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Motivation to Use Artificial Intelligence and Technology Self-Efficacy among Biology Education Students at an Indonesian University

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Abstract The rapid integration of artificial intelligence (AI) in higher education requires students to possess both strong motivation and sufficient technological confidence to use AI effectively for learning. This study investigates the relationship between motivation to use artificial intelligence and technology self-efficacy among Biology Education students at an Indonesian university. A mixed-methods survey design was employed involving 62 undergraduate students. Quantitative data were collected using two validated Likert-scale questionnaires measuring motivation to use AI and technology self-efficacy, while qualitative data were obtained through open-ended questions addressing students' perceived benefits and limitations of AI in learning. Descriptive analysis showed that students reported high motivation to use AI (mean scores across expectancy–value dimensions ranged from 3.46 to 3.90) and moderate to high technology self-efficacy (mean scores ranged from 3.51 to 3.85), with the highest level observed in AI-specific self-efficacy ($M = 3.85$). Pearson correlation analysis revealed a significant positive relationship between motivation to use AI and technology self-efficacy ($p = 0.001$). Qualitative findings indicated that students perceived AI as enhancing learning efficiency, conceptual understanding, and independent learning, while also expressing concerns related to accuracy, overdependence, and ethical issues. These findings highlight the importance of pedagogically guided and ethically informed AI integration in teacher education programs.

Keywords: Artificial intelligence motivation; Biology education students; Higher education; Technology self-efficacy

INTRODUCTION

The rapid advancement of artificial intelligence (AI) technologies has significantly transformed various sectors, including education. In higher education, AI-based applications such as intelligent tutoring systems, automated feedback tools, and

generative AI platforms (e.g., ChatGPT, Copilot, and similar tools) are increasingly used to support learning, academic writing, research activities, and instructional planning (Luo et al., 2025; Pillai et al., 2024; Nasution, 2023; Alotaibi & Alshehri, 2023). These technologies offer opportunities to enhance learning efficiency, personalize instruction, and expand access to academic resources (Rochmat et al., 2024; Li et al., 2023). For pre-service teachers, particularly students in Biology Education programs, AI has the potential to support both content mastery and the development of pedagogical competencies required for future professional practice (Ayanwale et al., 2025; Zhang et al., 2023). Given the central role of biology in the Indonesian school curriculum (Fatoni & Nasution, 2025; Rohmah et al., 2025), biology education study programs are essential in developing qualified and professional future teachers.

Despite the growing availability and use of AI in higher education, students' effective engagement with these technologies is not solely determined by access or technical features. Psychological and behavioral factors, such as motivation to use AI and technology self-efficacy, play a critical role in shaping how students adopt, utilize, and benefit from AI-based learning tools (Tummalapenta et al., 2025; Wang et al., 2023). Motivation influences students' willingness to explore, persist, and invest effort in using AI, while technology self-efficacy reflects students' confidence in their ability to operate digital tools, solve technical problems, and adapt to new technologies. When these factors are insufficiently developed, the educational potential of AI may not be fully realized.

In the Indonesian higher education context, AI can help address limitations in learning resources, support independent study, and assist students in understanding complex scientific concepts. On the other hand, preliminary observations and informal interviews with university students indicate several underlying concerns. Some students rely heavily on AI to complete assignments without critically evaluating the accuracy of the information, while others feel uncertain about their ability to use AI effectively or ethically. Concern related to overdependence (Paraso et al., 2024; Sharma, 2024), may reduced critical thinking (Ododo et al., 2024; Shah & Asad, 2024), limited contextual understanding (Khurma et al., 2024), and unequal access to advanced AI tools have also emerged (Dinker, 2024; Ahmed, 2024). These challenges suggest that the mere presence of AI technology does not guarantee meaningful learning outcomes.

The root problem lies in the limited empirical understanding of how students' motivation to use AI interacts with their technology self-efficacy, particularly among Biology Education students who are preparing to become future teachers. Most existing studies focus either on students' attitudes toward technology or on the technical aspects of AI implementation, often overlooking the interaction between motivational and self-efficacy factors. Moreover, research examining these variables within the Indonesian context remains limited, especially in discipline-specific settings such as biology

education, where conceptual complexity and pedagogical demands are high. Teacher education programs, particularly in science-related disciplines, require not only content mastery but also confidence in using educational technologies to support inquiry-based and conceptually demanding learning (Li et al., 2025; Stinken-Rösner et al., 2023; Valtonen et al., 2023).

Preliminary qualitative insights from students further highlight this gap. Several students reported that AI helps them learn more efficiently, understand difficult materials through simplified explanations, and manage academic tasks more effectively. At the same time, students acknowledged limitations, such as receiving overly general explanations, encountering inaccurate information, and feeling tempted to rely excessively on AI rather than engaging deeply with learning materials. These contrasting experiences suggest that students' perceptions and behaviors toward AI are shaped by both their motivational orientations and their confidence in using technology.

Therefore, a comprehensive investigation is needed to examine not only students' motivation to use artificial intelligence and their level of technology self-efficacy, but also the relationship between these two variables. Incorporating qualitative perspectives is also essential to capture students' lived experiences, perceived benefits, and perceived limitations of AI in learning, which may not be fully revealed through quantitative data alone.

This study addresses these gaps by employing a mixed-methods approach to explore the relationship between motivation to use artificial intelligence and technology self-efficacy among university Biology Education students in Indonesia. Specifically, the study aims to: (1) examine students' motivation to use artificial intelligence; (2) analyze their level of technology self-efficacy; (3) investigate the relationship between motivation to use AI and technology self-efficacy; and (4) explore students' qualitative perceptions of the benefits and limitations of AI in learning. By providing empirical evidence from both quantitative and qualitative data, this study contributes to the growing body of literature on AI in education and offers practical insights for educators, curriculum developers, and policymakers seeking to promote responsible, effective, and pedagogically sound use of artificial intelligence in teacher education.

METHOD

Research Design

This study employed a quantitative approach using a correlational survey design to examine the relationship between students' motivation to use artificial intelligence (AI) and their technology self-efficacy. A quantitative design was considered appropriate because the primary aim of the study was to measure students' perceptions and beliefs numerically and to analyze the statistical relationship between two psychological constructs. The correlational design was selected because the study did not involve

experimental manipulation, intervention, or treatment, but rather sought to explore naturally occurring associations between variables within an authentic educational setting (Fitri et al., 2023; Purnawinadi et al., 2023).

Through this design, the study aimed to understand how motivation to use AI relates to students' confidence in using technology to support learning activities in higher education. In addition to the quantitative component, the study incorporated a qualitative element through open-ended survey questions to obtain deeper insights into students' experiences, perceived benefits, and perceived limitations of AI in learning.

Participants

The participants of this study were undergraduate students enrolled in a Biology Education program (S1 level) at a state owned public university in Indonesia. Specifically, students in their third and fifth years of study were selected. These academic levels were chosen based on the assumption that students at these stages have had sufficient exposure to digital learning environments, learning management systems, and emerging educational technologies, including artificial intelligence tools.

Participant recruitment was conducted using voluntary sampling. Students who were willing to participate completed an online questionnaire distributed by the researchers through academic communication channels. A total of 62 students participated in the study. Of these, 56 were male and 6 were female. The participants' ages ranged from 18 to 22 years, with 12 students aged 18, 20 students aged 19, 20 students aged 20, 7 students aged 21, and 3 students aged 22. This age distribution reflects the typical demographic profile of undergraduate students in teacher education programs in Indonesia.

Research Instruments

Data were collected using a structured questionnaire consisting of two quantitative measurement scales and two open-ended qualitative questions. All quantitative items were measured using a five-point Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The use of a Likert scale allowed students to express varying degrees of agreement with each statement and enabled numerical analysis of their responses.

Motivation to Use Artificial Intelligence

Students' motivation to use artificial intelligence was measured using the Questionnaire of Artificial Intelligence Use Motives (QAIUM) developed by Yurt and Kasarci (2024). This instrument was designed to assess individuals' motivational tendencies toward AI usage in educational contexts. In this study, the questionnaire consisted of 20 positively worded items measuring students' perceived competence, interest, enjoyment, perceived importance, and willingness to invest effort in learning and applying AI technologies.

To provide a theoretically grounded analysis, the AI motivation construct was interpreted using the expectancy value theory framework embedded in the QAIUM.

Based on this framework, students' motivation was categorized into five dimensions: expectancy, task value attainment, task value utility, task value intrinsic/interest, and task value cost. Mean scores were calculated for each dimension, allowing the researchers to describe students' motivational profiles in greater detail and to identify which aspects of motivation were most prominent among biology education students.

Technology Self-Efficacy

Technology self-efficacy was measured using a scale adapted from Holcomb et al. (2004). This instrument consisted of 17 items assessing students' confidence in using computers, digital tools, and educational technologies in academic contexts. The items measured students' beliefs about their ability to operate digital devices, learn new software, solve technical problems independently, and adapt to emerging technologies, including artificial intelligence tools.

For descriptive purposes, the technology self-efficacy items were grouped into four functional dimensions: basic digital confidence, adaptive and learning self-efficacy, independent and problem-solving self-efficacy, and AI-specific self-efficacy. This grouping was used solely to enhance interpretability and did not alter the original structure of the instrument.

Both the AI motivation questionnaire and the technology self-efficacy scale had been previously tested and reported as valid and reliable in their original studies. Therefore, in this research, the instruments were reused without conducting additional validity or reliability testing. Minor contextual modifications were made only to align the wording of items with the current academic environment and common AI tools used by university students.

Qualitative Data Collection

In addition to the closed-ended items, the questionnaire included two open-ended questions to capture students' qualitative perceptions of AI in learning. The first question asked students to describe the perceived benefits of using AI in their learning activities, such as how AI supports understanding, efficiency, or independent study. The second question asked students to reflect on the perceived limitations or challenges of AI use, including issues related to accuracy, overdependence, ethical concerns, or technical constraints. These qualitative data were intended to complement the quantitative findings by providing contextual depth and personal perspectives.

Data Collection Procedure

Data were collected online using a digital survey platform to ensure accessibility and convenience for participants. Prior to completing the questionnaire, students were informed about the purpose of the study, the voluntary nature of their participation, and the confidentiality of their responses. No personally identifiable information was collected.

All participants were required to read and agree to an informed consent statement before proceeding with the survey. The consent form emphasized that participation was voluntary, responses would remain anonymous, and data would be used solely for academic research purposes. These procedures ensured that the study adhered to ethical standards for educational research involving human participants.

Data Analysis

Data analysis was conducted using the Statistical Package for the Social Sciences (IBM SPSS Statistics 27). Descriptive statistics were first calculated to summarize participants' demographic characteristics and to describe overall levels of motivation to use artificial intelligence and technology self-efficacy.

To interpret the Likert-scale data, mean scores were categorized as follows: 1.00–1.80 (very low), 1.81–2.60 (low), 2.61–3.40 (moderate), 3.41–4.20 (high), and 4.21–5.00 (very high). This categorization was applied consistently across both quantitative instruments.

Before conducting the correlation analysis, normality tests were performed to determine whether the data met the assumptions required for parametric analysis. The results indicated that the data were normally distributed and demonstrated linearity; therefore, Pearson's product–moment correlation coefficient was employed to examine the relationship between motivation to use artificial intelligence and technology self-efficacy.

Qualitative data obtained from the open-ended questions were analyzed using thematic analysis. Students' responses were reviewed, coded, and grouped into recurring themes related to perceived benefits and limitations of AI in learning. These themes were then used to support and enrich the interpretation of the quantitative findings.

FINDINGS AND DISCUSSION

1. Motivation to Use Artificial Intelligence among University Biology Education Students

The first research question examined the level of motivation to use artificial intelligence among university biology education students. Descriptive analysis of the AI Use Motives scale indicates that students generally demonstrated a high level of motivation toward the use of artificial intelligence in their academic activities. Across the 20 items, the mean scores ranged from 3.26 to 4.08 on a five-point Likert scale, reflecting an overall positive orientation toward AI use.

To further explain students' motivation to use artificial intelligence, the findings were analyzed based on the expectancy value dimensions proposed by Yurt & Kasarci (2024). The results show that students demonstrated high motivational levels across all dimensions, with mean scores ranging from 3.46 to 3.9 as shown in Figure 1. The

expectancy dimension, which reflects students' beliefs about their capability to successfully use artificial intelligence, obtained a mean score of 3.46. Although this score falls within the high category, it was comparatively lower than other motivational components, suggesting that while students generally believe they can use AI effectively, there remains room to strengthen their confidence through structured training and guided academic practice.

Among the task value components, attainment value recorded the highest mean score (M = 3.90), indicating that students strongly perceive artificial intelligence as important for their academic identity and success as university students. Utility value was similarly rated highly (M = 3.88), demonstrating that students clearly recognize the practical benefits of AI for completing academic tasks, improving learning efficiency, and supporting their future professional roles as biology teachers. The intrinsic or interest value dimension also yielded a high mean score (M = 3.86), suggesting that students not only value AI for its usefulness but also experience genuine interest and enjoyment when engaging with AI-based tools.

The task value cost dimension produced a mean score of 3.63, which, although still categorized as high, was lower than the other task value dimensions. This finding indicates that students may perceive certain costs associated with using artificial intelligence, such as the time, effort, or cognitive demands required to learn and apply AI tools effectively. Nevertheless, the relatively high score suggests that these perceived costs do not outweigh the benefits and values students associate with AI use.

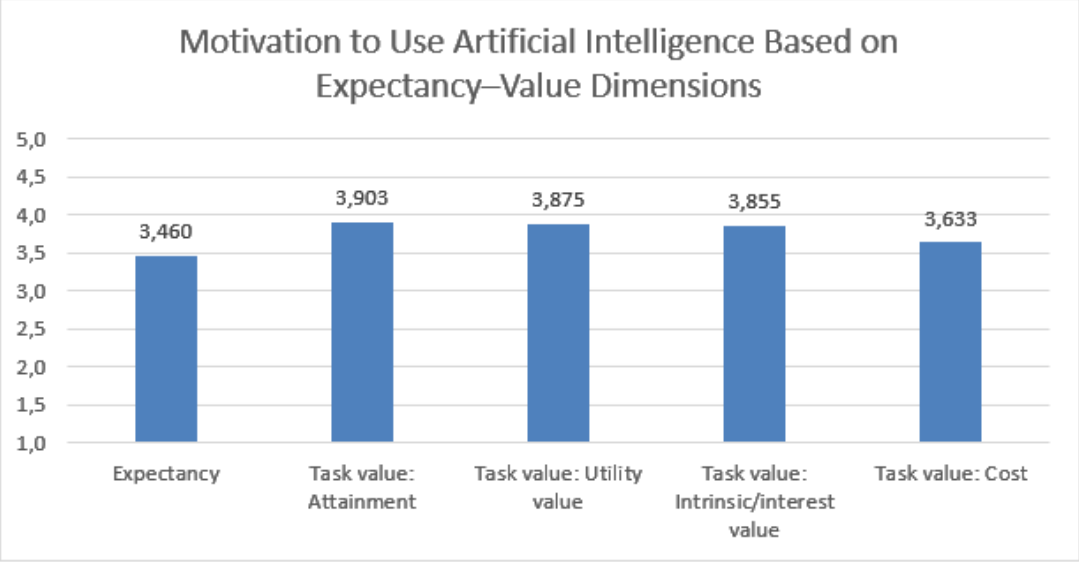

Figure 1. Mean scores of motivation to use artificial intelligence based on expectancy value dimensions among university biology education students.

Item-level analysis further supports this motivational profile. Mean scores of students' motivation to use artificial intelligence by item shown in Table 1. Students reported

strong agreement with statements related to the importance and relevance of artificial intelligence for their academic and future professional lives. The highest mean score was observed for the item *"I believe it is important to stay up to date with the latest developments in artificial intelligence"* (M = 4.08), followed by *"The use of artificial intelligence increases my efficiency and makes my learning activities more effective"* (M = 3.94) and *"Keeping up with the latest developments in artificial intelligence is an interesting activity for me"* (M = 3.94). These findings indicate that students not only recognize the instrumental value of AI but also perceive engagement with AI as intellectually stimulating and beneficial for improving learning efficiency.

Table 1. Mean scores of students' motivation to use artificial intelligence by item.

Items	Mean
I feel capable of learning the skills needed to use artificial intelligence applications effectively in my academic activities.	3.790
My general knowledge of artificial intelligence is already quite good compared to most people.	3.387
I consider myself more skilled than most of my peers in using artificial intelligence applications effectively.	3.258
I believe I have greater potential than many people around me to use artificial intelligence applications for learning or completing academic tasks.	3.403
The ability to use artificial intelligence effectively is very important to me as a university student.	3.919
Learning and applying innovations in the use of artificial intelligence is one of my priorities.	3.726
I believe it is important to stay up to date with the latest developments in artificial intelligence.	4.081
I pay close attention to improving my ability to use artificial intelligence applications.	3.887
Artificial intelligence applications help me become a more competent prospective professional teacher in the future.	3.758
The use of artificial intelligence increases my efficiency and makes my learning activities more effective.	3.935
In my daily life, artificial intelligence helps me complete various tasks more quickly and easily.	3.919
Artificial intelligence provides real benefits for me in various courses or academic activities.	3.887
I feel happy when using artificial intelligence applications for learning or work.	3.839
I enjoy experiences related to the use of artificial intelligence.	3.823
Keeping up with the latest developments in artificial intelligence is an interesting activity for me.	3.935
Developing my skills in using artificial intelligence is an enjoyable learning process.	3.823
I feel that the time and effort I invest in learning artificial intelligence are very worthwhile.	3.871
Learning how to use artificial intelligence feels quite easy for me.	3.790

I am willing to sacrifice some time from other activities to learn how to use artificial intelligence applications.	3.387
I do not hesitate to invest a great deal of time and effort to improve my ability to use artificial intelligence.	3.484

Motivational items related to perceived usefulness and professional development were also rated highly. Students agreed that AI applications help them become more competent prospective professional teachers (M = 3.76) and provide tangible benefits across various courses and academic activities (M = 3.89). This suggests that AI is viewed not merely as a supplementary learning tool, but as an integral component of academic learning and teacher preparation in biology education.

In terms of intrinsic motivation and enjoyment, consistently high scores were observed. Items such as *"I feel happy when using artificial intelligence applications for learning or work"* (M = 3.84), *"I enjoy experiences related to the use of artificial intelligence"* (M = 3.82), and *"Developing my skills in using artificial intelligence is an enjoyable learning process"* (M = 3.82) reflect positive emotional engagement with AI technologies. These findings align with motivational theory, which emphasizes enjoyment and interest as key drivers of sustained technology adoption.

However, comparatively lower mean scores were found for items related to self-perceived superiority and behavioral investment, including *"I consider myself more skilled than most of my peers in using artificial intelligence applications effectively"* (M = 3.26) and *"I am willing to sacrifice some time from other activities to learn how to use artificial intelligence applications"* (M = 3.39). Although these scores remain within the moderate-to-high range, they suggest that while students value and are motivated to use AI, they may be cautious in overestimating their comparative abilities or prioritizing AI learning over other academic and personal commitments.

The findings indicate that university biology education students exhibit high motivational readiness to use artificial intelligence, characterized by strong perceived importance, usefulness, enjoyment, and future relevance. This motivational profile suggests favorable conditions for the integration of AI-based tools into biology education curricula. As artificial intelligence technology plays a valuable role in supporting curriculum implementation and enhancing learning experiences (Karataş, 2025; Liua et al., 2021).

2. Technology Self-Efficacy among University Biology Education Students in Indonesia

The second research question explored the level of technology self-efficacy among university biology education students. Descriptive results from the Technology Self-Efficacy scale reveal that students generally possess a moderate to high level of confidence in their ability to use digital technologies and artificial intelligence for academic purposes. Mean scores across the 17 items ranged from 3.4 to 4.08, indicating

that most students perceive themselves as capable and relatively confident technology users in their learning activities.

A more detailed analysis was conducted by examining technology self-efficacy across four functional dimensions. Overall, the results indicate that students demonstrated high levels of self-efficacy across all dimensions as shown in Figure 2. The highest mean score was observed for AI-specific self-efficacy (M = 3.85), suggesting that students felt particularly confident in using artificial intelligence tools to support and enhance their learning. Adaptive and learning self-efficacy also yielded a high mean score (M = 3.67), indicating that students perceived themselves as capable of learning new technologies and adapting to newly introduced digital platforms. Similarly, basic digital confidence showed a high mean score (M = 3.65), reflecting strong foundational competence and comfort in using computers and digital technologies for academic purposes. In contrast, independent and problem-solving self-efficacy recorded a slightly lower, yet still high, mean score (M = 3.51), suggesting that although students generally felt capable of resolving technical issues independently, this aspect of self-efficacy was relatively less developed compared to the other dimensions.

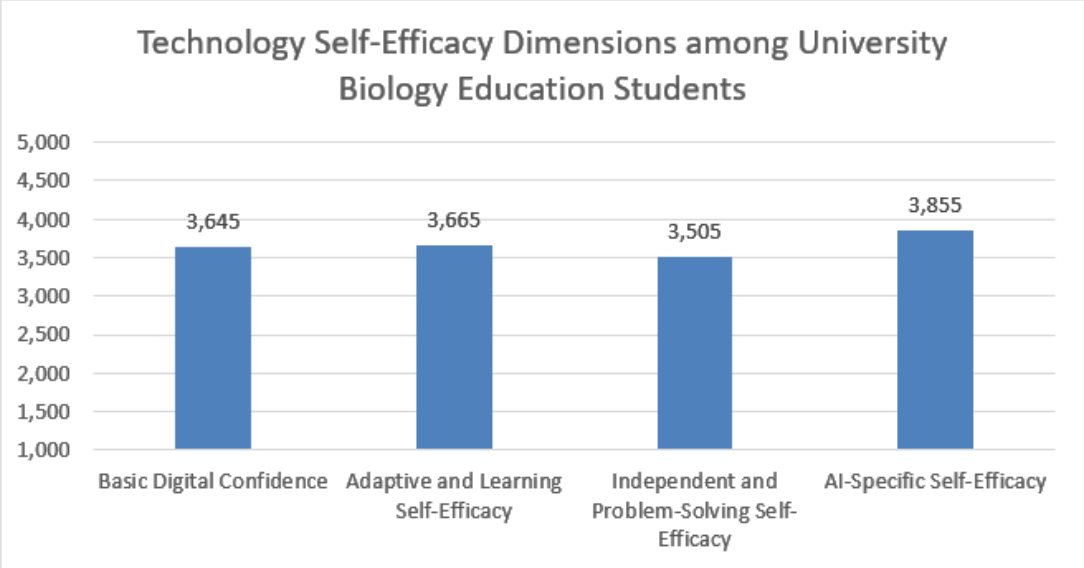

Figure 2. Mean scores of technology self-efficacy dimensions among university biology education students.

Item-level analysis further illustrates students' technological confidence. Mean Scores of Students' technology self-efficacy by item shown in Table 2. The highest mean score was found for the item *"I feel comfortable using new technologies to support my coursework and research"* (M = 4.08), indicating strong affective comfort and openness toward new technological tools. High confidence was also evident in items related to basic digital competence, such as *"I find it very easy to work and learn using a computer or laptop"* (M = 3.87) and *"I find digital technology and artificial*

intelligence easy to use to support my learning activities" (M = 3.76). These findings suggest that students possess a solid foundational level of digital literacy.

Table 2. Mean scores of students' technology self-efficacy by item.

Item	Score
I find it very easy to work and learn using a computer or laptop.	3.871
I am confident in my ability to use various digital technologies for learning.	3.694
I can easily understand how new applications or software used in academic activities work.	3.629
I feel comfortable using new technologies to support my coursework and research.	4.081
I can quickly learn how to use learning applications as well as general-purpose applications.	3.645
I am able to use technology without relying too much on guides or assistance from others.	3.403
I find the digital applications or platforms I use for learning to be fairly easy and clear.	3.726
I am confident that I can solve technical problems that arise when using learning technologies.	3.581
I am able to make computers, applications, or digital tools work according to my needs.	3.532
I rarely feel confused when using technology for learning or research activities.	3.581
I adapt quickly when instructors introduce new platforms or technologies in my courses.	3.661
I can manage my time well when using technology to support my academic tasks.	3.726
I easily understand technical terms related to computers and learning applications.	3.597
I find digital technology and artificial intelligence easy to use to support my learning activities.	3.758
I consider myself fairly skilled in using computers and technology for academic purposes.	3.613
I feel confident when using new technologies or applications without feeling anxious.	3.435
I am confident that I can use artificial intelligence (such as ChatGPT, Copilot, or other AI applications) to improve the quality of my learning.	3.726

Students also demonstrated strong adaptive and learning-related self-efficacy. Items such as *"I adapt quickly when instructors introduce new platforms or technologies in my courses"* (M = 3.66) and *"I can quickly learn how to use learning applications as well as general-purpose applications"* (M = 3.65) indicate that biology education students are not only familiar with existing technologies but are also confident in their ability to learn and adjust to new digital learning environments.

Nevertheless, several aspects of technology self-efficacy showed comparatively lower mean scores. Items related to independent problem-solving and confidence without external assistance, including *"I am able to use technology without relying too much on guides or assistance from others"* (M = 3.4) and *"I feel confident when using new technologies or applications without feeling anxious"* (M = 3.44), were rated slightly lower. These results suggest that while students generally feel competent using technology, a degree of uncertainty remains when dealing with unfamiliar technologies or technical challenges independently.

Importantly, students expressed positive self-efficacy specifically toward artificial intelligence. This is reflected in the item *"I am confident that I can use artificial intelligence (such as ChatGPT, Copilot, or other AI applications) to improve the quality of my learning"* (M = 3.73), reinforcing the notion that AI is increasingly perceived as an accessible and usable technology rather than an advanced or intimidating tool. As the advancement of artificial technology has grown so rapid that it is no longer feasible to avoid its application in education (Chen et al., 2022; Gao et al., 2021).

Taken together, the findings demonstrate that university biology education students in Indonesia possess adequate to high levels of technology self-efficacy, particularly in terms of comfort, adaptability, and functional use of digital and AI-based tools. However, the comparatively lower scores in independent problem-solving self-efficacy indicate a need for structured guidance and instructional support, especially when introducing more advanced or complex AI-driven learning technologies.

3. Relationship between Motivation to Use Artificial Intelligence and Technology Self-Efficacy among University Biology Education Students

To address the third research question, a correlational analysis was conducted to examine the relationship between students' motivation to use artificial intelligence and their technology self-efficacy. Prior to performing the correlation analysis, prerequisite tests were carried out to ensure that the data met the assumptions for parametric testing (Nasution et al., 2023). The Kolmogorov Smirnov normality test indicated that the data for Motivation to Use Artificial Intelligence were normally distributed, with a significance value of 0.200 ($p > 0.05$). Similarly, the Technology Self-Efficacy data also showed a normal distribution, with a significance value of 0.200 ($p > 0.05$). These results confirm that both variables met the assumption of normality.

In addition, a linearity test was conducted to examine whether the relationship between the two variables followed a linear pattern. The results of the linearity test yielded a significance value of 0.157 ($p > 0.05$), indicating that the relationship between Motivation to Use Artificial Intelligence and Technology Self-Efficacy was linear. Based on the fulfillment of both normality and linearity assumptions, a parametric bivariate Pearson correlation analysis was deemed appropriate for examining the relationship between the two variables.

The results of the Pearson correlation analysis revealed a statistically significant relationship between motivation to use artificial intelligence and technology self-efficacy, with a significance value of 0.001 ($p < 0.05$). This finding indicates that students who reported higher levels of motivation to use artificial intelligence also tended to demonstrate higher levels of confidence in their ability to use technology for academic purposes.

From a theoretical perspective, this finding aligns with expectancy value theory and self-efficacy theory, which emphasize the reciprocal relationship between motivational

beliefs and perceived competence. Students who believe that artificial intelligence is valuable, useful, and interesting are more likely to engage actively with AI tools, thereby strengthening their confidence in using technology. Conversely, students with higher technology self-efficacy are more inclined to explore and utilize artificial intelligence, as they feel capable of learning and managing new digital tools effectively. The significant positive relationship identified in this study suggests that motivation and technology self-efficacy function as mutually reinforcing factors in the context of AI-supported learning.

4. Qualitative Findings on Students' Perceptions of the Benefits and Limitations of Artificial Intelligence in Learning

Perceived Benefits of Using AI for Learning

Based on students' open-ended responses, the most commonly perceived benefit of using artificial intelligence in learning is increased efficiency in completing academic tasks and understanding learning materials more quickly. Many students reported that AI helps them grasp complex concepts through simple explanations, step-by-step guidance, and relevant examples, making learning easier, faster, and less confusing. Another frequently mentioned benefit is instant access to a wide range of information and references, which allows students to search for academic sources, clarify unfamiliar terms, and obtain concise summaries without spending excessive time searching manually. Students also highlighted AI's ability to personalize learning, as explanations can be adapted to their level of understanding, preferred learning style, and learning pace.

Beyond cognitive support, students emphasized practical advantages such as time management, task organization, and assistance in structuring assignments, outlines, and academic writing. Students found benefit from artificial intelligence beyond cognitive (Sain et al., 2024; Lin & Chen, 2024). AI was also perceived as a supportive tool for independent learning, enabling students to study anytime and anywhere without relying heavily on lecturers or peers. Some respondents noted that AI enhances creativity and instructional planning, particularly in designing engaging learning activities for future students. More uniquely, a number of students expressed positive emotional responses, describing feelings of enjoyment, satisfaction, and gratitude toward the presence of AI in modern education. Importantly, a smaller but meaningful group of students demonstrated critical awareness by emphasizing that AI should be used as a learning aid rather than a substitute for thinking, warning against overdependence and highlighting the importance of critical thinking, digital literacy, and academic ethics. Overall, these responses indicate that students perceive AI not only as a tool for efficiency and comprehension, but also as a personalized, flexible, and supportive learning partner when used responsibly.

Limitations of AI in Supporting Learning

Students' responses indicate that the most commonly perceived limitation of artificial intelligence in supporting learning is the lack of accuracy and depth in certain explanations. Many students reported that AI-generated answers are sometimes too general, insufficiently detailed, or not fully aligned with course-specific content and lecturers' explanations. Several students emphasized that AI occasionally provides information that appears convincing but is not entirely valid, requiring careful rechecking against textbooks, academic journals, or other reliable sources. Another frequently mentioned limitation relates to contextual understanding, as AI does not always grasp the nuanced meaning of academic questions, practical classroom situations, or real-world field experiences, particularly in applied or experiential learning contexts. Therefore, artificial intelligence can aid in learning, but it cannot fully replace teachers (Nikitina & Ishchenko, 2024; Fitria, 2023).

In addition, students highlighted concerns regarding overdependence on AI, noting that excessive reliance may reduce critical thinking, analytical skills, creativity, and independent problem-solving abilities. Some respondents admitted that AI can make students feel less motivated to study deeply, potentially fostering academic passivity. Technical and accessibility issues were also reported, including unstable internet connections, limited features in free versions, system errors, slow responses, and difficulties in crafting precise prompts to obtain relevant answers. A number of students pointed out linguistic challenges, such as overly formal language, unfamiliar vocabulary, or explanations that are difficult to understand. More uniquely, students raised ethical and structural concerns, including data privacy risks, unequal access to AI technologies, potential plagiarism, reduced social interaction, and digital distraction. Despite acknowledging these limitations, many students emphasized that AI remains a valuable learning aid when used wisely, critically, and in balance with direct instruction from lecturers, peer discussion, and independent learning efforts.

CONCLUSION

This study investigated the relationship between motivation to use artificial intelligence and technology self-efficacy among university Biology Education students in Indonesia using a mixed-methods approach. Four main research objectives were addressed, and the findings provide a comprehensive understanding of students' quantitative tendencies and qualitative experiences with AI in learning.

First, regarding students' motivation to use artificial intelligence, the findings indicate that students demonstrated a generally high level of motivation. The overall motivation score was above the midpoint of the Likert scale, with particularly strong values in task value components, including task value attainment ($M = 3.903$), task value utility ($M = 3.875$), and task value intrinsic/interest value ($M = 3.855$). These results suggest that students perceive AI as meaningful, useful, and interesting for their academic activities.

Although the task value cost dimension showed a slightly lower mean (M = 3.63), it remained within the positive range, indicating that perceived effort or potential drawbacks did not significantly hinder students' motivation to use AI.

Second, in terms of technology self-efficacy, the results reveal that students possessed a moderate to high level of confidence in using digital technologies and artificial intelligence. Among the categorized dimensions, AI-specific self-efficacy recorded the highest mean score (M = 3.855), indicating strong confidence in using AI tools such as ChatGPT or similar applications to support learning. This was followed by adaptive and learning self-efficacy (M = 3.665) and basic digital confidence (M = 3.645). Independent and problem-solving self-efficacy showed the lowest, yet still positive, mean score (M = 3.51), suggesting that while students are generally capable of using technology, some still experience challenges in solving technical problems independently.

Third, concerning the relationship between motivation to use artificial intelligence and technology self-efficacy, the statistical analysis confirmed a significant and positive correlation between the two variables. The normality and linearity assumptions were met, and the Pearson correlation analysis yielded a significance value of $p = 0.001$ (< 0.05). This finding indicates that motivation and self-efficacy appear to reinforce each other, suggesting that confident students are more motivated to engage with AI, while motivated students are more likely to develop confidence in using AI technologies.

Fourth, the qualitative findings enriched the quantitative results by revealing students' perceptions of both the benefits and limitations of AI in learning. Students most commonly perceived AI as a tool that enhances learning efficiency, simplifies complex concepts, provides instant access to information, and supports independent and flexible learning. AI was also valued for helping with task organization, academic writing, and instructional planning for future teaching practice. However, students also identified several limitations, including the risk of inaccurate or overly general information, limited contextual understanding, overdependence, reduced critical thinking, technical constraints, and ethical concerns such as plagiarism and data privacy. Importantly, many students demonstrated critical awareness by emphasizing that AI should function as a learning aid rather than a substitute for human reasoning and instructor guidance.

The high levels of motivation and AI-specific self-efficacy found in this study indicate that students are ready to engage with artificial intelligence as a learning tool. Rather than adopting restrictive policies, universities should prioritize guided and pedagogically informed integration of AI into coursework, supported by training programs and curriculum designs that strengthen technological confidence, ethical awareness, critical evaluation of AI-generated content, and problem-solving skills. Future research is recommended to involve larger and more diverse samples, employ longitudinal designs to examine changes in motivation and self-efficacy over time, conduct intervention-based studies to evaluate AI literacy and critical thinking

programs, and explore lecturers' perspectives and classroom dynamics to provide a more comprehensive understanding of AI integration in higher education.

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