EthAIca. 2025; 4:416
doi: 10.56294/ai2025416

ORIGINAL

Attitude, Anxiety, and Literacy among Teacher Aspirants' Embrace of Artificial Intelligence: Implications for Practical and Ethical Challenges in Integrating AI in Education

Actitud, Ansiedad y Alfabetización entre los Aspirantes a Docentes en la Aceptación de la Inteligencia Artificial: Implicaciones para los Desafíos Prácticos y Éticos en la Integración de la IA en la Educación

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Cite as: Torreciba ND, Alieto EO. Attitude, Anxiety, and Literacy among Teacher Aspirants' Embrace of Artificial Intelligence: Implications for Practical and Ethical Challenges in Integrating AI in Education. EthAIca. 2025; 4:416. https://doi.org/10.56294/ai2025416

Submitted: 20-02-2025 **Revised:** 28-05-2025 **Accepted:** 28-08-2025 **Published:** 29-08-2025

Editor: PhD. Rubén González Vallejo

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ABSTRACT

Attitude, anxiety, and literacy are essential factors in determining the acceptance of artificial intelligence (AI), particularly in its integration into education. Despite their relevance, few studies have explored their mutual influence and their impact on teacher aspirants' perspectives toward AI. This study aimed to analyze these constructs and their interrelationships through a descriptive-quantitative-correlational design. Stratified random sampling was employed to select 200 respondents from the education programs of a state university. The results indicated that teacher aspirants hold a positive attitude toward AI (M=4,19), exhibit low anxiety (M=2,44), and demonstrate very high literacy (M=6,22). Significant differences were observed in levels of anxiety, literacy, and attitudes across course programs. Furthermore, a significant interrelationship among the three constructs was established. The findings highlight the pivotal role of attitudes, anxiety, and literacy in shaping teacher aspirants' acceptance of AI and emphasize their importance in guiding future educational integration.

Keywords: Artificial Intelligence; Teacher Aspirants; Attitude, Anxiety and Literacy.

RESUMEN

La actitud, la ansiedad y la alfabetización son factores esenciales para determinar la aceptación de la inteligencia artificial (IA), particularmente en su integración en la educación. A pesar de su relevancia, pocos estudios han explorado su influencia mutua y su impacto en las perspectivas de los aspirantes a docentes hacia la IA. Este estudio tuvo como objetivo analizar estos constructos y sus interrelaciones a través de un diseño descriptivo-cuantitativo-correlacional. Se empleó un muestreo aleatorio estratificado para seleccionar a 200 encuestados de los programas de educación de una universidad estatal. Los resultados indicaron que los aspirantes a docentes tienen una actitud positiva hacia la IA (M=4,19), presentan baja ansiedad (M=2,44) y demuestran una alfabetización muy alta (M=6,22). Se observaron diferencias significativas en los niveles de ansiedad, alfabetización y actitud entre los programas de curso. Además, se estableció una interrelación significativa entre los tres constructos. Los hallazgos destacan el papel fundamental de la actitud, la ansiedad y la alfabetización en la configuración de la aceptación de la IA por parte de los aspirantes a docentes y enfatizan su importancia para guiar la futura integración educativa.

Palabras clave: Inteligencia Artificial; Aspirantes a Docentes; Actitud; Ansiedad y Alfabetización.

INTRODUCTION

Artificial intelligence (AI) has grown rapidly in recent years, becoming deeply embedded in nearly every part of modern life—from universities and industries to government agencies.[1,2,3,4,5,6,7,8,9,10] As noted by Ahmad et al.[11] and Brauner et al.[12], AI has become a key driver of change across all sectors of society. According to Tai[13] this shift is not surprising: humans are naturally drawn to innovations that simplify tasks and increase efficiency. Technology and digital innovations have long been recognized as transformative forces in education, reshaping how knowledge is accessed, delivered, and acquired.[14,15,16,17,18,19,20,21] From early digital platforms to interactive learning environments, these tools have expanded the possibilities of teaching and learning beyond traditional boundaries. In recent years, this progress has converged with artificial intelligence (AI), marking a new frontier in educational innovation.[22,23,24,25,26,27,28] Technology, especially AI, enhances our ability to perceive, learn, and reason through the world.[29] It is clear that AI has brought a level of ease and convenience to life that was not previously available.

In education, AI is no longer just a future possibility—it is already playing a role in classrooms across all levels, from early childhood to higher education.[29] Around the world, educators and institutions are starting to realize the need for meaningful change. This awareness has been reinforced by studies showing the value of personalized approaches to teaching.[30] AI supports this shift by helping teachers make more informed decisions, applying more effective teaching strategies, and creating learning experiences tailored to individual student needs.[31] Moreover, it makes it easier for educators to track student progress and for learners to manage their work with greater ease. [32] As a result, schools and institutions are steadily integrating AI into both teaching and learning, recognizing its potential to increase the quality of education worldwide.

However, even as the role of AI in education continues to expand, many educators still struggle to use it effectively. While its potential is widely acknowledged[33,34,35,36,37,38,39], many teachers still lack the knowledge and confidence to make the most AI in the classroom.[11,29,40] Research by Ayanwale et al.[33] and Chai et al.[41] further supports this, suggesting that AI often remains underutilized in practice, despite its promise.

To understand this gap, it is important to look more closely at the factors that influence how educators approach AI. Three key variables stand out: anxiety about using AI, attitudes toward it, and levels of AI literacy. These factors have been explored to some extent in previous research—sometimes on their own, sometimes in pairs. For example, Kaya et al.[42] examined how anxiety relates to attitudes toward AI, whereas Cengiz et al.[43] investigated how anxiety affects literacy. Nevertheless, there is a noticeable lack of studies that explore all three variables together, especially with respect to training to become teachers.

Anxiety, in particular, has been identified as a major barrier.[44,45,46] emphasized its impact, suggesting that anxiety around AI can strongly affect whether an individual embraces new technology. Studies by Khasawneh[47] and Ni et al.[48] revealed that technology-related anxiety often leads to negative emotions and avoidance behavior. Similarly, Almaiah et al.[49] reported that student participation tends to decrease in AI-enhanced learning environments, suggesting that discomfort or fear can negatively affect performance.

Attitudes also play a critical role. According to Schepman et al.[50], an individual's perception of AI often shapes their openness to using it. Attitudes are formed through beliefs, and these beliefs can influence behavior in powerful ways.[51] Cao et al.[52] and Edison et al.[53] both emphasize how personal experience, exposure, and education shape these attitudes—and ultimately affect how people respond to AI in educational settings.

Then, there is the matter of AI literacy. As Walter[54] emphasized, AI literacy equips both teachers and learners with the knowledge and skills to engage with AI confidently. Kim[55] and Kong et al.[56] provide frameworks that extend AI literacy beyond technical competence, linking it to attitudes and emotional readiness. Kong et al.[56], in particular, underscore the relationship between AI literacy and individuals' perceptions and willingness to adopt AI. Recognizing this connection offers important opportunities to examine how cognitive and emotional factors interact in shaping AI adoption in educational contexts. However, despite the growing body of international literature, few empirical studies in the Philippine context have investigated the interconnected roles of attitudes, anxiety, and literacy, particularly among teacher aspirants. This gap underscores the importance of exploring how these constructs interact and differ across teacher education programs in the country. Thus, this study seeks to determine the interrelationship among levels of anxiety, literacy, and attitudes toward artificial intelligence among teacher aspirants, as well as the significant differences across teacher education programs.

Literature review

Attitudes Toward Artificial Intelligence

Attitude refers to an individual's predisposition to respond positively or negatively toward a specific behavior, object, or situation shaped by one's internal evaluations and perceptions.[57,58] These evaluations, which may manifest as approval or disapproval, are rooted in the interplay of psychological responses that form the basis of one's overall attitude.[59,60,61,62,63,64,65,66] Vargas-Sánchez et al.[67] further articulated this by describing attitude as a combination of cognitive, affective, and behavioral components—three interdependent elements that collectively shape how individuals are inclined to think, feel, and act. In turn, changes in one's attitude often reflect shifts in behavior, as individuals strive for consistency between belief and action.[52,53]

Within the context of artificial intelligence (AI), attitude has emerged as a central construct across a range of disciplines. As interest in AI intensifies, so does scholarly attention to understanding how individuals perceive and respond to this technology. For example, Santos et al.[68] investigated how sociogeographical factors influence secondary school teachers' attitudes toward AI, whereas Fuentes et al.[69] examined teacher education students' attitudes toward the use of the ChatGPT as a learning support tool. These studies highlight that individuals' attitudes toward AI are not monolithic; rather, they are shaped by a host of internal and external factors that inform their openness, skepticism, or resistance to AI integration.[70]

According to Zhou[51], attitudes toward AI significantly increase an individual's likelihood of accepting and engaging with AI systems. This aligns with broader theoretical models asserting that attitudes play a predictive role in behavior. However, researchers such as Park et al.[71], Schepman[50] and Rodway[72] noted that the attitudes formed around AI often diverge from those seen in earlier technology adoption models. Unlike prior frameworks that emphasized utility or ease of use, contemporary studies show that psychological dispositions, social contexts, and trust in AI systems are equally—if not more—important in shaping attitudes.

The value of understanding attitudes toward AI lies in its potential to guide the development of policies and strategies that foster more informed and constructive engagement with technology. Public opinion data reinforce the complexity of this topic. In a study by Zhang et al.[73], 41 % of 2000 American adults expressed support for AI, whereas 22 % opposed its advancement. Similarly, a Europe-wide survey conducted by the Directorate-General for Communications Networks, Content and Technology[74] revealed that 61 % of the 27 901 respondents held a positive view of AI and robotics, particularly for their potential to assist with domestic and professional tasks. However, despite these favorable impressions, concerns persist. The same report noted that 74 % of participants feared that AI might eventually lead to job displacement.

These findings suggest that attitudes toward AI are shaped not only by emotional or cognitive predispositions but also by levels of knowledge, education, and exposure. Individuals with more familiarity and hands-on experience with AI technologies tend to express more informed and nuanced attitudes. Conversely, a lack of awareness may foster anxiety or skepticism. As such, attitudes become critical mediators of the acceptance and meaningful use of AI, particularly in educational settings where trust and efficacy are crucial.[50,72]

Ultimately, understanding and addressing these interconnected variables—attitude, knowledge, self-efficacy, and trust—are essential for promoting the thoughtful integration of AI. The acceptance of artificial intelligence, then, is not simply a matter of technological capability but of human disposition. As AI continues to expand its reach, fostering positive, well-informed attitudes will be key to unlocking its full potential across all sectors.

Anxiety Toward Artificial Intelligence

Anxiety is a future-oriented psychological state characterized by heightened sensitivity to potential negative outcomes, functioning as a preparatory mechanism in decision-making processes.[75] In the context of rapid technological advancement, traditional manifestations of anxiety have evolved, giving rise to more specific forms of apprehension—among them, anxiety surrounding artificial intelligence (AI). This form of anxiety can be traced back to early forms of technophobia, particularly fears associated with computer use.[76,77] Parasuraman et al.[78] defined computer anxiety as the innate tendency to feel uneasy, fearful, or hesitant in engaging with computers both in present and future contexts. Such anxiety has been shown to manifest not only in avoidance behaviors but also in negative attitudes toward technological advancement, leading to broader societal concerns.[79]

Importantly, this anxiety is often rooted in deeply held beliefs and cognitive interpretations rather than in emotional reactions to specific technological interactions.[80] As Epstein[81] suggested, persistent worry and apprehension can culminate in a sense of cognitive overload, reinforcing avoidance or resistance. Within this framework, AI anxiety emerges as a distinct phenomenon. Johnson et al.[82] conceptualized it as a form of apprehension centered around the perceived loss of control over autonomous systems. They identified three core contributors to AI anxiety: sociotechnical blindness, confusion about machine autonomy, and misperceptions of the trajectory of AI development. Building upon this, Wang et al.[46] characterized AI anxiety as a psychological barrier that discourages individuals from engaging with AI, which is often expressed through generalized emotional discomfort.

Central to the development and intensity of AI anxiety are individual differences in technological experience and knowledge. In studies of computer anxiety, individuals with greater exposure and more favorable attitudes toward technology tend to report lower levels of anxiety.[49] This pattern extends to AI-related contexts, where research indicates that educational background and prior experience with AI correlate with more positive attitudes and reduced anxiety.[32,42] Moreover, some scholars posit that learners' technological anxieties may be transferred into AI contexts depending on their preparedness and familiarity with AI-related learning environments. Unfortunately, many secondary school students have limited exposure to AI in formal curricula, often coupled with insufficient institutional support or qualified instructors.[83] This lack of exposure and support may negatively influence their perceptions of AI and heighten anxiety during attempts to engage with AI-powered educational tools.

The implications of AI anxiety are both profound and nuanced. High levels of technology-related anxiety have been linked to reduced user engagement, negative emotional responses, and diminished participation in academic settings.[47,48] Kaya et al.[42] identified two dimensions of AI anxiety: AI learning anxiety, which is correlated with diminished positive attitudes toward AI, and AI construction anxiety, which is associated with decreased tolerance and acceptance of AI. Both forms of anxiety were found to negatively affect the behavioral intention to use AI, which was largely mediated by users' attitudes. Similarly, Wang et al.[46] reported that AI learning anxiety undermines intrinsic motivation, thereby reducing one's willingness to engage with AI technologies.

Interestingly, not all outcomes associated with AI anxiety are detrimental. Some studies suggest that moderate levels of anxiety may, paradoxically, act as motivators. Wang and Wang [46,77] noted that certain anxieties may enhance students' motivation and learning behavior by prompting heightened attention and effort. In a related vein, Wang et al.[46] reported that job replacement anxiety—fear of being replaced by AI in the workforce—could positively influence extrinsic motivation. This aligns with Hsu's [84] argument that moderate anxiety and mental effort can, under certain conditions, promote deeper learning. These findings imply that the relationship between AI anxiety and learning outcomes is complex and potentially curvilinear: while excessive anxiety may impede engagement, moderate anxiety may stimulate beneficial cognitive and behavioral responses.

Despite some overlap with computer anxiety, AI anxiety is conceptually distinct because of the perceived autonomy and ethical implications associated with AI systems. Unlike traditional computing technologies, AI can make independent decisions, raising concerns about artificial agency and consciousness.[85,86] Ethical challenges also arise when AI systems process and act on data without necessarily adhering to human moral frameworks, potentially leading to violations of ethical norms.[87,88,89] Additionally, the proliferation of AI in everyday settings—from retail environments to banking and education—has made its influence more visible and pervasive.[85,90] This ubiquity has intensified public concerns, particularly regarding the potential of AI to displace human workers[91] and has implications for students preparing to enter an AI-influenced workforce.

These socioethical concerns have direct implications for education. As AI becomes more deeply embedded in pedagogical tools and platforms, students' anxiety may shape not only their immediate learning experience but also their longer-term academic and career trajectories. Therefore, addressing AI anxiety is not only a matter of technological training but also a matter of psychological and ethical engagement. Educational institutions must consider the emotional and cognitive dimensions of AI use, creating environments that foster informed, balanced, and constructive interactions with AI systems.

AI anxiety represents a multifaceted challenge. While it can impede motivation and reduce behavioral intention to engage with AI technologies, under certain conditions, it may also drive motivation and active learning. Understanding the delicate balance between debilitating and motivating levels of anxiety is essential for educators, developers, and policymakers alike. Effective AI integration in education depends not only on technological infrastructure but also on cultivating the mental readiness and emotional resilience of learners.

Artificial intelligence literacy

Literacy, as defined by UNESCO (2004; 2017), encompasses the capacity to understand, identify, analyze, create, and communicate meaning across diverse contexts. It represents an ongoing, developmental process that empowers individuals to achieve personal goals, expand knowledge, and engage meaningfully within their communities and society. With the onset of the 21st century and the rapid integration of artificial intelligence (AI) across various domains, the concept of AI literacy has emerged as a critical extension of this foundational competency.[92,93,94,95]

Although early discussions on AI literacy date back to the 1970s—primarily centered around the technical competencies of professionals in AI domains—its prominence has remained minimal for decades.[96] Renewed attention to AI literacy emerged in approximately 2020, coinciding with the widespread incorporation of AI in educational settings. This resurgence prompted a surge in scholarly inquiry and curriculum development focused on equipping learners with the competencies necessary to navigate AI-driven learning environments.[97,98]

In educational contexts, AI literacy is broadly understood as the knowledge and ability to engage effectively with AI technologies. This encompasses not only technical proficiency but also an understanding of the societal and ethical implications of AI.[54] Long et al.[99] define AI literacy as the capacity to critically evaluate AI systems, collaborate meaningfully with AI agents, and utilize AI as a tool to augment learning and problem solving. This literacy is pivotal in enabling individuals to act not only as consumers of AI technologies but also as informed, critical participants in AI-mediated environments.[99] Contemporary studies have proposed several frameworks for conceptualizing AI literacy.[56] identify three core dimensions: AI application, AI concepts, and AI ethics. AI application refers to practical engagement with AI in real-world scenarios; the AI concept addresses the foundational knowledge and historical development of AI; and AI ethics considers the moral, societal, and safety concerns intrinsic to AI deployment. Similarly, Kim[55] divides AI literacy into AI knowledge,

AI skills, and AI attitudes. In this model, AI knowledge pertains to the fundamental theories and principles of AI; AI skills involve computational competencies necessary for AI implementation; and AI attitudes reflect an individual's disposition toward understanding and evaluating the social impact of AI–human interaction. These frameworks emphasize the interconnectedness of AI literacy with adjacent literacies—such as digital, data, and computational literacies—which collectively form a foundational ecosystem of modern learning.[99] For example, digital literacy, defined as the ability to use digital tools and platforms effectively[100] is often a prerequisite for developing AI literacy. The capacity to engage with AI, therefore, builds upon and is contingent upon foundational digital competencies.

AI literacy not only enhances students' ability to comprehend and utilize AI technologies but also redefines the pedagogical landscape. It facilitates a transformative shift in education, where AI competence becomes as critical as traditional forms of literacy.[101] This paradigm shift is gradually being recognized by educators and stakeholders, who are beginning to embed AI literacy into curricula and instructional strategies.[102,103]

Nevertheless, the integration of AI literacy into educational practice remains nascent and fraught with challenges. The complex, rapidly evolving nature of AI technologies poses significant barriers to adoption within school systems, particularly in contexts lacking robust infrastructure, teacher training, or policy support. Despite these challenges, emerging pedagogical frameworks and policy guidelines offer a structured pathway for fostering students' capacities to understand, apply, and ethically engage with AI systems. Through intentional curriculum design and stakeholder collaboration, AI literacy can serve as a catalyst for cultivating deep, critical engagement with the societal implications and technological potential of artificial intelligence.

METHOD

Research Design

This study sought to examine the levels of anxiety, attitudes, and literacy toward artificial intelligence (AI) among prospective teachers. To achieve this goal, a quantitative descriptive-correlational research design was employed. As described by Kothari[104] this methodology involves the systematic collection and analysis of quantifiable data, enabling a statistical evaluation of the variables under investigation. The correlational component of the design aims to explore potential associations or relationships between two or more variables, including the degree and direction of their interaction.[105] Concurrently, the descriptive dimension provides a comprehensive snapshot of the key characteristics of the population concerning AI-related anxiety, attitudes, and literacy.[106]

The selection of this design aligns with the overarching objective of the study: to assess both the extent and interplay of the aforementioned constructs within the target population. Moreover, as data are gathered from a defined population sample during a single, limited time frame, the investigation can be classified as a cross-sectional study.[107] This methodological approach enables the identification of patterns and relationships at a specific point in time, thereby offering insights into the current state of teacher aspirants' psychological and cognitive orientations toward AI.

Respondents of the Study

The participants of this study were undergraduate students enrolled in various teacher education programs at a state-run higher education institution. Specifically, the sample included students from five distinct degree programs: Bachelor of Secondary Education, Bachelor of Elementary Education, Bachelor of Early Childhood Education, Bachelor of Special Needs Education, and Bachelor of Culture and Arts Education. To ensure representation across these different programs, a stratified random sampling technique was employed. As Glasgow[108] posited, stratified random sampling is appropriate when the target population is large and can be meaningfully subdivided into distinct groups or strata, each with shared characteristics. In the present study, stratification was based on the students' respective degree programs, allowing for proportionate and randomized selection within each stratum.

A total of 200 students were included in the study, with an equal distribution of 40 participants per program, ensuring balanced representation across the academic tracks. In terms of gender distribution, female respondents constituted the majority, comprising 113 individuals or 56,5 % of the sample. This gender disparity is consistent with trends observed in teacher education programs, which are frequently characterized by a greater proportion of female enrollees.[109,110,111,112,113,114,115,116,117]

The participants were predominantly within the 18-24 age group, with a mean age of 20,28 years and a standard deviation of 1,650, indicating a relatively homogenous age range typical of undergraduate cohorts in preservice education programs.

Research Tool

To determine the students' level of anxiety, attitudes, and literacy toward artificial intelligence, this study employed a survey questionnaire that utilized three adopted research instruments. The research instruments

that were utilized in this study were adopted from the studies of Schepman and Rodway titled The General Attitude toward Artificial Intelligence Scale (GAAIS): Confirmatory Validation and Association with Personality, Corporate Distrust, and General Trust developed in 2023;[72] next, an artificial intelligence anxiety scale was developed and validated: an initial application for predicting motivated learning behavior developed by Wang et al.[46]; and last, measuring user competence in using artificial intelligence: the validity and reliability of the artificial intelligence literacy scale was developed by Wang et al. in 2022.[118]

The general attitude toward artificial intelligence scale (GAAIS) measures the general attitude of individuals toward AI. The instrument has a total of twenty items that are divided into two dimensions: the positive subscale, with twelve items, and the negative subscale, with eight items. The instrument uses a five-point Likert scale with options ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). In the validation of the General Attitude toward Artificial Intelligence Scale of Schepman et al.[72] the Cronbach's alpha coefficient for the positive subscale was 0,82, and that for the negative subscale was 0,84, which is a good indicator that the instrument is generally satisfactory.[119] The negative subscale items of the instrument were reverse coded in the data analysis, as the scores decreased as the negative attitudes increased, and the negative attitudes decreased as the scores increased.[105]

The artificial intelligence anxiety scale (AIAS) aims to measure the level of anxiety toward artificial intelligence in its development and its impact on the behavior of a person in learning. The scale has twenty-one items and is categorized into four dimensions: the learning dimension with eight (8) items, the job replacement dimension with six (6) items, four (4) items for sociotechnical blindness, and three (3) items for AI configuration. Wang and Wang[46] reported that the reliability of the scale is 0,964, which exceeds the minimum of 0,70 recommended by Hair et al.[120] The reliability of each of the four dimensions was 0,974 for learning, 0,917 for job replacement, 0,917 for sociotechnical blindness, and 0,961 for the AI configuration. The instrument uses a seven-point Likert scale with options ranging from "Strongly Disagree" (1) to "Strongly Agree" (5).

The artificial intelligence literacy scale (AILS) measures the level of literacy of an individual with respect to the user's competence in using AI. The instrument consists of twelve items and is categorized into four (4) constructs, which are Awareness, Usage, Evaluation, and Ethics, with three (3) items in each category. The instrument uses a seven-point Likert scale with options ranging from "Strongly Disagree" (1) to "Strongly Agree" (7). Wang et al.[118] reported that the reliability of the scale was 0,82, which suggests that the instrument is generally accepted.[119]

Data collection procedure

The researcher conducted the data-gathering procedure via an online platform (Google Forms), and the adopted research instrument was digitalized. At the beginning of the form, a letter from the researcher is attached requesting approval for the potential study group. Upon their approval, they were asked to provide necessary information such as age, gender, and each of the study group course programs. It was ascertained that their personal information was kept confidential. Furthermore, the study group was informed about the information they needed before answering the digital questionnaire, which was followed by a 53-item questionnaire. The researcher contacted the study group several times through Facebook and Messenger to remind them and ensure that they were able to answer the given digitalized questionnaire. A total of 218 students received the online questionnaire; however, only 200 of them answered.

Data Analysis Procedure and Statistical Treatment

The data were collected via Google Forms and retrieved through a Microsoft Excel spreadsheet. The responses were coded accordingly. In the demographic section, the coding procedure was for gender (1 for males, 2 for females) and course programs (1 for a Bachelor of Elementary Education, 2 for a Bachelor of Secondary Education, 3 for a Bachelor of Special Needs Education, 4 for a Bachelor of Early Childhood Education, and 5 for a Bachelor of Culture and Arts Education). However, the age was written already in figure form.

The data gathered were analyzed via the IBM SPSS 25.0 program. First, whether the collected data were normally distributed was determined by examining the skewness coefficients to determine the normality of the sample, which was determined to be normally distributed according to the analysis via the Kolmogorov–Smirnov test. A value greater than 0,05 indicated the normality of the data. For the demographic data, a descriptive frequency test was used to identify the frequency. To determine the level of anxiety toward AI, AI literacy, and attitudes toward AI, descriptive statistics were employed. To determine the significant differences in attitudes, literacy, and anxiety toward AI among teacher aspirants across each course program, one-way analysis of variance and Tukey's honest significant difference (HSD) test were utilized. Finally, the Pearson product moment coefficient (Pearson r) was employed to test the relationships between the level of anxiety toward AI, AI literacy, and attitudes toward AI in the study group.

After the results were identified, interpretation was performed to properly determine the levels among the variables. The descriptive statistics for the attitude items were interpreted through the use of a five-

level scale for positive items ranging from 5,00–4,2, positive from 4,20–3,4, neutral from 3,40–2,61, somewhat negative from 2,60–1,81, and negative from 1,80–1,00. On the other hand, negative items ranged from 5,00–4,21; negative items ranged from 4,20–3,41; neutral items ranged from 3,40–2,61; positive items ranged from 2,60–1,81; and positive items ranged from 1,80–1,00. Additionally, the variables anxiety and literacy were interpreted through a 7-level scale ranging from 1--7 with a 0,85 interval, which was identified as very low, low, slightly low, moderate, slightly high, high, and very high, respectively. The interrelationship among variables was interpreted; accordingly, a positive value ($0 < r \leq 1$) indicates a direct relationship where both variables increase together, whereas a negative value ($-1 \leq r < 0$) indicates an inverse relationship where one variable increases as the other decreases. The closer the coefficient is to 1 or -1, the stronger the relationship. Additionally, the significance of the correlation is determined by the p value; a p value less than 0,05 suggests that the correlation is statistically significant and unlikely to have occurred by chance.

RESULTS AND DISCUSSION

Teacher Aspirants' Attitudes toward Artificial Intelligence

Table 1. Descriptive statistics on attitudes toward artificial intelligence

Attitude toward AI	Mean	SD	Interpretation
Positive Items	4,15	0,72	Somehow Positive
Negative Items	4,23	0,14	Positive
Overall	4,19	0,42	Somehow Positive

The results indicate that teacher aspirants generally exhibit a positive attitude toward artificial intelligence. As presented in table 1, positive statements yielded a mean score of 4,15, whereas negative statements reflected a mean of 1,57, both suggesting favorable perceptions of AI. Overall, teacher aspirants' attitudes leaned toward the positive end of the scale, with a mean of 4,19 (SD = 0,42), signifying trust in and acceptance of AI as part of their daily activities. These findings align with their beliefs and understanding, shaping how they evaluate and form attitudes toward AI.[50,70,72] This is consistent with Zhang et al.[73] findings that more positive attitudes toward AI correspond to greater acceptance of its use.

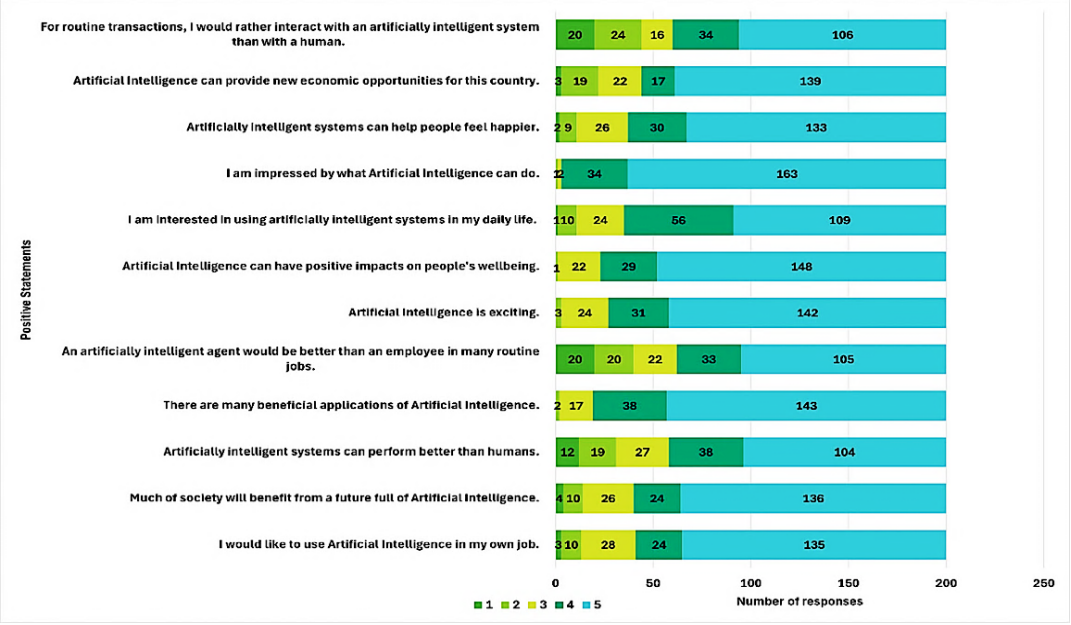

Figure 1. Positive Statements on Attitudes toward Artificial Intelligence

Figure 1 illustrates the distribution of teacher aspirants' responses to positive statements on artificial intelligence, showing that the majority answered with strong agreement. Among the twelve positive statements, the highest levels of agreement were observed for "I am impressed by what artificial intelligence can do" (163 strongly agree; 34 agree), followed by "There are many beneficial applications of artificial intelligence" (143 strongly agree; 38 agree) and "Artificial intelligence can have positive impacts on people's well-being" (148 strongly agree; 29 agree). These three items, which emphasize the applications and benefits of AI, recorded the

highest response rates. Overall, the responses indicate that teacher aspirants largely view AI as beneficial, with agreement and strong agreement emerging as the dominant responses, particularly in relation to its potential societal contributions and educational integration.

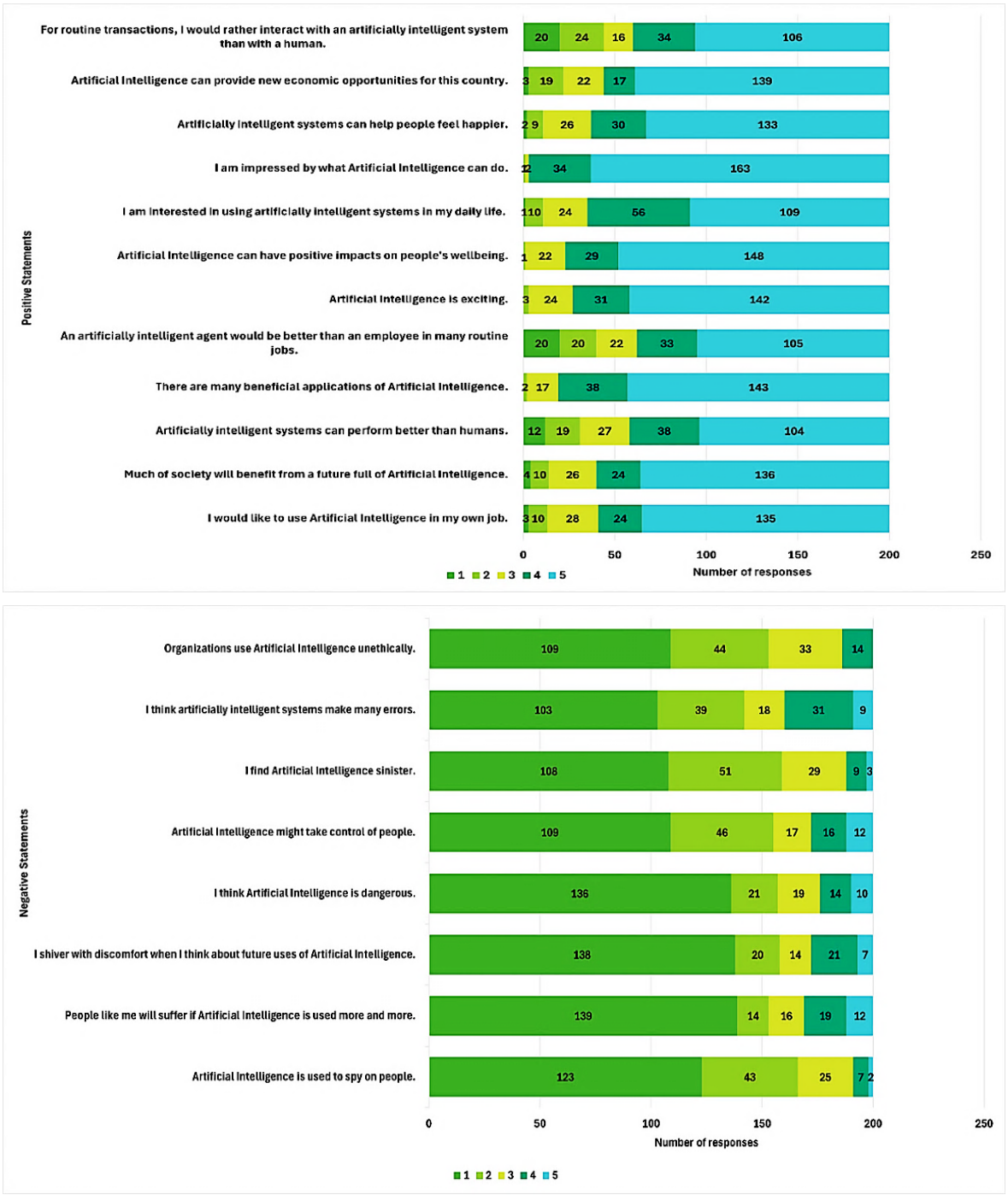

Figure 2. Negative Statements on Attitudes toward Artificial Intelligence

Similarly, figure 2 presents the distribution of teacher aspirants' responses to the negative statements, with the majority ranging from disagree to strongly disagree. Notably, 123 respondents strongly disagreed and 43 disagreed with the statement that artificial intelligence is used to spy on people; 108 strongly disagreed and 51 disagreed with the statement "I find artificial intelligence sinister"; and 138 strongly disagreed and 20 disagreed with the statement "I shiver with discomfort when I think about future uses of artificial intelligence." These results indicate that teacher aspirants do not perceive AI as threatening or dangerous.

Figures 1 and 2 together show the dispersion of teacher aspirants' attitudes toward artificial intelligence, with negative statements yielding low mean scores, including "organizations that use artificial intelligence unethically, and people such as me will suffer if artificial intelligence is used increasingly" (M = 1,76), "I find

artificial intelligence sinister" (M = 1,74), "I think artificial intelligence is dangerous" (M = 1,71), "I shiver with discomfort when I think about future uses of artificial intelligence" (M = 1,70), and "artificial intelligence is used to spy on people" (M = 1,61). These findings reinforce that teacher aspirants hold positive attitudes toward AI, perceiving it as beneficial and suitable for integration into education. This finding supports Zhou's [51] assertion that attitudes strongly influence individual perceptions of AI, underscoring that while attitudes toward AI may vary, the teacher aspirants in this study generally maintain a favorable outlook.

Teachers' Aspirant's Level of Artificial Intelligence Anxiety

Table 2. Descriptive statistics on the level of artificial intelligence anxiety

Domains	Mean	SD	Interpretation
Learning	2,13	1,09	Low Anxiety
Job Replacement	2,87	2,02	Slightly Low Anxiety
Sociotechnical Blindness	2,65	2,07	Slightly Low Anxiety
Artificial Intelligence Configuration	2,13	1,65	Low Anxiety
Overall	2,44	1,74	Low Anxiety

Table 2 presents the teacher aspirants' level of artificial intelligence anxiety, which yielded an overall mean of 2,44, interpreted as low anxiety. This indicates that there is a low level of anxiety among teacher aspirants regarding artificial intelligence. The highest mean of 2,87 was observed in the domain of job replacement, suggesting that among the four domains, teacher aspirants were slightly more anxious than others about the potential loss of jobs due to AI. This was followed by sociotechnical blindness, with a mean score of 2,65, whereas both the learning and AI configurations obtained mean scores of 2,13, all of which were interpreted as low anxiety. These results reveal that teacher aspirants generally have a low level of artificial intelligence anxiety, particularly in relation to learning and optimizing AI when performing tasks.

This finding signifies that teacher aspirants exhibit low anxiety toward artificial intelligence, which may contribute to improved performance in their education. As noted by Wang et al.[46], AI anxiety can serve as a factor that influences motivation in learning, either hindering or enhancing students' learning behaviors. In support of this, Kaya et al.[42] and Johnson et al.[82] reported that individuals with high AI anxiety tend to lack positive perceptions and show decreased motivation in learning AI, reinforcing the idea that teacher aspirants with lower levels of anxiety are more likely to demonstrate stronger motivation in engaging with AI. Conversely, heightened anxiety toward AI may reduce interaction and utilization among users and negatively affect various aspects associated with the effective use of AI.

Teachers' Aspirant Levels of Artificial Intelligence Literacy

Table 3. Descriptive statistics on the level of artificial intelligence literacy

Construct	Mean	SD	Interpretation
Awareness	6,22	1,16	Very High level
Usage	6,04	1,58	Very High level
Evaluation	6,33	1,10	Very High level
Ethics	6,31	1,12	Very High level
Overall	6,22	1,24	Very High level

Table 3 presents the teacher aspirants' level of artificial intelligence literacy, which was interpreted as ranging from high to very high. The Awareness construct obtained a mean of 6,22, indicating a very high level of awareness of artificial intelligence. The Usage construct recorded a mean of 6,04, interpreted as a high level of knowledge in the use of AI. The evaluation construct was likewise described as very high, reflecting the teacher aspirants' ability to critically assess AI. The Ethics construct yielded a mean of 6,31, also considered very high, signifying that teacher aspirants possess a strong capacity to identify the ethical and safety challenges of artificial intelligence. Overall, the mean score of 6,22 indicates that the literacy level of teacher aspirants toward AI is very high.

The analysis shows that teacher aspirants demonstrate a high ability to critically evaluate AI technologies, collaborate and communicate effectively with AI, and employ it as an instrument.[99] Zhang et al.[101] reported similar results, noting that students are literate in artificial intelligence and thus more capable of understanding and utilizing AI in educational contexts. Furthermore, Casal-Otero et al.[102] and Chiu[103] emphasized that these literacy levels enhance teachers' and stakeholders' strategies in education, as they recognize differences in learners' levels and recommend the development of new strategies that integrate AI. These findings reinforce the importance of developing and strengthening learners' literacy in artificial intelligence to promote deeper understanding and more effective application.

The Levels of Anxiety, Literacy, and Attitudes of Teacher Aspirants Toward Artificial Intelligence across Course Programs

Table 4. Levels of anxiety, literacy, and attitudes of teacher aspirants toward artificial intelligence across course programs

Domain	Course Program	Mean	SD	F value	p value	Remarks
Attitude	BEED	4,41	0,59	48,235	0,000	Significant
	BSED	3,17	0,48			
	BCAED	4,46	0,49			
	BECED	4,18	0,66			
	BSNED	4,53	0,25			
Anxiety	BEED	1,78	0,98	47,498	0,000	Significant
	BSED	4,43	1,13			
	BCAED	1,70	0,87			
	BECED	2,34	1,50			
	BSNED	1,95	0,48			
Literacy	BEED	5,30	0,36	12,178	0,000	Significant
	BSED	4,64	0,69			
	BCAED	5,25	0,49			
	BECED	5,09	0,54			
	BSNED	5,25	0,30			

Table 4 presents the significant differences in the levels of anxiety, literacy, and attitudes of teacher aspirants toward artificial intelligence across different course programs, with F values ranging from 12,178 to 48,235 and statistically significant p values of 0,000 < 0,05. Since the p values are less than the 0,05 level of significance, the results confirm significant differences in anxiety, literacy, and attitudes toward AI across course programs.

The data further show that the BSED program recorded the lowest mean score for attitudes (3,17) and the highest mean score for anxiety (4,43), indicating greater apprehension and less favorable views toward AI than the other programs did. Conversely, the BSNED program obtained the highest mean score for attitudes (4,53) and a relatively low anxiety mean score (1,95), reflecting a more positive and confident perception of AI. Differences were also noted in AI literacy across programs, with BEED, BSNED and BCAED showing the highest literacy scores of 5,30 and 5,25, respectively, indicating stronger understanding and knowledge of AI. In contrast, BSED had the lowest literacy score of 4,64, indicating that an area that may require improvement in AI literacy.

Tukey's HSD test was used to determine which specific groups' means were significantly different following one-way ANOVA

Table 5. Tukey's HSD test on levels of anxiety, literacy, and attitudes of teacher aspirants toward artificial intelligence across course programs

Variables	Course Program		Mean Difference	SD	p value
Positive Attitude	BEED	BSED	1,241	0,11455	0,000*
		BSNED	-0,04800	0,11455	0,994
		BECED	0,23200	0,11455	0,258
		BCAED	-0,11450	0,11455	0,855
	BSED	BSNED	-1,28900	0,11455	0,000*
		BECED	-1,00900	0,11455	0,000*
		BCAED	-1,35550	0,11455	0,000*
	BSNED	BECED	0,28000	0,11455	0,108
		BCAED	-0,06650	0,11455	0,978
	BECED	BCAED	-,34650	0,11455	0,023
Negative Attitude	BEED	BSED	-1,51825	0,14273	0,000*
		BSNED	0,06675	0,14273	0,990
		BECED	-0,34125	0,14273	0,122
		BCAED	0,02375	0,14273	1,000
	BSED	BSNED	1,58500	0,14273	0,000*
		BECED	1,17700	0,14273	0,000*
		BCAED	1,54200	0,14273	0,000*
	BSNED	BECED	-,40800	0,14273	0,038
		BCAED	-0,04300	0,14273	0,998
	BECED	BCAED	0,36500	0,14273	0,083
Anxiety	BEED	BSED	-2,64925	0,23378	0,000*
		BSNED	0,07875	0,23378	0,997
		BECED	-0,55825	0,23378	0,123
		BCAED	-0,16725	0,23378	0,953
	BSED	BSNED	2,72800	0,23378	0,000*
		BECED	2,09100	0,23378	0,000*
		BCAED	2,48200	0,23378	0,000*
	BSNED	BECED	-0,63700	0,23378	0,054
		BCAED	-0,24600	0,23378	0,830
	BECED	BCAED	0,39100	0,23378	0,453
Literacy	BEED	BSED	,66050	0,11039	0,000*
		BSNED	0,04975	0,11039	0,991
		BECED	0,21425	0,11039	0,299
		BCAED	0,05150	0,11039	0,990
	BSED	BSNED	-,61075	0,11039	0,000*
		BECED	-,44625	0,11039	0,001*
		BCAED	-,60900	0,11039	0000*
	BSNED	BECED	0,16450	0,11039	0,570
		BCAED	0,00175	0,11039	1,000
	BECED	BCAED	-0,16275	0,11039	0,580

In terms of positive attitudes, the comparison between BSED and the other course programs, specifically BSNED, BCAED, and BECED, yielded mean differences of -1,289, -1,009, and -1,3555, respectively, with a p value of 0,000, indicating that BSED students have significantly lower positive attitudes than the other three groups do. BEED students also displayed a more positive attitude than BSED students did, with a mean difference of 1,241 and a p value of 0,000. Additionally, the comparison between BECED and BCAED students revealed that BECED students had more positive attitudes than did BCAAED students, with a mean difference of -0,34650 and a p value of 0,023. For negative attitudes, BEED students exhibited significantly lower negative attitudes than BSED students did, with a mean difference of -1,51825 and a p value of 0,000. Moreover, BSED students demonstrated significantly greater negative attitudes than BSNED, BECED, and BCAED students did, with mean differences of 1,585, 1,177, and 1,542, respectively, all with p values of 0,000. The results further show that BSNED students had significantly lower negative attitudes than BECED students did, with a mean difference of -0,408 and a p value of 0,038.

The table also summarizes the differences in AI anxiety and literacy among the different course programs, confirming significant variations. BEED students presented significantly lower anxiety levels than BSED students did, with a mean difference of -2,64925 and a p value of 0,000. Conversely, BSED students presented significantly higher anxiety levels than BSNED, BECED, and BCAED students did, with mean differences of 2,728, 2,091, and 2,482, respectively, all with p values of 0,000. These findings indicate that BSED students experience higher anxiety levels than other groups do, whereas BEED students have the lowest anxiety levels. With respect to literacy, the Tukey test results revealed that BEED students had significantly higher literacy levels than BSED students did, with a mean difference of 0,66050 and a p value of 0,000. In contrast, BSED students demonstrated significantly lower literacy levels than BSNED, BECED, and BCAED students did, with mean differences of -0,61075, -0,44625, and -0,60900, respectively, all with p values of 0,000.

Overall, these findings confirm significant differences in AI attitudes, anxiety levels, and literacy across course programs. BEED students consistently exhibit more positive attitudes, lower negative attitudes, lower anxiety levels, and higher literacy levels than BSED students do. In contrast, BSED students tend to have more negative attitudes, higher anxiety levels, and lower literacy levels than their counterparts in other programs do. These results underscore the importance of addressing the distinct needs of BSED students and considering the varying characteristics and challenges across programs to foster an environment that supports effective learning.

Interrelations between teachers' levels of anxiety, literacy, and attitudes toward artificial intelligence

Table 6. Tukey's HSD test on levels of anxiety, literacy, and attitudes of teacher aspirants toward artificial intelligence across course programs

Variables	p value	r-value		Interpretation
Attitude toward AI	AI Anxiety	0,000	-0,811	Strong Negative Correlation
AI Anxiety	AI Literacy	0,000	-0,592	Moderate Negative Correlation
AI Literacy	Attitude toward AI	0,000	0,589	Moderate Positive Correlation

The Pearson correlation results reveal significant relationships among attitudes toward AI, AI anxiety, and AI literacy among teacher aspirants. A strong negative correlation between attitudes toward AI and AI anxiety (r = -0,811) indicates that the two variables are inversely related, meaning that students with more positive attitudes toward AI tend to experience lower levels of AI anxiety. This suggests that fostering positive attitudes toward AI can contribute to reducing anxiety, which is important for sustaining students' motivation and engagement with AI technologies.

A moderate positive correlation between attitudes toward AI and AI literacy (r = 0,589) suggests that students with more positive attitudes toward AI are more likely to have higher levels of AI literacy. This underscores the value of promoting favorable attitudes toward AI, as such attitudes can enhance students' understanding and proficiency in using AI technologies within the educational context.

Finally, a moderate negative correlation between AI anxiety and AI literacy (r = -0,592) demonstrated that higher levels of AI anxiety are associated with lower AI literacy skills. This implies that addressing anxiety toward AI is essential to prevent adverse effects on students' literacy development. Reducing AI-related anxiety can support improved learning outcomes, academic success, and overall well-being.

CONCLUSIONS

The rise of artificial intelligence has been an element of the difference in the perspective and experience of every individual. In terms of education, AI has varied in terms of perceptions of its effectiveness and utilization among teachers and students, which implies that there might be an effect on the insight and application of artificial intelligence for the accomplishment of tasks. The present study highlights the literacy, anxiety, and attitudes of teacher aspirants, which significantly affect their teaching and learning. The results suggest that in the field of education, artificial intelligence plays a crucial role in enabling students to take the opportunity to advance their skills in the field of technology integration.

The analysis of attitudes toward AI revealed that teacher aspirants have a positive attitude toward artificial intelligence, which indicates a positive outlook on the use of AI. Additionally, the examination of artificial intelligence anxiety reveals an overall low anxiety level among teacher aspirants. This result implies that teacher aspirants are expected to perform well in their education, as low anxiety enhances motivation and learning. Finally, the analysis of AI literacy presents a very high level of literacy among teacher aspirants. The very high level of literacy on AI denotes the teacher aspirants' ability to critically evaluate, communicate effectively, and use AI as a tool in the context of education. Furthermore, this study revealed that there is a significant difference in the level of anxiety, literacy, and attitudes toward artificial intelligence across different course programs. This highlights the difference in the overall perception and use of AI across course programs. Moreover, there is a significant interrelationship among the variables, suggesting that the variables affect each other. This study highlighted various correlations among variables, from negative correlations to positive correlations, which can provide insights into the roles of attitudes, anxiety, and literacy toward AI.

With these implications, it is worth noting the attitudes, anxieties, and literacy of teacher aspirants toward AI to maximize the potential of AI in the education sector. As future educators, it is important also to identify their level of anxiety, literacy, and attitudes toward the integration of artificial intelligence to further enhance their knowledge and skills in the application of AI to teacher aspirants' future role in education.

RECOMMENDATIONS

In light of these findings, it is recommended that teacher education institutions strengthen their curriculum by embedding structured programs on artificial intelligence literacy. While teacher aspirants already demonstrate a very high level of literacy, integrating formal instruction that emphasizes both technical competencies and critical evaluation of AI can sustain and further enhance their ability to apply AI responsibly in educational contexts. Such initiatives will ensure that future educators are not only knowledgeable but also equipped to guide learners in navigating emerging technologies.

The results also point to notable differences in the levels of attitudes, anxiety, and literacy across course programs. Addressing these variations requires the design of program-specific interventions that respond to the unique needs of each discipline. Through targeted workshops, seminars, and training sessions, institutions can reduce disparities and provide more consistent preparation for AI integration, thereby ensuring equity in technological readiness among teacher aspirants.

Furthermore, the positive attitudes toward AI reflected in the study should be nurtured and sustained. This can be achieved by providing opportunities for teacher aspirants to engage directly with AI tools in practical and meaningful ways. Moreover, although anxiety levels were reported as low, it remains important to proactively manage potential sources of apprehension through mentoring, peer learning, and supportive environments that foster confidence in technology use.

Finally, as teacher aspirants transition into professional educators, continuous professional development opportunities should be made available to further advance their knowledge and skills. Policymakers and educational leaders are encouraged to integrate AI-related competencies into teacher education standards and policies, ensuring that attitudes, literacy, and responsible practices concerning AI are recognized as essential outcomes of teacher preparation. Such measures will not only maximize the potential of AI in education but also help educators lead classrooms that are adaptive, innovative, and future oriented.

Implications for the Practical and Ethical Challenges of Integrating AI in Education

The integration of AI in education, while offering significant opportunities, presents both practical and ethical challenges that need to be addressed for its effective and equitable implementation. In practice, varying levels of AI literacy among teachers, inconsistent integration across different educational programs, and inadequate technological infrastructure may hinder the successful adoption of AI tools in classrooms. Additionally, there is a need for ongoing teacher training and support to ensure that educators can effectively implement AI in their teaching. Ethically, AI systems in education face concerns around bias, as algorithms may inadvertently favor certain student groups, perpetuating inequalities. Data privacy and security are also critical issues, as AI relies on sensitive student information that must be protected. Moreover, the overreliance on AI risks diminishing the human element of teaching, whereas the potential for reduced teacher autonomy raises concerns about the

erosion of professional judgment. Finally, disparities in access to AI resources, particularly among underfunded or rural schools, exacerbate existing inequalities. To maximize AI's potential in education, these challenges must be addressed by fostering AI literacy, ensuring fairness, safeguarding data, and maintaining the essential human aspects of teaching.

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FINANCING

The authors did not receive financing for the development of this research.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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