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Profile of technology literacy and information literacy of pre-service teachers: Readiness to become teachers in the technological era

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ABSTRACT

This study describes the profiles of information literacy (IL), technology literacy (TL), and digital literacy (DL) among pre-service science teachers as an indicator of their readiness for teaching in the technology-driven education era. Employing a quantitative descriptive design, the study involved 146 first-year students from the Department of Mathematics and Science Education at the University of Mataram, selected via purposive sampling. Data were collected using validated and reliable questionnaires adapted from UNESCO (2010) and Greenstein (2012) frameworks. The findings revealed that the majority of students (ranging from 67.08% to 74.94% across the three domains) were classified at the basic and proficient levels. The highest achievement areas were recognizing information needs (IL), technical proficiency (TL), and safety (DL). Conversely, the lowest scores were recorded in storing and retrieving information (IL), legal and ethical aspects (TL), and digital problem-solving (DL). Overall, the results indicate that while pre-service science teachers possess solid foundational skills in technical and safety aspects, they still lack depth in ethical awareness, information application, and creative problem-solving using digital tools. This suggests a need for targeted interventions to enhance their advanced digital competencies.

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INTRODUCTION

Technological advancements are rapidly accelerating. Every aspect of global existence has been influenced by technology, including education. Innovations in technology and educational practices are intricately interconnected and mutually influential. The development of technologically driven learning tools, including mobile devices, interactive whiteboards, massive open online courses, notebooks and tablets, simulations, dynamic visualizations, and virtual laboratories, has transformed education in schools and institutions (Mulaydinov et al., 2024). Instruction should incorporate social media inside the educational process in the current era. Moreover, this social media platform can effectively serve as a virtual meeting space, a discussion forum, a repository for educational resources, a medium for exchanging movies and images, and a source for disseminating informational links related to classes (Martoredjo, 2023).

The use of digital technologies facilitates the cultivation of skills essential for students' professional performance, including problem-solving, the formulation of structured thinking, and the understanding of processes (Dudar et al., 2021). Students receive instructions concerning the ethical and strategic use of technology, aiding them in decision-making and fostering self-discipline. Educational technology can facilitate students' preparation for lifetime learning. These technologies offer students a virtual environment and the autonomy to acquire digital information according to their learning preferences (Danilovic, 2004; Haleem et al., 2022; Lin & Yu, 2023; Stošić, 2015). First, educators are required to be active in all information technology and digital developments (McGarr & Ó Gallchóir, 2020). Education necessitates technology to enhance pedagogical approaches and streamline the learning process. Conversely, technology necessitates that the education sector utilizes it efficiently and increase its application (Martoredjo, 2023).

Numerous adverse occurrences frequently transpire in this digital realm. Internet issues also impact schooling. Conversely, the rapid and convenient access to a vast array of material via this tool results in information overload, complicating the ability of academics to disregard the significant role of internet access (Saryanto et al., 2023). Information is currently accessible in printed formats, such as newspapers, periodicals, and books, and digital formats, including internet connections, repositories of electronic books, and online journals (Kamaruddin et al., 2023). Problems related to internet things can be solved by teaching digital literacy and information literacy.

Digital literacy is a competency anticipated of educators to effectively utilize diverse digital technologies in the learning process (Asari et al., 2019). In fact, Falloon (2020) revealed that in the future, the educational process will depend on digital literacy. Digital literacy encompasses a broad spectrum of digital technologies and media, emphasizing the significance of information and knowledge in digitally mediated human endeavors (Jin et al., 2020). Similarly, Hatlevik (2017) found the digital competence of Norwegian teachers significantly forecasted their utilization of information and communication technologies (ICT) in instruction.

Information literacy enables individuals across all domains to proficiently seek, assess, utilize, and generate information to fulfill personal, social, professional, and educational objectives. It constitutes a fundamental human right in a digital era and fosters social inclusion across all nations. An educator need competence to facilitate learning effectively (De Vera & Valencerina, 2022). Students' awareness of the ethics and consequences of utilizing information sources is essential as they acquire and employ information. Students are responsible for ensuring the ethical use of information. Students must be informed about issues related to academic integrity, including copyright and intellectual property legislation (Ozor & Toner, 2022). It can be concluded that information literacy lays the foundations for lifelong learning which ultimately enhances creative skills (Naveed et al., 2023).

The capacity of informants to extract information remains in its nascent phase of development. An enhanced capacity to retrieve information is essential for the progression of information technology. The instructor's information use skills are satisfactory (Saryanto et al.,

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2023). Tasu'ah et al. (2023) discovered that 80 percent of 138 preschool educators operating in inclusive classrooms in Central Java had not participated in training pertaining to inclusive education and programs. This figure demonstrates a deficient degree of information literacy in inclusive education, particularly for knowledge and learning management. In both Indonesia and Thailand, pre-service teachers exhibit an intermediate degree of digital literacy, followed by basic and advanced levels (Yuvita et al., 2023).

Research at Ghanaian universities indicates that, although information literacy is present, these institutions face numerous hurdles in enhancing information literacy training (Yebowaah, 2018). A study by Dadzie (2007) an evaluation of institutions' preparedness for delivering information literacy teaching revealed that such programs face numerous hurdles. This encompasses insufficient commitment from colleges towards the information literacy program and a deficient comprehension of its nature. utilize it ethically owing to insufficient skills and resources (Anafo et al., 2014). A study by Yebowaah (2018) also found Insufficient information literacy abilities among postgraduate students at the University of Ghana attributable to the absence of an organized information literacy instruction program.

Most previous studies have examined digital or information literacy in isolation, and mainly in developed country contexts, leaving limited evidence on how these literacies intersect in pre-service teacher education in Indonesia. This study addresses that gap by providing an integrated analysis of information, technology, and digital literacy using internationally recognized frameworks. The novelty lies in mapping the strengths and weaknesses across these domains simultaneously, offering a comprehensive picture of teacher readiness for the technology-driven education era.

The main objective of this study is to analyze the literacy competencies of pre-service science teachers as indicators of their readiness to engage in the technology-driven education era. Specifically, this research aims to identify and describe the levels of information literacy, technology literacy, and digital literacy among first-year students in the Department of Mathematics and Science Education at the University of Mataram. Furthermore, the study seeks to determine the strengths and weaknesses within each literacy domain and to provide an integrated profile that reflects the overall preparedness of future teachers to effectively utilize, manage, and apply digital technologies in educational contexts. By achieving these objectives, the research intends to generate empirical evidence that can inform curriculum development and teacher education programs, particularly in promoting the balanced integration of technical competence, ethical awareness, and innovative digital pedagogy in higher education.

METHODS

This is a quantitative descriptive study conducted utilizing the survey method. This study included 146 freshman students in the Department of Mathematics and Natural Science Education at the University of Mataram. The sample was determined using a purposive sampling. The sample consisted of 34 biology education students, 25 physics education students, 39 chemistry education students, and 48 mathematics education students, comprising 117 female students and 29 male students.

The instruments employed consisted of questionnaires assessing information and assessed five indicators: (1) recognizing information needs, (2) locating information, (3) evaluating information quality, (4) storing and retrieving information, and (5) applying information to create and communicate knowledge (UNESCO, 2010), technology consisted of four dimensions: (1) knowing computer-based technologies, (2) technical proficiency, (3) selection and utilization of technology tools, and (4) legal and ethical skills (Greenstein) 2012), and Digital Literacy contained five dimensions: (1) information and data literacy, (2) communication and collaboration, (3) digital content creation, (4) safety, and (5) problem solving by UNESCO. Each instrument used a four-level Likert scale (1 = novice, 2 = basic, 3 = proficient, 4 = exemplary). The validity and reliability of all

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instruments was assessed using Pearson's product-moment correlation coefficient and Cronbach's Alpha. The results of the validity and reliability tests suggested that all of the test items demonstrated both validity and reliability. The collected data were further examined utilizing measures of information, technology, and digital literacy.

Data were analyzed descriptively by calculating the mean score for each indicator and converting the results into percentage values. These percentages were then used to classify students into the four literacy levels (novice, basic, proficient, exemplary) based on established criteria.

RESULTS AND DISCUSSION

The results of students' information, technology, and digital literacy levels are shown in Figure 1. Figure 1 reveals that the majority of students are concentrated at the basic and proficient levels across all domains. In information literacy, the highest proportion is at the basic level (33.44%) with only 15.09% reaching exemplary. Technology literacy also shows the largest percentage at the basic level (34.98%), while the exemplary category remains lowest (14.76%). In contrast, digital literacy demonstrates comparatively stronger outcomes, with the highest exemplary achievement across domains (20.07%), while most students are classified as proficient (33.79%) and basic (33.64%). Overall, the highest exemplary level is observed in digital literacy, whereas the highest basic level occurs in technology literacy. The findings of this study highlight important trends in pre-service teachers' information, technology, and digital literacy that are highly relevant in the context of teacher preparation for the digital era.

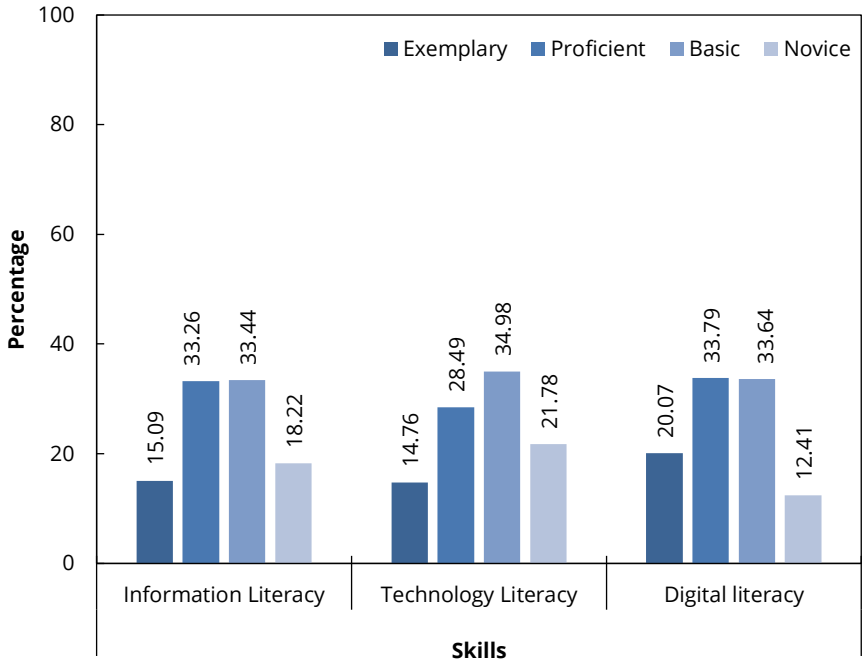

Figure 1. Pre-service teacher literacy levels

Information Literacy

The results of students' information literacy are shown in Figure 2. Figure 2 shows that the highest exemplary achievement is in the indicator recognizing information needs (23.15%), whereas the lowest is in storing and retrieving information (12.25%). At the proficient level, the highest proportion appears in recognizing information needs (40.25%), followed by making effective and ethical use of information (32.73%). The basic level is most dominant in locating and evaluating the quality of information (35.80%) and storing and retrieving information (35.05%). Meanwhile,

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the highest novice percentage is recorded in applying information to create and communicate knowledge (25.85%). Overall, the results highlight that students are relatively strong in identifying their information needs but face challenges in deeper skills such as retrieval and knowledge application.

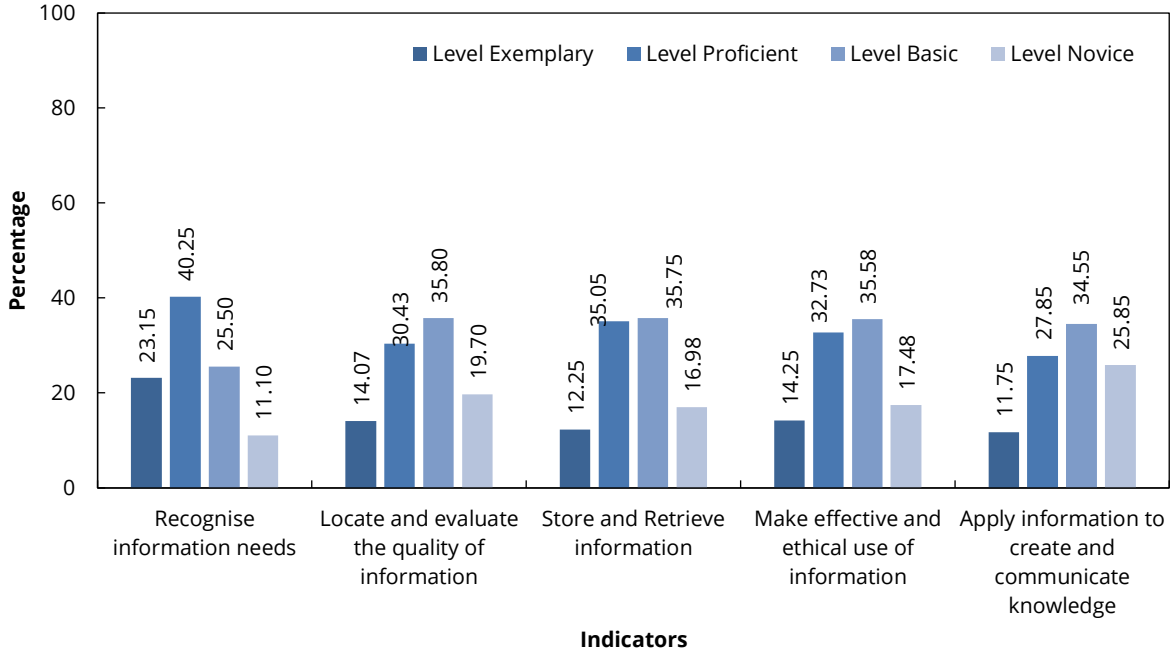

Figure 2. Pre-service teacher information literacy levels

In terms of information literacy, students demonstrated relative strength in recognizing information needs, with 40.25% at the proficient level, yet their ability to retrieve (12.25% exemplary) and apply information for knowledge creation (25.85% novice) remains limited. It implies that freshman students are not used to using the information in real world condition or to solve the problem. This result is consistent with prior studies in Ghana and Indonesia (Dadzie, 2007). Yebowaah (2018) reported that students often struggle to move beyond recognizing information to critically evaluating and ethically applying it. Rose-Wiles et al. (2017) reported that students only understand the facts from the information obtained without the effort to expand or apply it in learning. Study by Rohmanurmeta et al. (2024) showed that the ability of students to understand technology and digital information is low. Strengthening these competencies is crucial, as information literacy serves as the foundation for lifelong learning and academic integrity (Naveed et al., 2023). Students' lack in information literacy is a consequence of lack in holistic approach. Learning mainly focus on one factor only in searching on information only (Dann et al., 2022; Smith et al., 2013).

Teacher's information literacy is influenced by the rich work environment. A technologically rich work environment promotes information literacy and professional skills (Shonfeld et al., 2020). To improve information literacy, a change in digitalisation of information resources is needed as well as the curricula (Park et al., 2021; Shonfeld et al., 2022). Participation in a digital programme shows a strong relationship to information literacy self-efficacy as well as age and digital skills. Teacher's perception of information literacy has changed through participating in a digital programme (Gouseti et al., 2023; Tauhidah & Wijayanti, 2023).

Digital Literacy

The results of students' digital literacy are shown in Figure 3. Figure 3 reveals that the highest exemplary achievement is in safety (26.26%), followed by information and data literacy (24.03%).

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At the proficient level, the strongest performance is in digital content creation (36.75%), while the basic level is most dominant in problem solving (40.46%). The novice proportion is highest in digital content creation (21.14%). Overall, students demonstrate strong skills in safety and data literacy but face challenges in digital problem solving. With regard to digital literacy, students achieved comparatively stronger outcomes, particularly in safety (26.26% exemplary) and information and data literacy (24.03% exemplary). However, they faced significant difficulties in digital problem-solving, with 40.46% remaining at the basic level and only 14.04% reaching exemplary. This result supports arguments by Falloon (2020) and Jin et al. (2020) that higher-order digital competencies, such as problem-solving and innovation, require more intentional pedagogical approaches than basic tool use. Rohmanurmeta et al. (2024) explained the low skill students to create product using technology is affected by learning strategy that never explained how to create learning product using technology. Pre-service teachers must be encouraged to move beyond being functional users of technology towards becoming creative and transformative practitioners capable of leveraging digital tools for innovative teaching and learning.

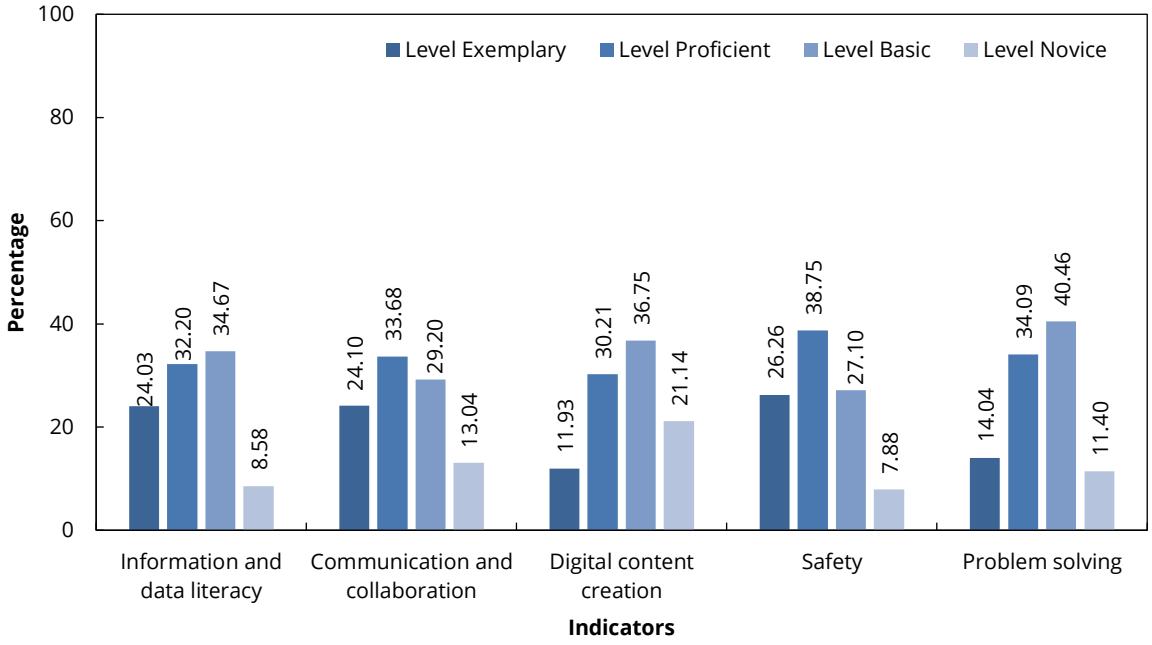

Figure 3. Pre-service teacher digital literacy levels

CONCLUSION

This study concludes that pre-service science teachers at the University of Mataram generally possess basic to proficient levels of information, technology, and digital literacy, reflecting a moderate level of readiness to engage in technology-enhanced education. Students demonstrated notable strengths in recognizing information needs, technical proficiency, and digital safety awareness. However, significant weaknesses remain in ethical and legal awareness, information retrieval, and the ability to apply digital tools for creative problem-solving and knowledge construction. These findings suggest that while pre-service teachers are technically capable, they are not yet fully prepared to function as effective and ethical educators in the technology-driven learning environment of the 21st century.

Despite these insights, the study has several limitations that must be acknowledged. First, it only involved first-year students from a single institution, which restricts the generalizability of the findings to other contexts or levels of teacher education. Second, the use of self-report questionnaires may have introduced bias, as participants' responses reflect perceived rather than

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demonstrated competencies. Third, contextual factors such as access to digital resources, prior training, and disciplinary differences were not examined, which may have influenced students' literacy profiles. Therefore, future studies should employ mixed-method approaches and include broader samples across multiple institutions to capture a more comprehensive and comparative picture of pre-service teachers' technological readiness.

Given that first-year students demonstrated moderate literacy levels, each study program should strengthen digital readiness by integrating digital-literacy-oriented activities into coursework, providing targeted training on essential digital skills, and ensuring that lecturers model effective and ethical technology use. Continuous monitoring of students' literacy development is also necessary to guide timely interventions and support their preparation as digitally competent future teachers.

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Authors' Note

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