

The implementation of artificial intelligence (AI) in education: Patterns, perceptions, and implications for educators and students

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Abstract

This study examines the implementation of Artificial Intelligence (AI) in education and its impact on educators and students in Jambi Province, Indonesia. Using a quantitative descriptive design, data were collected through a structured questionnaire administered to 44 respondents, including educators and students. The instrument measured AI usage frequency, digital competence, ethical awareness, and perceived learning effectiveness. Data were analyzed using descriptive statistics, including frequencies, percentages, and mean scores. The findings indicate that AI is frequently used for accessing information and supporting learning tasks; however, respondents demonstrate moderate levels of critical evaluation and ethical awareness in AI utilization. While AI contributes positively to learning efficiency and instructional support, its effectiveness depends on digital literacy competence and responsible usage. The study highlights the need for structured AI literacy training, ethical guidelines, and improved digital infrastructure to ensure sustainable and equitable integration of AI in education.

Keywords

Artificial Intelligence (AI), digital literacy, education technology, educators, learning innovation

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Introduction

In the context of human cognition, artificial intelligence (AI) refers to computer systems capable of adapting to their environment through sensors and other mechanisms, thereby facilitating effective human interaction (Kumar et al., 2025). More educational applications are shifting from conventional to artificial intelligence, allowing this technology to assist educators and students in the initial stages of learning about the application of artificial intelligence system technology. The use of artificial intelligence in the education sector can enhance the learning experience, supporting administration, instruction, and learning. This shift represents a significant challenge, particularly for educators in Jambi Province. Digital transformation is occurring at a rapid pace, particularly in the shift from conventional to digital learning (Mohammed Hasim et al., 2022). This type of use has become a highly popular topic among researchers, particularly in education. Rapid technological advancements have enabled the application of artificial intelligence to permeate all fields. The need for more effective and efficient education is a primary need in improving the quality of education.

Utilizing artificial intelligence for educators, from elementary to higher education levels, enables them to develop adaptive learning systems that cater to students' needs and abilities. Artificial intelligence can be utilized to analyze student learning and provide recommendations to improve student performance. Students can develop interactive and engaging learning content, and educators can utilize it to monitor and evaluate student performance, providing more precise and accurate feedback.

In its implementation, there are certainly obstacles that pose challenges for educators, especially in areas with limited infrastructure and technology that educators cannot yet utilize effectively. Therefore, possessing adequate skills is necessary to utilize artificial intelligence effectively in the learning process. However, it is also important to consider ethics and privacy. Adopting artificial intelligence in education requires thorough preparation from various components to integrate AI technology with educators, one of which is using software. Utilizing artificial intelligence can enhance learning efficiency by providing access to broader, more easily understood information and materials (Sain, 2024). As artificial intelligence continues to develop, questions arise about data privacy and users' responsibility to use technology wisely and responsibly. Emerging issues surrounding the use of artificial intelligence in education must be addressed to maintain moral, ethical, and responsible values within the educational environment.

This study empirically investigates the implementation of artificial intelligence in educational settings in Jambi Province and examines patterns of use, digital competence levels, and ethical awareness among educators and students. Through an analytical and evaluative approach, the author also presents recommendations to enhance the ease of use of various artificial intelligence applications, helping to develop educators' learning capabilities.

Literature Review

The development and role of Artificial Intelligence (AI) in education

The evolution of Artificial Intelligence (AI) has profoundly transformed numerous

aspects of human activity, including education. Since its acceleration in the mid-2010s, AI has rapidly grown from a theoretical concept to an essential technological tool reshaping how people teach, learn, and interact with information. AI encompasses machine learning, data analytics, and automation systems that can adapt, reason, and perform tasks traditionally requiring human intelligence (Wang & Siau, 2019).

In the educational domain, AI serves not only as a support mechanism but also as an interactive partner in teaching and learning processes. The emergence of AI-driven platforms, such as ChatGPT, Gemini, Canva, Meta, and others, has transformed how educators design lessons, assess student performance, and manage classroom administration (Pratschke, 2024). These applications enable personalized learning by analyzing students' abilities, preferences, and learning pace, allowing educators to tailor their strategies accordingly.

In Indonesia, the integration of AI has gained momentum with the Ministry of Education's initiative to include coding and artificial intelligence as elective subjects in elementary and junior high schools starting in the 2025/2026 academic year. This policy aligns with the national agenda to prepare students for the Industrial Revolution 4.0 era, where digital literacy and computational thinking are essential competencies. Nevertheless, significant challenges remain, particularly in underdeveloped areas such as Jambi Province. Many educators continue to struggle with adapting to technological change due to limited access to infrastructure, inadequate training, and varying levels of digital literacy. As a result, the digital divide continues to hinder equal access to AI-based learning opportunities (Huda, 2023).

The role of educators in adopting AI is critical. Teachers must not only possess pedagogical competence but also digital proficiency and ethical awareness in using AI systems. While AI improves efficiency and accessibility, it also raises concerns regarding data privacy, ethical responsibility, and the risk of technological dependency.

AI's positive influence on education lies in its ability to create a more adaptive, inclusive, and efficient learning environment. However, this potential can only be realized through careful planning, adherence to ethical guidelines, and the equitable distribution of digital infrastructure, ensuring that no learner is left behind in the transition toward intelligent education systems.

Integration of AI in teaching and learning

Integrating AI into education has marked a paradigm shift in teaching and learning. AI systems, driven by deep learning and natural language processing, can analyze vast amounts of data to identify learning patterns and provide personalized educational experiences. This personalization makes learning more engaging, efficient, and tailored to each student's individual needs.

According to Steinbauer et al. (2021), AI technologies can serve as pedagogical tools that significantly improve educational outcomes. For example, intelligent tutoring systems and adaptive learning platforms can dynamically adjust the difficulty of content, recommend supplementary materials, and provide instant feedback. These systems reduce teachers' administrative burdens and enhance students' self-directed learning skills.

One of AI's notable contributions is its ability to support synchronous and asynchronous communication. Through AI chatbots and virtual teaching assistants, learners can receive answers, clarifications, and study guidance at any time, transcending the limitations

of classroom schedules. Li and Xing (2021) also demonstrated how AI-generated natural language content enhances online learning environments, such as MOOCs, by assisting with the generation of personalized responses and feedback for learners.

Beyond instruction, AI streamlines administrative functions such as grading, attendance tracking, and course management. Automation of these repetitive tasks enables educators to allocate more time to mentoring, developing critical thinking, and engaging in creative teaching. Despite these advantages, research findings suggest that digital evaluation skills remain relatively weak among educators and students. Many users of AI technologies demonstrate limited awareness of data security, intellectual property, and ethical usage. Such deficiencies increase the risks of plagiarism, misinformation, and data misuse. Therefore, the integration of AI into education must be accompanied by comprehensive training that emphasizes digital ethics, critical literacy, and responsible use of technology.

Moreover, AI-based learning can stimulate creativity and innovation; however, this potential has not yet been fully realized in many educational settings (Alotaibi & Alshehri, 2023). A significant proportion of teachers and students still use AI passively rather than creatively, relying on it to complete tasks instead of exploring it as a tool for generating new ideas or problem-solving. As a result, the true pedagogical power of AI remains underutilized.

In essence, integrating AI into teaching and learning requires more than just access to technology—it demands a shift in mindset, pedagogy, and institutional policy. Educational institutions must foster a culture of innovation that positions AI as a collaborative partner in the learning process, rather than merely a technical assistant.

Ethical, legal, and social challenges to AI implementation

While AI offers significant advantages for education, its implementation presents complex ethical, legal, and social challenges. The first and most prominent issue concerns data privacy. AI systems rely on collecting and analyzing personal information, such as students' learning patterns, behaviors, and academic records (Rehan, 2023). Without robust legal frameworks, the data are vulnerable to misuse or unauthorized access.

Currently, Indonesia lacks specific legislation governing the use of AI in education. However, general regulations such as Law No. 11 of 2008 and Law No. 19 of 2016 on Electronic Information and Transactions (ITE) provide a partial legal basis for managing digital interactions. Additionally, Circular Letter No. 9 of 2023 from the Ministry of Communication and Information emphasizes the importance of adhering to ethical AI principles, including inclusivity, accessibility, safety, and accountability.

Another critical concern is the potential for dehumanization in the educational system. Over-reliance on AI may erode the interpersonal dimensions of learning, such as empathy, creativity, and moral reasoning. When students and teachers depend excessively on machine-generated responses, they risk losing critical thinking and authentic intellectual engagement.

From a societal perspective, the digital divide remains a pressing issue. Regions unevenly distribute technological resources and expertise, leading to disparities in AI adoption. Rural schools often lack the necessary infrastructure and internet connectivity to effectively implement AI-based systems. Consequently, the benefits of AI tend to concentrate in urban centers, exacerbating educational inequality (Farahani & Ghasemi, 2024).

Furthermore, algorithmic bias poses another ethical dilemma. AI models trained on limited or skewed data can perpetuate existing inequalities by favoring specific demographics or linguistic groups. For instance, automated assessment systems might misinterpret responses from students whose first language differs from the model's training data. To address this issue, transparency and diversity in AI development are essential to ensure fairness and inclusivity.

Finally, there is the issue of public trust. Without transparency regarding how AI systems operate and use data, both educators and students may resist adopting them. Therefore, governments and institutions must foster trust through clear communication, data protection policies, and public participation in AI governance. Only through collaborative and transparent regulation can AI be integrated into education ethically and sustainably.

Implications of AI for digital competence and the future of education

AI's influence on digital competence represents a fundamental transformation in educational paradigms. The 21st century learning framework emphasizes the importance of competencies such as critical thinking, creativity, collaboration, and communication—all of which are enhanced by intelligent technologies. Digital literacy, as defined by Spires et al. (2018), refers to the ability to understand and effectively use information from various digital sources. Walker et al. (2019) later expanded this concept to include three components: technical (operating digital tools), cognitive (analyzing and evaluating information), and socio-emotional (using technology ethically and responsibly). These dimensions are crucial for preparing both educators and learners to navigate AI-driven educational environments effectively.

The research involving 44 respondents—comprising educators and students—revealed that most participants possessed adequate skills in accessing and using AI tools such as ChatGPT and Meta Chat. However, their ability to critically evaluate information and apply AI creatively was relatively low. This finding underscores a vital gap between access to technology and digital competence.

AI literacy, therefore, must be integrated into teacher training programs and student curricula. Beyond learning how to operate AI systems, educators must understand their pedagogical implications, ethical boundaries, and data-driven decision-making capabilities. Students, on the other hand, must be taught to use AI not merely as a shortcut for assignments but as a cognitive partner that supports exploration, analysis, and innovation.

In the broader context of the Fourth Industrial Revolution, AI represents the convergence of multiple technologies—machine learning, cloud computing, and the Internet of Things—that together redefine the future of education. These technologies enable smart classrooms, real-time analytics, and immersive learning experiences such as virtual simulations and augmented reality. Moreover, AI contributes to institutional improvement through data-driven educational management. With AI analytics, schools and universities can monitor learning outcomes, detect academic risks early, and design interventions to enhance student success. At a policy level, governments can utilize AI-generated data to evaluate educational effectiveness, allocate resources more efficiently, and formulate responsive educational strategies.

However, as AI continues to evolve, the challenge lies in maintaining the balance

between technological efficiency and human values. Education should not focus solely on producing digitally skilled individuals but also on nurturing moral, emotional, and social intelligence. AI must be considered an extension of human intellect—a tool that augments, rather than replaces, human reasoning and empathy.

Ultimately, the integration of AI into education holds the promise of transforming traditional learning into a more dynamic, inclusive, and personalized process. However, this transformation must be guided by ethical principles, equitable access, and continuous human oversight to ensure that technology serves humanity, not the other way around.

Methodology

This study employed a quantitative descriptive research design to examine the implementation of Artificial Intelligence (AI) in education and its impact on educators and students in Jambi Province, Indonesia. A quantitative approach was selected to measure patterns of AI usage, levels of digital competence, and perceptions regarding ethical and security considerations using numerical data. Quantitative descriptive research is appropriate when the objective is to systematically describe phenomena and analyze relationships among measurable variables (Creswell & Creswell, 2018). The study aimed to describe the extent of AI adoption and to analyze how frequently AI is used in learning activities, and how this relates to digital literacy and perceived learning effectiveness.

The population of this research consisted of educators and students who had experience using digital tools in educational contexts. A total of 44 respondents participated in the study. Although the sample size is relatively small, the research aims to provide descriptive insights into local AI adoption patterns rather than statistical generalization to a broader population. Because the number of accessible participants was relatively small, total sampling was applied, meaning all eligible individuals were included as research participants. The respondents represented different age groups and educational backgrounds, allowing the researcher to observe variations in AI usage across demographic categories.

Data were collected using a structured questionnaire with a five-point Likert scale ranging from 1 (never) to 5 (always). The instrument measured several aspects, including the frequency of AI use, the ability to access and operate AI tools, the ability to evaluate digital information, awareness of data security and ethical considerations, and perceptions of AI's contribution to learning effectiveness. The questionnaire items were developed based on established digital literacy and AI integration frameworks to ensure conceptual relevance.

Content validity was ensured through expert review, in which the questionnaire items were examined to confirm alignment with the research objectives. Reliability was tested using internal consistency analysis, and a Cronbach's Alpha coefficient of 0.70 or higher was considered acceptable, as recommended in quantitative research standards (Hair et al., 2019). This procedure ensured that the instrument consistently measured the intended constructs.

The collected data were analyzed using descriptive statistical techniques, including frequency distributions, percentage analyses, mean scores, and standard deviations. These statistical measures were used to describe the overall level of AI usage and digital competence among respondents. The analysis focused primarily on descriptive statistical measures to identify trends in AI usage and digital competence.

Ethical principles were observed throughout the study. Participation was voluntary, and

respondents were informed about the purpose of the research. All responses were kept private and used only for academic research; no personally identifiable information was gathered.

Results and Discussions

Artificial intelligence development

Artificial intelligence (AI) has advanced rapidly since 2015, driven by innovations from companies and individuals such as Elon Musk and Sam Altman. ChatGPT, software focused on AI development, is now widely recognized, particularly in education. Furthermore, several application vendors have also created software to assist users in learning and design, such as Gemini, Meta, Canva, Sider, and others.

Educators, particularly teachers and lecturers in Jambi Province, remain unfamiliar with the application and utilization of artificial intelligence to support classroom management and learning. Some individuals face challenges in adopting technology and implementing innovative learning approaches. Through this research, the authors examine educators' readiness for an AI-based educational ecosystem. Therefore, to improve efficiency, personalization, and effectiveness in education, the adoption of AI is necessary. This approach enables various components, particularly teachers as facilitators and primary educators of future learning, to develop within the framework of technology implementation. In Indonesia, efforts to integrate technology into education have been made, but numerous challenges remain. Among these are professional, pedagogical, social, and personality competencies. However, there is still a need to improve professional competencies in the structure, concepts, and principles of science, as well as in the field of study.

The government, through the Ministry of Primary and Secondary Education's policy, has begun implementing AI technology that can help educators design learning experiences tailored to students' needs and automate routine administrative tasks. In the media, the Minister of Primary and Secondary Education confirmed that coding and artificial intelligence (AI) subjects will be electives in schools starting in the 2025/2026 academic year, especially at the elementary school level (grades 4, 5, and 6) and junior high school, provided schools have adequate infrastructure. Such an arrangement allows teachers to focus more on teaching and interacting with students. In addition, AI-based technology can reduce energy consumption, thereby lowering operational expenses in schools and campuses and lowering carbon emissions (Yuvita et al., 2023). According to Pan and Ye (2017), without education, humans will struggle to develop and be left behind. Researchers assert that inadequate education has a significant impact on individuals and their environment, potentially leading to suboptimal socialization and communication.

However, although this policy does not yet have specific legislation governing the use of AI in education, existing regulations such as Law No. 19 of 2016, which amends Law No. 11 of 2008 concerning Information and Electronic Transactions (ITE Law), provide a general legal framework for electronic agents, including AI, and their legal responsibilities in electronic transactions, as well as the circular letter of the Minister of Communication and Information No. 9 of 2023 concerning the ethics of the use and utilization of artificial intelligence, which includes inclusivity, accessibility, security, humanity, credibility, and accountability in the use of artificial intelligence. To adapt to the artificial intelligence-based education ecosystem,

educators must be prepared to face this transformation, as several key factors, including teaching experience, training, and the adoption of information technology, will influence it.

However, it is undeniable that challenges will inevitably arise, including the risk of data theft and misuse by unauthorized individuals. It would be beneficial if the government took concrete steps, in this case, by establishing a legal framework to protect citizens' privacy and prevent data breaches. It is essential to develop public trust in the use of artificial intelligence technology so that people feel comfortable with it. Government representatives, namely the Ministry of Education and Science and Technology, must ensure that artificial intelligence technology is designed to support an AI-based education system and is accessible to all groups, including people with disabilities. This will certainly build student trust and ensure they understand the technology.

In this research, we investigate whether educators understand and effectively assist in the adoption of artificial intelligence technology in education. The issue poses challenges for both individuals and groups within technology-based education circles, as well as for the government, which is a key pillar in building sound infrastructure as we advance. Previous research (Instefjord & Munthe, 2016; Yuvita et al., 2023) has highlighted the importance of professional competence for prospective educators in integrating technology. However, empirical evidence examining AI implementation at the regional level in Indonesia, particularly in Jambi Province, remains limited. Most prior studies focus on national policy or experienced educators, while data on local readiness and digital competence are still underexplored. Most previous research has focused on experienced educators, while research on the readiness of prospective educators remains limited.

In this case, the government has not implemented proper legal safeguards in the use of artificial intelligence. All educators and students are acting independently. Without a strong legal umbrella, undesirable things can happen, such as the loss of identity as professional educators and the loss of self-identity as human beings who can reason. These factors can lead to dependence on technology without understanding the future consequences, which are detrimental to themselves, resulting in a loss of self-confidence. In classroom learning, students may hesitate to accept feedback generated by artificial intelligence. Therefore, it is essential to establish trust with students so that they feel comfortable using this technology. Intelligence systems in education are certainly challenging to implement, given that maintenance, budget constraints, and limited human resources remain prevalent, and infrastructure is often inadequate, especially in remote areas. Educators and students require a clear, transparent system. What are the future challenges, such as user data security? Such clarity certainly helps build trust among educators and students, ensuring they understand the technology effectively.

In 2020, according to data from Similar, cited by IDC and Bloomberg Intelligence, the market for hardware and artificial intelligence-based services reached nearly USD 36 billion. This market value reflects the growing demand for artificial intelligence-based solutions across sectors, including education, amid the global adoption of digitalization. The growth of artificial intelligence-based services is showing a positive trend (Lu, 2019). This market is experiencing significant growth, with a compound annual growth rate (CAGR) of approximately 20%, and it is expected to reach a substantial value of USD 90 billion by 2025. In the early stages, particularly with chat applications, GPT has enabled the monetization of artificial intelligence

in conversations, contributing approximately 10% to the total market for other artificial intelligence applications in 2020. This application can help answer questions quickly, provide explanations, and assist in both collaborative and independent learning. In 2023, GPT chat features are expected to improve significantly, including the ability to understand more complex instructions through deeper reasoning and training on larger, more diverse datasets, resulting in more accurate, relevant, and context-aware answers.

The findings suggest that while AI adoption is increasing, the development of higher-order digital literacy skills remains uneven, revealing a gap between technological access and critical competence. This is due to the current technological advantages in the academic context, particularly the wise and ethical use of applications to prevent misuse and to support independent and responsible intellectual development as a relevant tool in supporting technology-based learning processes. This approach aligns with the Industrial Revolution 4.0, incorporating integrated educational processes such as machine learning, the Internet of Things, and artificial intelligence (AI). This approach supports and adapts the education system to meet the needs of the 21st century, encompassing digital skills, critical thinking, creativity, and collaboration (Miranda et al., 2021; Rodrigues Abitia et al., 2020). Educators and students can benefit from the use of artificial intelligence in computing-based learning to improve educational efficacy (Li & Wang, 2023).

Education in the industrial revolution 4.0

Education, which embraces a new era of change, integrates technology aligned with the industrial revolution, including artificial intelligence, machine learning, and the Internet of Things (IoT). This is undoubtedly part of the learning process, adapting the education system to the 21st century, including the development of digital, creative, and collaborative skills, enabling critical thinking (Novia et al., 2024; Reaves, 2019). The use of artificial intelligence in both learning and teaching can encourage innovation in design, learning development, and implementation, making learning more adaptive and value-added. One advantage of artificial intelligence for learning is its ability to facilitate synchronous communication, allowing educators and students to discuss and ask questions without time constraints (Li & Xing, 2021). The use of artificial intelligence in education, particularly in learning, is crucial for both educators and students. In the realm of education, educators have reported that the adoption of artificial intelligence in various forms as a teaching aid or pedagogical tool significantly impacts educational and teaching goals (Steinbauer et al., 2021).

Digital literacy is essential for accessing, understanding, evaluating, and creating information through technology in a practical, ethical, and responsible manner. According to Nawaz and Kundi (2010), digital literacy refers to the ability to understand and utilize information in various formats from diverse sources when delivered via a computer. Meanwhile, Martínez-Bravo et al. (2022) explained that digital literacy encompasses three main components: technical, cognitive, and socio-emotional. In an educational context, it enhances critical thinking skills regarding digital information, filters information, supports technological learning, expands digital communication and collaboration, and improves human resource productivity. With the advancement of technology and communication (ICT), artificial intelligence is projected to further develop, presenting a more personalized and adaptive learning system designed to facilitate information retrieval in the educational world, using

increasingly sophisticated and well-structured algorithms. The following table presents the result of this research, which involved 44 university students and educators.

Table 1. *Number of artificial intelligence users by age*

No	Age group	Educators	Students	Students	Total
1	< 25 years	8	10	6	24
2	25-34 years	10	-	-	10
3	35-44 years	10	-	-	10
Total					44

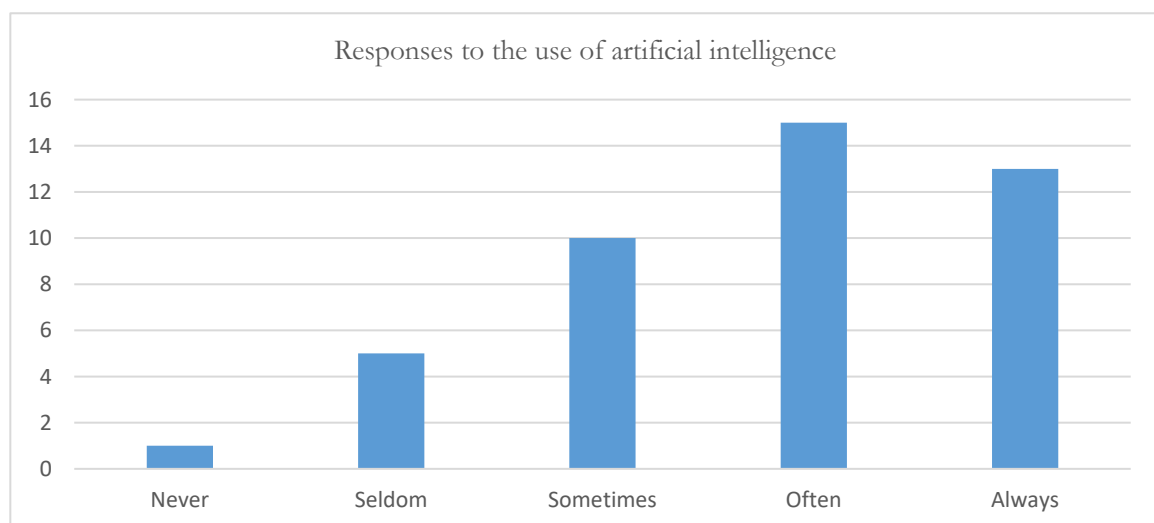
Table 1 above shows the number of age groups using artificial intelligence in learning, which is one factor influencing learning outcomes with artificial intelligence.

Table 2. *Number of users by education level*

No	Education level	Educators	Students	Students	Total
1	Senior/Vocational high school	-	14	10	24
2	S1 (Bachelor)	-	-	-	-
3	S2 (Magister)	20	-	-	20
Total					44

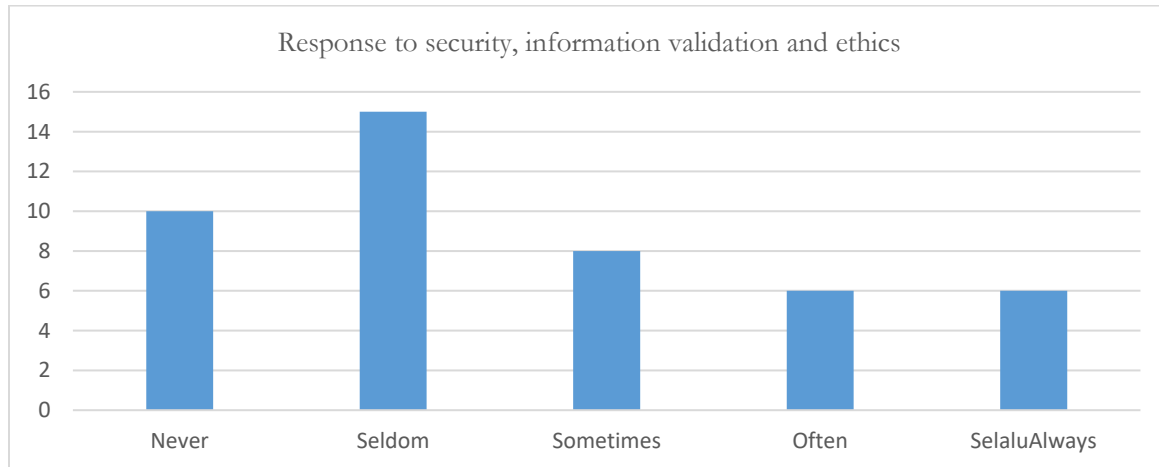
Table 2 describes the current level of education that uses artificial intelligence. Due to the relatively small population size, the researcher used total sampling. In this data collection technique, the author used a questionnaire and participant profile data based on age and education level, arranged on a Likert scale of 1-5, ranging from “never” to “always.” This research aims to determine the extent to which the application and learning of artificial intelligence can improve the digital skills and literacy of educators, students, and learners. The distribution of the questionnaire to 44 respondents yielded the following data: Respondents are familiar with digital devices and have experience with artificial intelligence, which provides a favorable foundation for implementing AI learning.

Figure 1. *The access capability graph using artificial intelligence*



The majority of respondents (63.6%) reported frequent or consistent use of AI tools, indicating a high level of access and operational familiarity. Of the 44 respondents, 15 reported frequently using artificial intelligence in the form of GPT and Meta Chat, 13 reported always using it, and only 1 reported never using it. Conversely, the ability to evaluate digital information remains relatively low, particularly in terms of security, information validation, and ethics.

Figure 2. *Response to security, information validation, and ethics*



In this aspect, some respondents also demonstrated varying levels of understanding. Their low level of information analysis and security, in fact, leads to unethical use that can potentially result in problems such as the dissemination of personal data, copyright infringement, and digital fraud. Therefore, AI training should not only introduce the technology but also require vigilance in using and analyzing the information obtained, as it often involves inappropriate methods for personal or group gain.

Meanwhile, respondents' creativity in using and leveraging Artificial Intelligence (AI) or digital technology has not yet become a universal practice for completing tasks innovatively. This presents both a future challenge and an opportunity for AI training in education to have a tangible impact on improving learning efficiency. Furthermore, the government's role in fostering a rational mindset among students is critical to promoting original thinking among students and educators, enabling them to develop strong, sustainable academic competencies without the risk of plagiarism.

Conclusion

The findings indicate that artificial intelligence is perceived as supportive of learning effectiveness; however, its successful integration depends on digital literacy competence, ethical awareness, and infrastructure readiness. This also emphasizes that in learning with artificial intelligence, human thinking must not be limited; critical thinking and an understanding of the ethics of technology use are essential. Digital literacy is not only about

using technology; it also requires understanding how it works and its impacts. If AI-based learning is used and designed with sound intentions, it can serve as a bridge, encouraging educators and students to approach the digital era more maturely. Furthermore, for educators, integrating AI into the learning process strengthens teaching skills, supports learning assessment, and fosters the development of academic competencies in the future.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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