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ORIGINAL

Preservice Teachers and AI in Education 5.0: Examining Literacy, Anxiety, and Attitudes across Gender, Socioeconomic Status, and Training

Futuros Docentes y la IA en la Educación 5.0: Un Examen de la Alfabetización, la Ansiedad y las Actitudes según el Género, el Estatus Socioeconómico y la Formación

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ABSTRACT

Education 5.0 underscores the central role of artificial intelligence (AI) in reshaping teaching and learning, yet the readiness of preservice teachers to engage with these technologies remains at an early stage. This study set out to examine the levels of AI literacy, anxiety, and attitudes among preservice teachers in state universities and colleges in the Zamboanga Peninsula, taking into account gender, socioeconomic status, and training as key demographic variables. Using a descriptive-quantitative, correlational-comparative design, data were gathered from 378 respondents and analyzed through descriptive statistics, independent samples t-tests, one-way ANOVA, and Pearson correlation. Results revealed that preservice teachers demonstrated moderately high literacy (M = 3,80), moderate anxiety (M = 3,00), and generally positive attitudes (M = 3,60). Gender differences were evident, with males reporting higher literacy but lower anxiety, while females showed greater anxiety and slightly more positive attitudes. Socioeconomic status also influenced literacy and anxiety, favoring students from higher-income groups, though attitudes showed little variation. Training enhanced literacy but had negligible effects on anxiety and attitudes. Correlation analysis confirmed that higher literacy was strongly linked to lower anxiety and moderately associated with more positive attitudes, while anxiety was related to less favorable attitudes. These findings highlight the pivotal role of literacy in reducing apprehension and strengthening acceptance of AI. The study recommends embedding structured AI literacy programs in teacher education curricula, alongside targeted interventions for female and low-income students, to ensure equitable and confident readiness for AI integration in line with the goals of Education 5.0.

Keywords: Artificial Intelligence; Preservice Teachers; AI Attitudes; AI Anxiety; AI Literacy.

RESUMEN

La Educación 5.0 subraya el papel central de la inteligencia artificial (IA) en la transformación de la enseñanza y el aprendizaje, aunque la preparación de los futuros docentes para interactuar con estas tecnologías se encuentra aún en una etapa inicial. Este estudio se propuso examinar los niveles de alfabetización en IA, ansiedad y actitudes entre los futuros docentes de universidades e institutos estatales de la Península de Zamboanga, considerando el género, el nivel socioeconómico y la formación como variables demográficas clave. Utilizando un diseño descriptivo-cuantitativo, correlacional-comparativo, se recopilaron datos de 378 participantes y se analizaron mediante estadísticas descriptivas, pruebas t de muestras independientes, ANOVA de un factor y correlación de Pearson. Los resultados revelaron que los futuros docentes demostraron una alfabetización moderadamente alta (M = 3,80), una ansiedad moderada (M = 3,00) y actitudes generalmente positivas (M = 3,60). Se observaron diferencias de género, con los hombres reportando mayor alfabetización,

pero menor ansiedad, mientras que las mujeres mostraron mayor ansiedad y actitudes ligeramente más positivas. El nivel socioeconómico también influyó en la alfabetización y la ansiedad, favoreciendo a los estudiantes de grupos de mayores ingresos, aunque las actitudes mostraron poca variación. La formación mejoró la alfabetización, pero tuvo efectos insignificantes sobre la ansiedad y las actitudes. El análisis de correlación confirmó que una mayor alfabetización se vinculaba fuertemente con una menor ansiedad y se asociaba moderadamente con actitudes más positivas, mientras que la ansiedad se relacionaba con actitudes menos favorables. Estos hallazgos resaltan el papel fundamental de la alfabetización en la reducción de la aprensión y en el fortalecimiento de la aceptación de la IA. El estudio recomienda incorporar programas estructurados de alfabetización en IA en los planes de estudio de formación docente, junto con intervenciones específicas para estudiantes mujeres y de bajos ingresos, a fin de garantizar una preparación equitativa y segura para la integración de la IA en consonancia con los objetivos de la Educación 5.0.

Palabras clave: Inteligencia Artificial; Profesores en Formación; Actitudes Hacia la IA; Ansiedad Ante la IA; Alfabetización en IA.

INTRODUCTION

Education 5.0 envisions a learning environment where human development and technological innovation progress together, positioning higher education as a catalyst for preparing learners to thrive in an AI-driven world.[1,2,3,4] This framework underscores not only technical expertise but also flexibility, innovation, and social responsibility as essential competencies for graduates.[5,6] For teacher education, the challenge lies in equipping preservice teachers with the ability to critically and ethically engage with artificial intelligence (AI) in ways that enrich pedagogy and promote inclusive learning. Their readiness is pivotal, as insufficient preparation at this formative stage risks widening existing inequities[7,8] and constraining the transformative potential of Education 5.0.

AI is now embedded in daily life, from algorithm-driven platforms to healthcare diagnostics and education technologies.[9,10,11,12] In schools and universities, its applications include adaptive platforms, intelligent tutoring systems, and automated administration, signaling a shift in how learning is organized and experienced.[13,14] While these developments hold promise, countries such as the Philippines face persistent challenges, including weak digital infrastructure, uneven access, and limited training.[15,16,17]

For preservice teachers, readiness for this shift can be framed through three interrelated constructs: AI literacy, attitudes toward AI, and AI anxiety. Literacy captures the knowledge, skills, and values required for meaningful engagement.[18,19] Attitudes influence whether preservice teachers approach AI with openness or resistance.[20,21,22], whereas anxiety reflects apprehensions about AI risks and their implications for education and employment.[23,24] These constructs are interconnected: stronger literacy fosters more positive attitudes and reduces anxiety, whereas limited knowledge often generates fear and skepticism.[25,26,27] Addressing these factors during teacher preparation is crucial, as early dispositions toward AI tended to persist into professional practice.[28,29]

In the context of the Philippines, preservice teachers are at an early stage of readiness for AI integration. Studies report curiosity and cautious optimism toward AI but also highlight uneven literacy, ethical concerns, and limited exposure in teacher education programs.[30,31] These challenges are especially pronounced in the Zamboanga Peninsula, where cultural diversity, socioeconomic disparities, and infrastructural gaps affect access to innovation. Examining preservice teachers in these regions is critical because they represent not only the future teaching force but also a group whose professional preparation has historically lagged behind that of their urban counterparts, raising concerns of equity in AI readiness. Demographic factors such as gender, socioeconomic status, and training further influence literacy, attitudes, and anxiety, making them important variables in this study.[2,7,32]

Although international research on AI in education is expanding, Philippine studies have yet to investigate preservice teachers through a combined lens of AI literacy, attitudes, and anxiety. Existing studies often examine these constructs in isolation or focus primarily on in-service teachers, leaving unclear how these factors interact during the critical stage of teacher preparation. Addressing this gap is vital since the dispositions that preservice teachers develop in their training years strongly influence how effectively the goals of Education 5.0 can be realized in Philippine classrooms.

Thus, this study addresses this gap by examining the relationships among AI literacy, anxiety, and attitudes of preservice teachers in state universities and colleges on the Zamboanga Peninsula, with gender, socioeconomic status, and training as moderating variables. By grounding the inquiry within the broader digital transformation of Philippine higher education, this research aims to provide localized evidence that can inform teacher education curricula, strengthen professional preparation, and guide institutional policy in advancing Education 5.0.

LITERATURE REVIEW

Artificial Intelligence in Education within Education 5.0

Education 5.0 positions higher education as a transformative force that prepares learners for a digital society where artificial intelligence (AI) plays a central role in how knowledge is accessed, produced, and applied. It emphasizes not only technical proficiency but also adaptability, innovation, and ethical responsibility, requiring teachers to become facilitators of learning who can guide students in navigating increasingly AI-mediated environments.[3,5,6, 33] Within this vision, AI is not merely an instructional aid but also a driver of reform, reshaping pedagogy, assessment, and educational administration.[34,35]

The global literature documents how AI has already been integrated into education through adaptive learning systems, intelligent tutoring platforms, predictive analytics, and generative applications such as ChatGPT.[10,14,36] These technologies move beyond experimental stages to provide personalized learning experiences, automate routine administrative tasks, and support data-informed decision-making.[13] In higher education, institutions are beginning to embed AI in teaching, curriculum design, and research support, whereas in early childhood and K-12 settings, AI is being applied to foster creativity, language learning, and differentiated instruction.[37] The rise of generative AI further signals a paradigm shift in academic practice, expanding opportunities for self-directed learning but also raising concerns over plagiarism, authenticity, and the redefinition of assessment.[38]

However, alongside these opportunities are persistent challenges. Scholars emphasize that AI adoption in education is uneven, marked by infrastructural constraints, ethical dilemmas, and the absence of comprehensive training for educators.[39,40,41]

In developing countries, disparities in internet connectivity, access to devices, digital divide, and professional development are particularly present.[42,43,44,45,46] The Philippine context reflects these realities. While digital education has expanded during the COVID-19 pandemic.[47] AI integration remains at an early stage and is hindered by resource limitations and a lack of systematic institutional support.[8,48] These gaps underscore the necessity of contextualizing AI within teacher education, especially for preservice teachers, who will carry forward the aspirations of Education 5,0 into classrooms shaped by socioeconomic and cultural diversity. This step sets the stage for a closer look at the competencies that underpin effective AI integration, beginning with literacy.

Literacy toward Artificial Intelligence

AI literacy has emerged as a foundational competency for both teachers and students, extending beyond technical understanding to include critical, ethical, and social dimensions. Unlike general digital literacy, AI literacy equips individuals not only to use AI tools but also to evaluate their implications, interpret their outputs, and apply them responsibly in various contexts.[49,50] Systematic reviews highlight its multidimensional nature, encompassing technical knowledge, critical appraisal, practical application, and ethical responsibility.[18,19] Instruments such as the Scale for the Assessment of Non-Experts' AI Literacy[18] and frameworks developed for higher education have attracted increasing scholarly attention; however, research on how AI literacy is cultivated in teacher education remains limited.

Empirical studies consistently show that higher levels of AI literacy are associated with openness to adoption, confidence in use, and reduced anxiety, whereas low levels of literacy are correlated with skepticism or resistance.[51] For preservice teachers, AI literacy is crucial, as their preparedness to critically integrate technology shapes not only their professional growth but also how they mentor students in navigating AI-driven learning environments. Findings, however, suggest that preservice teachers often report only moderate literacy, with gaps in understanding both technical operations and ethical considerations.[52,53] In the context of the Philippines, preservice teachers display high awareness of digital tools,[54,55,56] yet limited exposure to AI-specific applications in their training.[57] These limitations reveal the urgency of embedding AI literacy into teacher education curricula to ensure that future educators can engage meaningfully with the promises and challenges of Education 5,0. Moreover, literacy cannot be considered in isolation, as emotional responses such as anxiety play an equally important role in shaping readiness.

Anxiety toward artificial intelligence

Parallel to literacy, anxiety toward AI has gained prominence as a psychological construct that shapes how individuals perceive and engage with emerging technologies. AI anxiety refers to apprehension or unease arising from concerns about AI's impact on employment, ethics, social relations, or personal competence.[23,58] It is conceptually related to technology anxiety but distinct in its focus on the disruptive and often uncertain role of AI in society.[59] Systematic reviews reveal that AI anxiety influences behavioral intention, self-efficacy, and learning outcomes and is moderated by demographic and contextual factors.[24,60]

Research has shown different responses among preservice teachers: while many express curiosity and little fear of learning about AI, they also voice concerns about the potential of AI to displace jobs, undermine academic integrity, or diminish human roles in education.[25,61] International findings further demonstrate that

anxiety tends to decrease as literacy and confidence increase, suggesting that targeted training can mitigate apprehension.[62,63] For teacher education, addressing AI anxiety is particularly important, as negative emotions may hinder preservice teachers' willingness to engage with AI tools, thereby limiting their readiness for AI-integrated classrooms. This interplay between knowledge, confidence, and apprehension leads directly to the broader question of how attitudes toward AI are shaped, especially when examined alongside demographic factors.

Attitudes toward AI and the Interplay of Literacy, Anxiety, Gender, Socioeconomic Status, and Training

Attitudes toward AI remain a critical determinant of acceptance and adoption. Globally, studies reveal that positive perceptions stem from recognition of AI's potential to increase efficiency, reduce workload, and expand learning opportunities, whereas negative perceptions emerge from fears of surveillance, bias, or loss of human control.[20,64] Crucially, attitudes evolve with exposure, often becoming more favorable as individuals gain literacy and experience.[26,61] In support of this, Brauner et al.[65] demonstrated that risk–benefit trade-offs largely explain public acceptance of AI, with perceived benefits driving more positive attitudes and perceived risks reinforcing skepticism.

In the Philippine context, both preservice and in-service teachers generally hold neutral or mixed attitudes, reflecting limited engagement with AI in classrooms. Alieto et al.[30] and Serdenia et al.[66] reported ambivalence among teachers, whereas Balasa et al.[67] noted cautious optimism tempered by uncertainty among aspirants. Francisco et al.[68] reported greater openness among senior high school students, although gender had little influence. These local findings resonate with the international literature, which shows that while gender sometimes influences optimism or caution, its effects often diminish once literacy and training are factored in.[20,27] Brauner et al.[65] add further nuance by showing that demographic variables such as age and gender interact with perceived risks and benefits, shaping acceptance in ways that go beyond simple differences in optimism or pessimism.

Other demographic and contextual variables further complicate this picture. Socioeconomic status (SES) has been linked to disparities in access to digital tools and infrastructures, influencing both literacy and attitudes.[69,70] Training opportunities emerge as a decisive factor, with structured interventions shown to improve literacy, reduce anxiety, and foster more positive attitudes.[29,32,71] In-service teacher studies add that institutional support often outweighs demographic predictors, highlighting the importance of program design and professional development.[72,73]

Taken together, the literature establishes that AI is reshaping education within the framework of Education 5,0, but its integration depends on how teachers and preservice teachers develop literacy, manage anxiety, and form attitudes toward its use. Studies consistently show that AI literacy strengthens confidence and fosters positive attitudes, whereas anxiety undermines readiness unless it is mitigated through training and support. At the same time, demographic and contextual variables such as gender and socioeconomic status shape how these constructs are expressed, yet their effects are inconsistent across settings. In the context of the Philippines, most available research has focused on in-service teachers, often treating literacy, attitudes, and anxiety as separate dimensions, leaving little understanding of how these factors interact among preservice teachers, who are still at an early stage of readiness. This gap is significant, as preservice teachers represent the future teaching force whose preparedness will directly affect how effectively Education 5,0 is realized in diverse and resource-constrained environments.

METHOD

This study utilized a descriptive-quantitative, correlational-comparative research design, which was most appropriate for the research questions posed. A descriptive-quantitative design allowed the study to systematically measure and describe preservice teachers' levels of AI literacy, anxiety, and attitudes, providing a clear profile of their readiness for Education 5,0. The correlational aspect addressed the question of whether literacy, anxiety, and attitudes were significantly related, while the comparative aspect directly responded to the objective of identifying group differences across gender, socioeconomic status, and prior training. The use of this design is justified by Creswell[74] and Creswell[75] who emphasize its relevance when the intent is to quantify variables, test associations, and compare subgroups.

Respondents of the Study

The respondents of this study were 378 preservice teachers enrolled in teacher education programs at state universities and colleges in the Zamboanga Peninsula. A convenience purposive sampling method was employed, as participation was limited to students who were readily accessible and willing to take part in the study. This approach was deemed practical given the geographical dispersion of the SUCs and the time constraints of data collection.

Although not randomized, the sample was purposively structured to capture diversity across key demographic

variables relevant to the research questions: gender, socioeconomic status, and prior AI-related training. Among the respondents, 246 (65,1 %) were female and 132 (34,9 %) were male; 170 (45,0 %) came from low-income families, 140 (37,0 %) from middle-income families, and 68 (18,0 %) from high-income families. In terms of training, 187 (49,5 %) had attended AI-related workshops, seminars, or courses, while 191 (50,5 %) had not.

While convenience purposive sampling presents limitations in terms of generalizability, the sample size and distribution across demographic groups provided sufficient variation to allow the application of comparative (t-test, ANOVA) and correlational (Pearson r) analyses. Thus, the chosen sampling method was appropriate for addressing the objectives of this study.

Research Tool

The study utilized three standardized instruments to measure preservice teachers' literacy, anxiety, and attitudes toward artificial intelligence (AI). The AI Literacy Scale developed by Ayanwale et al.[76] consists of 25 items across six constructs: use and apply AI (5 items), know and understand AI (4 items), detect AI (2 items), AI ethics (2 items), create AI (4 items), and AI self-efficacy (8 items). Responses were rated on a six-point Likert scale (1 = Strongly Disagree to 6 = Strongly Agree). Reliability analysis showed Cronbach's alpha values ranging from 0,704 to 0,821, indicating acceptable to good internal consistency.

To assess anxiety toward AI, the study employed the AI Anxiety Scale of Wang and Wang [23], which comprises 21 items rated on a seven-point Likert scale (1 = Strongly Disagree to 7 = Strongly Agree). The items were grouped into four dimensions: learning (8 items), job replacement (6 items), sociotechnical blindness (4 items), and AI configuration (3 items). Reliability indices demonstrated strong internal consistency, with Cronbach's alpha values ranging from 0,772 to 0,884 across the subscales.

Meanwhile, attitudes toward AI were measured using the General Attitudes toward Artificial Intelligence Scale (GAAIS) by Schepman et al.[22], which contains 20 items rated on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The GAAIS includes 12 positive and 8 negative statements to balance perspectives. Reliability analysis yielded an overall Cronbach's alpha of 0,801, reflecting good internal consistency.

In addition, a demographic section was included to gather information on gender, socioeconomic status, and prior training, which served as independent variables in the analysis.

Data collection procedure

Survey data were collected online using Google Forms, which allowed for efficient distribution and retrieval of responses from preservice teachers. The survey link was shared through official academic communication channels and social media class groups to maximize reach. At the beginning of the form, an informed consent section outlined the objectives of the study, emphasized the voluntary nature of participation, and assured respondents of anonymity and confidentiality. Only participants who confirmed consent were able to proceed with the questionnaire. All procedures adhered to ethical research guidelines, ensuring that the data were treated with privacy and used solely for academic purposes.

Data Analysis Procedure and Statistical Treatment

The data gathered from the survey questionnaires were encoded, cleaned, and organized using the Statistical Package for the Social Sciences (SPSS) version 30. Descriptive statistics, including frequency counts, percentages, means, and standard deviations, were used to summarize the demographic profiles of the respondents and to describe the overall levels of AI literacy, anxiety, and attitudes.

To examine group differences, inferential tests were applied. Independent samples t-tests were used to test differences in literacy, anxiety, and attitudes when the data were grouped according to gender and training. One-way analysis of variance (ANOVA) was conducted to assess variations across socioeconomic groups, and significant results were further analyzed using post hoc tests. Effect sizes (Cohen's d, η^2) were computed to evaluate the practical significance of differences.

Finally, Pearson product–moment correlation was employed to determine the relationships among AI literacy, anxiety, and attitudes. For all the statistical tests, the significance level was set at 0,05.

RESULTS AND DISCUSSION

Literacy, anxiety, and attitudes toward AI in education among preservice teachers

Figure 1 illustrates the levels of literacy, anxiety, and attitudes of preservice teachers toward artificial intelligence (AI) in education on the basis of the computed means and standard deviations. The results show that preservice teachers demonstrate a moderately high level of literacy in AI (M = 3,80, SD = 0,15), indicating that they possess a relatively good understanding of AI concepts, applications, and potential implications for teaching and learning. This aligns with Ayanwale et al.[76] and Gregorio et al.[57], who reported that preservice teachers generally report moderate to high competence in AI-related knowledge and skills, although gaps in their technical and ethical understanding persist. Similar findings by Laupichler et al.[18] and Sperling et al.[19]

emphasize that while AI literacy initiatives are emerging globally, their depth and consistency remain uneven, particularly in teacher education programs.

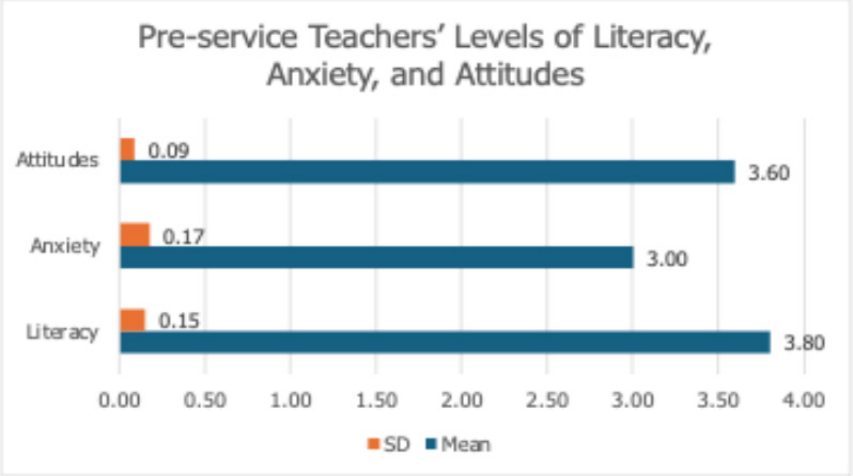

Figure 1. Preservice Teachers' Levels of Literacy, Anxiety, and Attitudes toward AI in Education

In terms of anxiety, the mean score (M = 3,00, SD = 0,17) suggests a moderate level of apprehension toward AI in education. This finding corroborates Hopcan et al.[61], who reported that teacher candidates often worry about AI's impact on employment and social life despite showing interest in learning about the technology. Wu et al.[24] noted that AI anxiety is a common but varied response that is influenced by demographic and contextual factors and tends to decrease as literacy improves.

With respect to attitudes toward AI, preservice teachers reported a generally positive orientation (M = 3,60, SD = 0,09). This finding indicates that most preservice teachers view AI as beneficial for improving educational processes and outcomes, showing openness to its potential integration into teaching practices. These results are consistent with those of Balasa et al.[67], who reported curiosity and optimism among Filipino teacher aspirants, although they were often tempered by ambivalence. International studies also show that as literacy increases, attitudes become more favorable.[26,27]

Overall, the findings reveal that preservice teachers are relatively literate about AI, maintain positive attitudes, and experience only moderate levels of anxiety. This profile suggests that they are at an early stage of readiness for Education 5.0, where openness to AI integration exists but remains fragile without sustained support. The moderately high literacy levels observed are encouraging, yet the gaps noted in technical and ethical understanding highlight the urgent need for more structured AI training in teacher education programs.[19,57,76] The presence of moderate anxiety underscores that while preservice teachers are curious and willing, apprehensions about AI's implications persist, echoing Wu et al.[24] argument that targeted interventions are necessary to reduce uncertainty. Their generally positive attitudes, aligned with findings by Grassini[26], indicate a favorable disposition that can be reinforced through enhanced literacy and practical exposure. Taken together, the results suggest that strengthening AI literacy is central to lowering anxiety and sustaining positive attitudes, ensuring that future educators are not only prepared to adopt AI but also capable of guiding learners responsibly in an AI-driven educational landscape.

Test of differences in literacy, anxiety, and attitudes toward AI in education among preservice teachers when grouped according to gender

Table 1. Independent samples t-test of the levels of literacy, anxiety, and attitudes toward AI in education among preservice teachers when grouped according to gender

Variables	Gender	N	Mean	SD	t	df	p value	d	Interpretation
LITERACY	Female	246	3,73	0,16	-9,472	376	0,000	0,15	Significant; Small Effect
	Male	132	3,88	0,14	-9,844	298,818			
ANXIETY	Female	246	3,19	0,11	20,747	376	0,000	0,17	Significant; Small Effect
	Male	132	2,82	0,24	17,048	162,379			
ATTITUDE	Female	246	3,63	0,08	6,350	376	0,000	0,09	Significant; Small Effect
	Male	132	3,57	0,09	6,192	249,533			

Table 1 presents the results of the independent samples t-test examining whether there are significant

differences in the levels of literacy, anxiety, and attitudes toward AI in education among preservice teachers when grouped according to gender.

For literacy, a statistically significant difference was found between female and male preservice teachers, t(376) = -9,472, p < 0,001, with a small effect size (d = 0,15). Male preservice teachers (M = 3,88, SD = 0,14) demonstrated higher levels of AI literacy than their female counterparts (M = 3,73, SD = 0,16). This indicates that male preservice teachers possess slightly greater knowledge and understanding of AI concepts and applications. Similar patterns were reported by Hajam et al.[27], who found that literacy and attitudes toward AI varied across demographic lines, with male students often demonstrating stronger familiarity. Likewise, Balasa et al.[67] observed that Filipino male teacher aspirants expressed higher levels of AI engagement, suggesting possible differences in prior digital exposure and experience.

In terms of anxiety, a significant difference was also observed, t(376) = 20,747, p < 0,001,with a small effect size (d = 0,17). Female preservice teachers reported higher levels of AI-related anxiety (M = 3,19, SD = 0,11) compared with males (M = 2,82, SD = 0,24). This suggests that female students tend to experience more apprehension or discomfort regarding the integration of AI in educational contexts. These findings are consistent with Wu et al.[24], who emphasized the role of demographic and contextual factors in shaping AI anxiety, and with Hopcan et al.[61], who reported heightened concerns among female teacher candidates about AI's impact on employment and social life.

For attitudes toward AI, a significant difference also emerged, t(376) = 6,350, p < 0,001, though the effect size was small (d = 0,09). Female preservice teachers reported slightly more positive attitudes (M = 3,63, SD = 0,08) than their male peers (M = 3,57, SD = 0,09). Although statistically significant, the difference is minimal in practical terms. This reflects the mixed conclusions in the literature: Balasa et al.[67] suggested more favorable dispositions among male aspirants, yet Francisco et al.[68] and Hajam et al.[27] found that gender differences often fade once literacy levels and exposure to AI are considered.

Overall, the results indicate that gender does shape preservice teachers' literacy, anxiety, and attitudes toward AI in education, but the effects are relatively modest. Male preservice teachers show higher literacy and lower anxiety, while females demonstrate greater anxiety yet slightly more positive attitudes. Since effect sizes are small, the practical implications suggest that gender alone does not determine readiness. Instead, consistent with Ofosu-Ampong[73] and Guan et al.[77], contextual and experiential factors such as access, training, and institutional support may exert stronger influence. This highlights the importance of designing teacher education programs that focus less on demographic generalizations and more on providing equitable opportunities for all preservice teachers to build literacy, reduce anxiety, and strengthen constructive attitudes toward AI.

Test of differences in literacy, anxiety, and attitudes toward AI in education among preservice teachers when grouped according to socioeconomic status

Table 2. One-way ANOVA of the levels of literacy, anxiety, and attitudes toward AI in education among preservice teachers when grouped according to socioeconomic status

Variables	Socioeconomic	N	Mean	SD	SS	df	MS	F	p value	η^2	Interpretation
LITERACY	Low Income	170	3,69	0,12	2,910	2	1,455	69,097	0,000	0,269	Significant; Small effect
	Middle Income	140	3,82	0,13	7,897	375	0,021				
	High Income	68	3,92	0,21	10,807	377					
	Total	378	3,78	0,17							
ANXIETY	Low Income	170	3,19	0,14	6,830	2	3,415	83,012	0,000	0,307	Significant; Small effect
	Middle Income	140	3,00	0,22	15,428	375	0,041				
	High Income	68	2,83	0,28	22,258	377					
	Total	378	3,06	0,24							
ATTITUDE	Low Income	170	3,60	0,06	0,081	2	0,040	5,004	0,007	0,026	Significant; Small effect
	Middle Income	140	3,62	0,13	3,019	375	0,008				
	High Income	68	3,58	0,05	3,099	377					
	Total	378	3,60	0,09							

Table 2 presents the results of the one-way ANOVA test examining whether there are significant differences in the levels of literacy, anxiety, and attitudes toward AI in education among preservice teachers when grouped according to socioeconomic status.

For literacy, a statistically significant difference was found across socioeconomic groups, F(2, 375) = 69,097, p < 0,001, with an effect size of η^2 = 0,269. Post hoc comparison of means revealed that preservice teachers from high-income groups (M = 3,92, SD = 0,21) reported the highest levels of AI literacy, followed by those from

middle-income groups (M = 3,82, SD = 0,13), whereas low-income students reported the lowest literacy levels (M = 3,69, SD = 0,12). These findings suggest that higher socioeconomic status is associated with greater AI literacy among preservice teachers, likely due to better access to digital tools, training, and learning resources. This pattern is consistent with Berganio et al.[54], who noted that digital literacy tends to be reinforced by access and resources, and with Ayanwale et al.[76], who highlighted the predictive power of knowledge and access in shaping AI literacy outcomes.

In terms of anxiety, significant differences also emerged, $F(2, 375) = 83,012$, $p < 0,001$, with an effect size of $\eta^2 = 0,307$. Preservice teachers from low-income backgrounds reported the highest anxiety levels (M = 3,19, SD = 0,14), followed by those from middle-income groups (M = 3,00, SD = 0,22), whereas high-income students reported the lowest levels of anxiety (M = 2,83, SD = 0,28). This indicates that students with lower socioeconomic status tend to feel more apprehensive about AI in education, likely because of limited exposure and fewer opportunities for practice. Comparable findings were reported by Wu et al.[24], who emphasized that demographic and contextual factors, including socioeconomic background, moderate AI anxiety. Similarly, Ayduğ et al.[25] argued that technical digital fluency can help reduce AI anxiety, which may explain why higher-income students, who often have greater digital exposure, demonstrate lower anxiety levels.

With respect to attitudes toward AI, a statistically significant difference was observed, $F(2, 375) = 5,004$, $p = 0,007$, although the effect size was small ($\eta^2 = 0,026$). Students from middle-income groups reported the most positive attitudes (M = 3,62, SD = 0,13), followed closely by low-income students (M = 3,60, SD = 0,06), whereas high-income students reported slightly fewer positive attitudes (M = 3,58, SD = 0,05). Despite being statistically significant, the practical differences in attitudes are minimal compared with those observed in literacy and anxiety. This finding is in line with Perla et al. [78], who noted that teachers' attitudes often remain ambivalent or cautiously optimistic until they engage with AI in concrete teaching situations.

The findings indicate that socioeconomic status exerts a strong influence on literacy and anxiety but only a limited effect on attitudes. Students from higher-income groups appear better positioned to engage with AI due to access to resources, while those from lower-income groups face disadvantages that manifest as lower literacy and higher anxiety. This underscores the importance of equitable access to digital resources and structured AI training in teacher education programs. Addressing these disparities is essential to ensure that future teachers, regardless of background, are adequately prepared for Education 5.0.

Test of differences in literacy, anxiety, and attitudes toward AI in education among preservice teachers when grouped according to training

Table 3. Independent samples t test of the levels of literacy, anxiety, and attitudes toward AI in education among preservice teachers when grouped according to training

Variables	Training	N	Mean	SD	t	df	p value	d	Interpretation
LITERACY	No Prior Training	191	3,67	0,15	-16,027	376	0,000	0,13	Significant;
	With Prior Training	187	3,89	0,10	-16,093	331,354			Small effect
ANXIETY	No Prior Training	191	3,07	0,18	0,802	376	0,425	0,24	Not Significant;
	With Prior Training	187	3,05	0,29	0,798	310,118			Small effect
ATTITUDE	No Prior Training	191	3,63	0,11	6,318	376	0,000	0,09	Significant;
	With Prior Training	187	3,58	0,04	6,371	235,940			Small effect

Table 3 presents the results of the independent samples t-test examining whether there are significant differences in the levels of literacy, anxiety, and attitudes toward AI in education among preservice teachers when grouped according to training.

For literacy, a statistically significant difference was found between students with prior AI-related training and those without, $t(376) = -16,027$, $p < 0,001$, $d = 0,13$. Preservice teachers with prior training reported higher AI literacy levels (M = 3,89, SD = 0,10) than those without training (M = 3,67, SD = 0,15). Although the effect size is small, this still carries practical significance: even incremental increases in literacy can translate to greater confidence and competence in applying AI concepts during teacher preparation. These findings support Abdulayeva et al.[71] and Dilek et al.[79], who demonstrated that training interventions, even short-term ones, create measurable gains in preservice teachers' AI readiness.

In terms of anxiety, no significant difference emerged between the two groups, $t(376) = 0,802$, $p = 0,425$,

d = 0,24. Students with training (M = 3,05, SD = 0,29) and those without (M = 3,07, SD = 0,18) reported nearly the same levels of apprehension toward AI. The small effect size confirms that training alone does not alleviate anxiety, suggesting that feelings of unease about AI are driven by broader issues such as concerns over job replacement, ethical dilemmas, and social consequences rather than training exposure. This aligns with Hopcan et al.[61] and Wu et al.[24], who emphasized that anxiety often persists despite skill development, requiring deeper interventions that address values, ethics, and long-term professional implications.

For attitudes, a statistically significant difference was observed, t(376) = 6,318, p < 0,001, d = 0,09. Interestingly, preservice teachers without prior training reported slightly more positive attitudes (M = 3,63, SD = 0,11) than those with training (M = 3,58, SD = 0,04). The difference, though statistically detectable, is trivial in practice. It is plausible that training heightened students' awareness of the limitations and ethical issues in AI, tempering their initial enthusiasm. Kohnke et al.[29] and Perla et al.[78] similarly found that structured exposure to AI fosters cautious optimism rather than unqualified excitement.

Taken together, these results highlight that while training significantly improves literacy, its effect sizes suggest modest gains, and its influence on anxiety and attitudes is minimal in practice. This underscores the importance of designing AI training programs that go beyond technical knowledge. Training must integrate reflective, ethical, and experiential components so that preservice teachers not only learn how AI works but also feel reassured and motivated to use it in classrooms. The findings resonate with Sanusi et al.[53] and Lucas et al.[2], who argue that sustainable adoption requires preparation that balances competence with confidence and ethical sensitivity.

Test of the relationships among literacy, anxiety and attitudes toward AI in education among preservice teachers

Table 4. Pearson's r test on the relationships among literacy, anxiety and attitudes toward AI in education among preservice teachers

Variables	Literacy	Anxiety	Attitudes
Literacy	—	−0,610**	−0,282**
Anxiety		—	0,254**
Attitudes			—

Note: *N* = 378. Pearson's correlation coefficients are reported. p < 0,01 (2-tailed).

Table 4 presents the results of the Pearson correlation test examining the relationships among literacy, anxiety, and attitudes toward artificial intelligence (AI) in education among preservice teachers. The findings reveal a significant and strong negative correlation between literacy and anxiety (r = −0,610, p < 0,01), suggesting that as preservice teachers' literacy levels toward AI increase, their anxiety levels decrease substantially. This finding indicates that higher levels of AI-related knowledge and skills are associated with reduced apprehension when individuals engage with AI technologies in educational contexts. This pattern aligns with Ayduğ et al.[25] and Wu et al.[24], who reported that improved digital and AI fluency directly contributes to lowering AI-related anxiety.

Additionally, a moderate negative correlation was observed between literacy and attitudes toward AI (r = −0,282, p < 0,01), implying that as literacy improves, preservice teachers are slightly less likely to hold unfavorable or uncertain attitudes toward AI integration in education. This is consistent with Grassini[26] and Ayanwale et al.[76], who emphasized that literacy fosters confidence, which in turn strengthens openness and positive perspectives toward AI.

Conversely, the results demonstrate a significant positive correlation between anxiety and attitudes (r = ,254, p < ,01), indicating that higher anxiety levels are associated with less favorable attitudes toward AI use in teaching and learning. Similar findings were reported by Hopcan et al.[61] and Lund et al.[63], who reported that AI-related fears, particularly concerning employment and ethical concerns, can hinder the development of positive attitudes despite awareness of AI's potential benefits.

Overall, these findings suggest that enhancing AI literacy among preservice teachers could play a critical role in lowering anxiety levels and shaping more favorable attitudes toward AI integration in education. The results echo insights from Guan et al.[77] and Kohnke et al.[29], who argued that literacy and reflective training are pivotal in ensuring that future educators not only gain competence but also develop the confidence and readiness to embrace AI responsibly in their teaching practice.

CONCLUSION

This study shows that preservice teachers in the Zamboanga Peninsula are at an early but uneven stage of readiness for Education 5.0. They demonstrated moderately high literacy, generally positive attitudes,

and moderate anxiety toward AI. However, differences across gender, socioeconomic status, and training revealed patterns that reflect wider inequalities in Philippine higher education. Male students showed greater literacy and less anxiety, while female students, though reporting more positive attitudes, also expressed higher apprehension. Students from higher-income families reported higher literacy and lower anxiety, while those from low-income backgrounds carried the disadvantages of limited access and exposure. Training improved literacy but had little effect on lowering anxiety or strengthening attitudes, showing that short-term interventions are not enough. The strong negative link between literacy and anxiety, and the positive connection between literacy and attitudes, highlight the central role of knowledge in shaping confidence and openness to AI. Without deliberate changes in teacher education, preservice teachers' readiness will continue to be uneven, limiting how fully Education 5.0 can be realized.

RECOMMENDATIONS

Teacher education programs need to move beyond incidental training and embed structured AI literacy into the curriculum. Preparation should combine technical knowledge with ethical reflection and classroom application, so preservice teachers learn to use AI responsibly and with confidence. Targeted support is needed for female students to reduce anxiety, as well as for low-income students who require more equitable access to resources and training. Practicum-based workshops that give real, hands-on experience with AI in teaching can help translate literacy into confidence and ease fears. Collaboration among SUCs, CHED, and DepEd is also important to build sustained AI preparation programs that align with the goals of Education 5.0. With these efforts, preservice teachers will be better equipped to face the challenges of AI in education and lead their future classrooms with both competence and confidence.

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