. Teachers can explore various digital sources as a basis for developing and using learning models, learning media, and various digital learning support platforms. Teachers can build a critical and adaptive learning ecosystem for global developments based on reliable data and facts (Kusumawati et al., 2021; Rifai, 2021).

The empowerment of prospective teachers in digital literacy must be carried out holistically, and all aspects of digital literacy must be considered, as Nugroho and Nationality (2020) convey. The first aspect, namely the Functional Skill and Beyond aspect, is the ability to utilize various technologies and digital devices, including accessing the internet to meet the need for information. The second aspect, namely the Creativity aspect, is the ability to explore various digital technology devices to produce ideas, innovations, and creative products according to the community's needs. The third aspect, collaboration, is building cooperation in the digital world. The fourth aspect, namely communication, is the ability to utilize digital technology to convey messages and ensure that the message is conveyed clearly to the recipient. The fifth aspect is finding and selecting information, which is the ability to search for, select, and use valid and

reliable information. The sixth aspect, namely Critical Thinking and Evaluation, is the ability to think critically about the information received so that individuals can make decisions based on in-depth analysis. The seventh aspect, namely Cultural and Social Understanding, is an awareness of the cultural and social values in the digital environment so that interactions in the digital space can occur with mutual respect. E-Safety is the eighth aspect of protecting oneself from digital world threats such as hacking, online fraud, and privacy violations. By empowering all these aspects comprehensively, individuals become competent technology users and can adapt, think critically, and contribute positively to a dynamic digital ecosystem.

The challenges in developing digital literacy for teachers are still quite significant, even though they are important in determining the quality of education today. According to Siregar (2024), some problems when teaching digital literacy are the fast progress in science and technology, the lack of appropriate curriculum, and the fact that teachers are not trained to use technology. Digital literacy can be hard to learn in places with few technological resources, unstable internet connections, and insufficient digital literacy training. This is especially true in remote areas or places with little digital infrastructure. This has a more severe effect if teachers and prospective teachers do not comprehend the significance of digital literacy in the learning process, resulting in a lack of motivation to develop this skill independently. In reality, digital literacy is not merely an auxiliary skill but an essential requirement for educators to ensure the success of learning in the digital age. Teachers who lack digital literacy are inclined to perceive technological advancements as a hindrance and a burden on their responsibilities. Conversely, educators with a high level of digital literacy will perceive the rapid advancement of science and technology as an opportunity to advance and leverage technology to enhance the quality of education. One of the mandatory competencies that must be developed is digital literacy, particularly for prospective teachers who will later interact directly with the current generation of students who are highly proficient in technology (Ahmad, 2022; Warsiyah et al., 2022).

Until now, several studies have reported the urgency of digital literacy for teachers. However, what should be noted is that the study is still being carried out involving teachers in areas with adequate access to technology. These studies focus on efforts to uncover teachers' digital literacy and supporting factors for digital literacy for teachers in areas equipped with technological devices and stable and good internet access (Nahdi & Jatisunda, 2020; Sholihah, 2022). In particular, no research has analyzed the digital literacy of teachers in border areas, including the Indonesia-Timor Leste border. This needs attention because information about digital literacy can be the basis for developing digital literacy for teachers facing the challenge of limited technological facilities that are not as complete as other areas. Information specific to border areas can be the basis for exploring the challenges and opportunities for teachers in developing their digital literacy, including prospective teachers in border areas.

The main reason for this research is the lack of information regarding the digital literacy profile of prospective teachers in the Indonesia-Timor Leste border area. The urgency of this research lies in the need for specific information regarding the digital literacy of prospective teachers in border areas, which can then become the basis for analysis of the challenges and opportunities for preparing prospective teachers. Although regionally, prospective teachers in these areas face challenges that may be more complex than prospective teachers in other regions, adapting to the needs of the digital era has become a global challenge that cannot be ignored. This research is important to provide an initial overview and a basis for formulating strategies for developing the competencies of prospective teachers. Thus, this research not only provides an academic contribution to understanding the digital literacy of prospective teachers but also has a significant practical impact in supporting the transformation of education in the digital era. It is hoped that this research can be the first step in creating more inclusive, adaptive, and technology-based education so that it can produce teacher candidates who are superior and ready to face the challenges of the digital era.

METHODOLOGY

Research Design

This research is a quantitative descriptive study to analyze the digital literacy profile of prospective teachers in border areas as a basis for mapping challenges and opportunities in preparing prospective

teachers for the digital era. This study specifically aims to (1) identify the level of digital literacy of prospective teachers based on the aspects of digital literacy measured, (2) analyze the main challenges faced by prospective teachers in improving digital literacy, and (3) explore opportunities that can be utilized in improving the digital literacy of prospective teachers in the Indonesia-Timor Leste border area.

Participants

The prospective teachers are students at the Faculty of Teacher Training and Education at Timor University, located in the Indonesia-Timor Leste border area. We conducted the research in three stages: preparation, implementation, and final. The description of the research procedure can be seen in Figure 1. In the preparation stage, sample determination and preparation of digital literacy instruments were carried out. From 1447 FKIP Timor University students who were the population in this study, a sample of 15-25% of students was taken. The sampling technique used was simple random sampling, while the number of samples of 15-25% was determined by referring to Arikunto's opinion (2006). The questionnaire was distributed to prospective teachers who could be accessed with the consideration that all students had an equal opportunity to be selected as a sample. The digital literacy instrument employed in this investigation was a digital literacy questionnaire created and validated by Nugroho and Nationality (2020).

Data Collection and Analysis

The instrument consists of general statements that can be applied in various contexts without requiring modification. Therefore, this questionnaire is still used in its original form to assess the digital literacy of prospective teachers in border areas. The aspects of digital literacy explored were Functional Skill and Beyond, Creativity, Collaboration Communication, The Ability to find and select Information, Critical Thinking and Evaluation, Cultural and Social Understanding, and E-Safety. Furthermore, at the implementation stage, the activities carried out were distributing and filling research instruments both offline and online in the form of Google Forms. The research was then continued to the final stage, namely the data analysis stage. The data analysis was carried out using quantitative descriptive analysis, and the digital literacy category of prospective teacher students was determined by referring to the digital literacy category as explained in Table 1. Descriptive analysis includes calculating percentages and average values to gain a deeper understanding of the digital literacy profile of prospective teachers.

Table 1. Digital Literacy Category

No.	Score	Category
1.	20-35	Very bad
2.	36 - 52	Bad
3.	53– 68	Fairly good
4.	69-84	Good
5.	85-100	Very good

Solahudin et al., (2022)

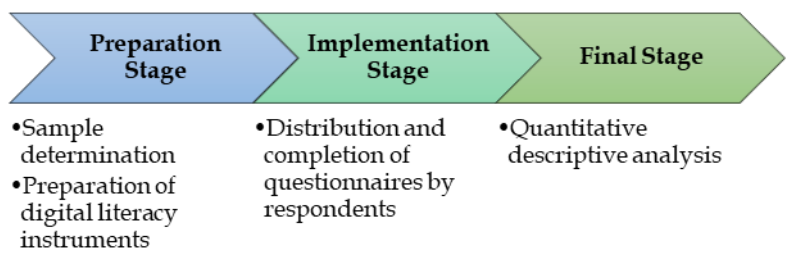


Figure 1. Research Implementation Flow

FINDINGS

Digital literacy instruments were distributed and completed to assess the digital literacy profile of prospective teachers in the border region between Indonesia and Timor Leste. 250 prospective teacher students, or 17.3% of the population, comprised the sample in this study. These students were all active students at the Faculty of Teacher Training and Education at Timor University. Table 2 presents the details of the respondents' data.

Table 2. Respondent Data Details

Variables	Freq	%
Gender		
Man	57	22,8
Woman	193	72,2
Origin of Study Program		
1.Mathematics Education	48	19,2
2.Biology Education	78	31,2
3.English Education	42	16,8
4.Indonesian Language and Literature Education	82	32,8

Based on the results of the digital literacy data analysis, the average digital literacy score of prospective teacher students was 73.86, which is in the good category. The digital literacy categories of prospective teacher students are presented in detail in Figure 2.

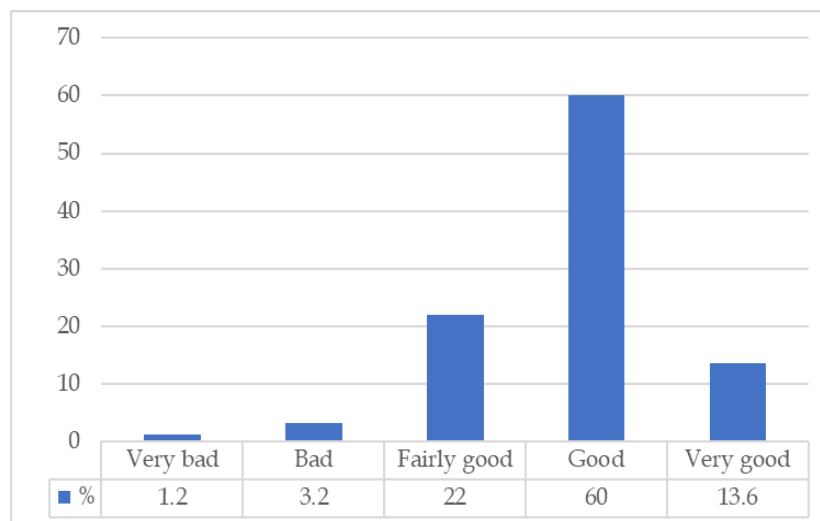


Figure 2. Digital Literacy Categories of Prospective Teachers in the Indonesia-Timor Leste Border Area

Based on the facts presented in Figure 2, it can be seen that as many as 1.2% or three respondents have digital literacy in the naughty category, as many as 3.2% or eight respondents have digital literacy in the bad category, as many as 22% or 55 respondents have digital literacy in the reasonably good category, as many as 60% or 150 respondents have digital literacy in the good category and only 13.6% or 34 respondents have digital literacy in the very good category level. This shows that even though most students have reasonably good digital literacy skills, a small number still need more attention in developing their digital literacy.

Furthermore, to obtain a more detailed picture of the digital literacy of prospective teachers in the Indonesia-Timor Leste border area, Figure 3 will present the average value for each aspect of digital literacy, namely the Functional Skill and Beyond aspect, the Creativity aspect, the Collaboration aspect, the Communication aspect, the ability to find and select Information aspect, the Critical Thinking and Evaluation aspect, the Cultural and Social Understanding aspect and the E-Safety aspect. The data in Figure 3 shows that all aspects of digital literacy of prospective teachers in the border areas of the Indonesia-Timor Leste are in a good category. The Functional Skill and Beyond aspect has an average value of 71.16; the

Creativity aspect has an average value of 74.45; the Collaboration aspect has an average value of 71.52; the Communication aspect has an average value of 75.65, the ability to find and select Information aspect has an average value of 74.68, the Critical Thinking and Evaluation aspect has an average value of 72.11, the Cultural and Social Understanding aspect has an average value of 77.68, and the E-Safety aspect has an average value of 75.52. Information regarding the average value of each aspect shows that the aspect with the lowest value is the Functional Skill and Beyond aspect. In contrast, the aspect with the highest value is the Cultural and Social Understanding aspect. This indicates that compared to basic skills in using technology, prospective teachers in border areas better understand sociocultural aspects of the digital world.

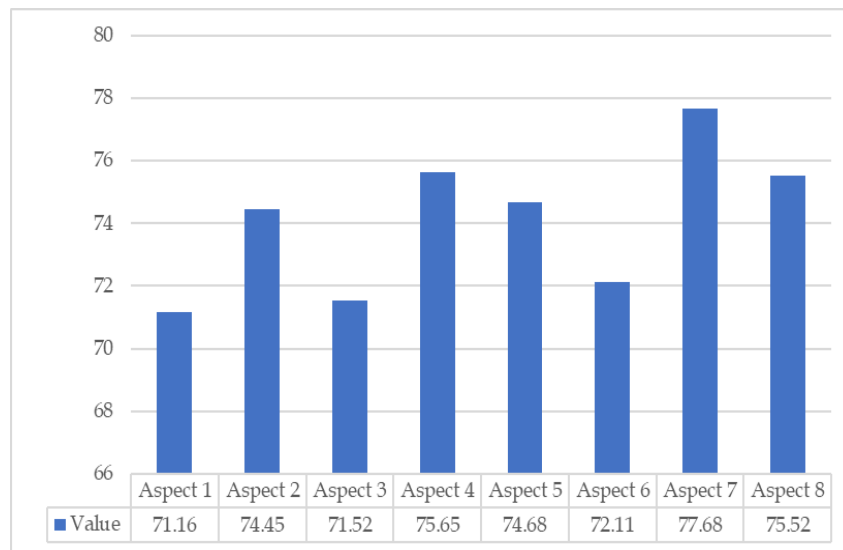


Figure 3. Average Value of Each Aspect of Digital Literacy of Prospective Teachers in the Indonesia-Timor Leste Border Area

DISCUSSION

The study results showed differences in the quality of digital literacy between prospective teachers in the Indonesia-Timor Leste border area, and differences in personal quality could have caused it. Previous studies, namely McDougall et al. (2018) and Syah et al. (2019), reported that several aspects of personal abilities that can affect the quality of digital literacy are academic abilities, reading habits, and habits of using online media. These personal abilities can be influenced by support from external parties. Academic ability is the personal ability to understand, process, and conduct a critical analysis of the information obtained. Reading habits and habits of online media refer to the quality of individual interaction with various sources of information, both printed and digital. External support can describe the broad opportunities for a person to develop themselves optimally with the available facilities. Although research data shows that the average digital score of border area teacher candidates is in a good category, only a few teachers have digital literacy in the very good category. This needs attention because digital literacy empowerment has not been optimal. This empowerment needs to be carried out holistically by optimizing various supporting factors. There is a need to increase mentoring and mentoring activities for prospective teachers to use technology for academic purposes. It is also necessary to increase the quantity and quality of activities using technology in learning. These activities need to be designed and implemented in a structured and integrated manner with the prospective teacher education curriculum (Golth et al., 2024; Marais, 2023).

Facts about academic grades, reading routines, online media usage activities, and external support have also been reported by previous studies, including Eryansyah et al. (2020), Rosalina et al. (2021), and Terras & Ramsay (2016). Furthermore, Rini et al. (2022) and Siswanto et al. (2022) reported that curiosity, motivation, and self-determination can influence students' digital literacy. Curiosity and motivation can be significant capital for someone to access various information sources, including digital sources, as a basis for forming new knowledge and experiences through 21st-century developments. Meanwhile, self-determination allows

someone to control themselves in their learning activities so that all activities are carried out solely for academic purposes. Individuals who have curiosity, motivation, and good self-control will not only be able to access a wide variety of information, but these individuals will also be able to select all information from digital media so that the use of technology will be carried out well and responsibly. In addition to individual factors, socio-economic and institutional aspects also play a role in achieving digital literacy. Prospective teachers with better access to digital devices, stable internet, and a good academic environment tend to have higher levels of digital literacy. However, for prospective teachers who come from low-income economic backgrounds or have limited access to digital resources, the development of their digital literacy can be hampered. Therefore, efforts to increase digital literacy can be carried out at the individual level and need to consider institutional policies and government intervention (Indari, 2022).

The facts regarding the digital literacy of prospective teacher students in the Indonesia-Timor Leste border area, which is in the good category, show that geographical location is not the main barrier for someone to have good digital literacy. Although it is acknowledged that digital devices, including internet resources in the Indonesia-Timor Leste border area, may not be as complete as in other areas, these facilities can still have a positive impact if used properly. The available digital devices and internet resources can be capital for efforts to improve education. This fact is supported by research by Eryansyah et al. (2020), who reported that the availability of digital devices and internet access can positively impact digital literacy. In line with that, Fajri et al. (2023) revealed that access to the digital world can be a bridge for exchanging information without geographical limitations.

The results of further analysis also show that the quality of the eight aspects of digital literacy is in a good category. The first aspect, Functional Skill and Beyond, which is in the good category, shows that amidst existing limitations, prospective teachers still have opportunities to meet their information needs using available digital devices and internet access. The second aspect, Creativity, which is in the good category, shows that there are still opportunities to produce ideas, innovations, and creative products according to the community's needs. The third aspect, collaboration, which is in the good category, shows an opportunity for cooperation in the digital world. The fourth aspect, communication, in the good category, shows an opportunity for communication in the digital world by utilizing available digital resources. The fifth aspect, The Ability to find and select information, which is in the good category, shows an opportunity to develop prospective teachers' abilities to search for, select, and use valid and reliable information. Likewise, the sixth, seventh, and eighth aspects, namely Critical Thinking and Evaluation, Cultural and Social Understanding, and E-Safety, which are in the good category, indicate that the available digital resources still provide the potential to empower the digital literacy of prospective teachers. (Dinata, 2021; Hidayati et al., 2022). These results show that whatever the condition of the available digital resources, they will still be able to have a positive impact if their utilization is maximized. Moreover, it is supported by the current generation's potential to operate computers, gadgets, and various digital resources (Nada & Sari, 2020; Sekolah & Rahmadani, 2020).

In addition to the facts about opportunities, the research results also show challenges that need attention from various related parties. Among the prospective teachers involved in this study, there are still prospective teachers with digital literacy quality in the reasonably good, bad, and even bad categories. Afrina et al. (2024) and Bahri et al. (2022) reported that the suboptimal quality of digital literacy can be influenced by several factors, such as low knowledge of digital devices and resources, continuous guidance not being implemented, low ability to select valid information and the suboptimal training and learning integrated with digital technology.

The fact that prospective teacher students still have average digital literacy scores in the reasonably good, bad, and even very bad categories should not be ignored. Research data also shows that the number of prospective teacher students whose digital literacy is very good is still limited. Nada & Sari (2020) and Ririen & Daryanes (2022) explain that efforts to empower digital literacy can be carried out by optimizing internal and external factors of prospective teacher students. The optimization of internal factors is related to efforts to increase students' self-awareness and maximize their various potentials as capital to master 21st-century

skills and meet the demands of a digital society. The optimization of external factors can be done by implementing technology-based education and training to empower all aspects of digital literacy.

This is a challenge in preparing prospective teachers by the Teacher Training Institution. Teacher Training Institutions must facilitate prospective teachers with various personal characteristics, including individual ability and differences in access to technology. Students with inadequate digital literacy have the potential to face various difficulties in accessing digital-based learning resources and integrating technology into learning (Dewi et al., 2024; Liza & Andriyanti, 2020). This condition indicates variations in personal abilities and variations in external factor support. Furthermore, Nada and Sari (2020) and Sakolah and Rahmadani (2020) reported that a program to prepare prospective teachers needs to be carried out to provide opportunities for prospective teachers to access technology and participate in structured and ongoing training. Teacher Training Institution, as an institution that provides future teachers, is responsible for providing a learning environment that can accommodate prospective teachers from various backgrounds (Safitri, 2024; Safitri et al., 2024; Safitri & Ansyari, 2024). The hope is that during the challenges they face, every prospective teacher will still be allowed to develop, including the opportunity to develop their digital literacy.

As previously described, the challenges of the variation in characteristics and backgrounds of prospective teachers in the Indonesia-Timor Leste border areas indicate the need for a special strategy to be implemented by Teacher Training Institutions to accommodate the needs of prospective teachers with diverse digital literacy qualities. If this is not done, it could hurt the poor quality of learning that prospective teachers will carry out in the future. Prospective teachers who are not well prepared will have low competence and will not be able to answer challenges in the world of work. To overcome these challenges, the Teacher Training Institution needs to design adaptive and relevant strategies for prospective teachers in border areas. Emidar et al. (2023) explained that strategic efforts that can be carried out internally by Teacher Training Institutions are to develop a curriculum based on the demands of the world of work and the digital world. The hope is that prospective teachers will get theoretical provisions and practical skills. In its implementation, the curriculum must be supported by improving supporting facilities to implement intensive and sustainable guidance.

Mulenga (2021) and Sa'dullah (2023) explained that one of the wise steps that a Teacher Training Institution can take is to develop a curriculum with a project-based approach and problem-based learning. This approach has proven effective in empowering 21st-century skills such as problem-solving, collaboration, and digital skills (Aljareh, 2020). The use of technology in learning should not only be an aid but must be the primary tool and means of learning. In this way, prospective teacher students can be given tasks and responsibilities to design technology-based learning programs, for example, making learning videos, developing digital learning modules, developing interactive learning applications, and developing online discussion forums that enable more interesting learning. Working on projects will open space for prospective teachers to be more innovative in solving learning challenges. Prospective teachers can also work together in teams to find the best solutions in the context of learning. Working on assignments in the form of projects or problem-solving can be a valuable experience. Prospective teachers can develop practical skills to design active, creative, and innovative learning. This method not only helps the development of digital literacy but also helps the ability to adapt to changes and various innovations in the world of education. This is in line with the Molina-Torres report (2022), which explains that implementing project-based learning integrated with digital technology can be the key to creating prospective teachers ready to face the challenges and opportunities of the digital era.

In addition to internal improvements, Teacher Training Institutions can implement strategies involving external parties. Teacher Training Institutions must collaborate with various parties, such as the government, other educational institutions, and students as partners to prepare prospective teachers for the digital era. Firmansyah et al. (2024) explain that collaboration between Teacher Training Institutions and partners can provide opportunities to face the challenges of preparing prospective teachers with good digital literacy quality. Collaboration allows the preparation of adequate learning environments and resources according to the needs of digital areas. For example, through partnerships with the government, Teacher Training

Institutions can ensure the availability of digital devices that support the preparation of prospective teachers. Through partnerships with the private sector, prospective teachers are given access to technical experience using technology that can be integrated into learning.

Overall, preparing prospective teachers for the digital era requires a change in a more holistic approach to education that includes individual factors, institutional support, and policies that encourage maximum use of technology in education. There needs to be collaboration between Teacher Training Institutions and various related parties, such as the government, other educational institutions, and the private sector. Teacher Training Institutions must also develop and implement a curriculum for digital literacy and 21st-century skills. With close collaboration between various parties and implementing a project-based curriculum that effectively integrates technology, prospective teachers can be equipped with skills that are relevant to today's educational needs and prepare prospective teachers to face future challenges.

CONCLUSION

Preparing prospective teachers in the digital era faces challenges related to variations in digital literacy levels among prospective teacher students. Based on the results of the study, the average digital literacy score of prospective teachers was 73.86, with 60% of respondents in the good category. However, only 13.6% had digital literacy in the very good category. As many as 26.4% of respondents were in the fairly good, bad, and very bad categories. This variation indicates a gap that needs to be addressed by optimizing internal factors, such as student self-awareness, and external factors, such as technology-based training and increasing access to digital devices. Therefore, increasing digital literacy needs to be a priority in the curriculum for prospective teacher education.

However, these challenges also open up more effective digital literacy development opportunities. Collaboration between educational institutions, the government, and the private sector can create an environment that supports the improvement of digital literacy through training and providing adequate facilities. By implementing a project-based curriculum that integrates technology, prospective teachers can improve the 21st-century skills needed in digital learning. Studies can be conducted longitudinally to evaluate the impact of digital training programs on improving prospective teacher skills in the long term. In addition, future research can also explore the most effective intervention strategies to improve the digital literacy of student teachers, especially in areas with limited technological infrastructure. Through comprehensive empowerment efforts, prospective teachers can be prepared to face the challenges of education in the digital era and contribute maximally.

ACKNOWLEDGMENT

The authors thank the Institute for Research and Community Service (LPPM) Universitas Timor for financially supporting this research. They also thank the Faculty of Teacher Training and Education at Timor University and various parties who have helped carry out this research.

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