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ORIGINAL

Gender and Age Dynamics in Future Educators' Attitudes toward AI Integration in Education: A Sample from State-managed Universities in Zamboanga Peninsula, Philippines

Dinámica de género y edad en las actitudes de los futuros educadores hacia la integración de la IA en la educación: Una muestra de universidades públicas de la península de Zamboanga (Filipinas)

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ABSTRACT

Gender and age are critical factors in understanding attitudes toward artificial intelligence (AI) in education, yet limited research has directly explored their influence on teacher aspirants' perspectives on AI integration. This study employed random sampling to select 603 respondents from two state-managed institutions. Findings indicate that prospective teachers generally hold neutral attitudes toward AI (M=2,84), reflecting uncertainty about preferring AI over human interaction in routine tasks, consistent with prior research. Male respondents (M=2,91) exhibited significantly more positive attitudes toward AI in education than females, as evidenced by a t value of -2,66 and a p value of 0,008. Additionally, adults (M=2,86) demonstrated significantly higher attitude scores than adolescents (M=2,80), with a t value of -2,05 and a p value of 0,040. These results highlight the role of demographic variables in shaping perceptions of AI in educational contexts, emphasizing the need for targeted interventions to address concerns and optimize AI adoption in teacher training programs.

Keywords: Gender; Age; Artificial Intelligence.

RESUMEN

El género y la edad son factores críticos para comprender las actitudes hacia la inteligencia artificial (IA) en la educación. Sin embargo, hay poca investigación que haya explorado directamente su influencia en las perspectivas de los aspirantes a docentes sobre la integración de la IA. Este estudio empleó un muestreo aleatorio para seleccionar a 603 encuestados de dos instituciones administradas por el estado. Los hallazgos indican que los futuros docentes generalmente tienen actitudes neutrales hacia la IA (M=2,84), lo que refleja incertidumbre sobre la preferencia de la IA sobre la interacción humana en tareas rutinarias, en línea con investigaciones previas.
Los encuestados masculinos (M=2,91) mostraron actitudes significativamente más positivas hacia la IA en la educación que las mujeres, con un valor t de -2,66 y un valor p de 0,008. Además, los adultos (M=2,86) obtuvieron puntuaciones de actitud significativamente más altas que los adolescentes (M=2,80), con un valor t de -2,05 y un valor p de 0,040.

Estos resultados destacan el papel de las variables demográficas en la configuración de las percepciones sobre la IA en contextos educativos, subrayando la necesidad de intervenciones específicas para abordar preocupaciones y optimizar la adopción de la IA en los programas de formación docente

Palabras clave: Género; Edad; Inteligencia Artificial.

INTRODUCTION

Artificial intelligence (AI) has rapidly emerged as a critical component of contemporary technology, with applications spanning numerous fields such as healthcare,[1,2,3] education,[4,5,6,7,8,9] and logistics.[10,11] This transformative technology is reshaping various sectors, driving significant changes in processes and curricula, particularly within higher education institutions.[4,12] As part of the Fourth Industrial Revolution (IR4), AI has played a pivotal role in catalyzing a significant shift in the education system, as evidenced by the emergence of online learning platforms such as Digital Classroom, YouTube, and MOOC courses, which leverage AI to enhance educational delivery and accessibility.[13] Additionally, AI's role in promoting digital competencies—such as information literacy and digital content creation—highlights its integral place in modern education.[14]

As AI continues to evolve and integrate into various aspects of daily life, understanding the attitudes of individuals, particularly students and prospective teachers, toward this technology becomes crucial. This understanding can significantly influence the successful implementation and usability of AI in educational settings. Therefore, the ongoing development of AI necessitates a deep understanding of the factors shaping people's attitudes toward it. Previous studies have highlighted that general attitudes toward AI are closely linked to its acceptance and use in daily life.[15,16,17,18] Without current research on AI-related attitudes, it is challenging to effectively consider end-users' opinions regarding the implementation and usability of AI-driven solutions. Hence, continuous research is necessary to capture evolving attitudes and inform the development of AI technologies that align with users' needs and concerns.

Research must continue to monitor attitudes toward AI over time to understand how they change in response to relevant news stories or events.[19] The type of content, whether it is positive success stories or negative experiences such as scams, can significantly influence public perception and attitudes toward AI. Hence, it is crucial to continuously track these changes to inform policy and educational strategies. Delcker et al.[5] argued that to unlock AI's potential in learning, students need not only practical skills and theoretical knowledge but also comprehensive attitudes toward AI. Educators and higher education institutions play a pivotal role in creating safe learning environments that provide points of contact with AI and opportunities for active engagement. These environments should give students access to relevant AI tools and be grounded in holistic legal frameworks and regulations to ensure ethical and responsible AI use.

In the Philippines, Amante-Nochefranca et al.[20] found that AI-assisted English language learning positively impacts ESL students in developing countries, with students placing trust in AI-powered language learning apps due to the time-saving benefits and personalized learning features they offer. According to the European DigComp Framework 2.2, digital competencies essential for digitally competent citizens include AI literacy in three dimensions: knowledge, proficiency, and attitudes.[14] Understanding teachers' attitudes toward AI is crucial for comprehending their perspectives in the classroom, which can influence how AI is integrated into educational practices. Technological competence, as defined by the European Commission's Joint Research Center, encompasses the integration of knowledge, skills, and attitudes necessary for utilizing digital skills appropriately and responsibly across educational, professional, and social domains.[21] Teachers need more than just technical ability; they must engage in reflective thinking about how technology intersects with pedagogy and its impact on student learning.[22]

Despite the growing body of research examining university students' attitudes toward AI,[4,8] a significant gap remains in the literature concerning preservice teachers. Public attitudes are pivotal to the societal adoption of AI-enabled technologies.[23] Understanding the factors influencing these attitudes can provide valuable insights for the effective implementation of AI in educational settings. Moreover, previous studies have often neglected the potential malicious applications of AI, an area that warrants closer scrutiny.[24] Addressing this oversight can reveal the determinants that influence individual acceptance or resistance to AI, particularly among preservice teachers.

Examining the attitudes of prospective teachers toward AI integration is crucial for several reasons. First, teachers and educational institutions play a critical role in the dissemination and adoption of AI technology.[9] If teachers are hesitant to adopt new AI tools or incorporate AI-related subjects into their curricula, the full potential of AI may not be realized, leading to its benefits being restricted to a select few within society, thereby exacerbating existing inequalities. Second, understanding these attitudes can inform the development of professional development programs that adequately prepare teachers to integrate AI into their teaching practices. Third, it can guide the creation of educational policies that support the ethical and effective use of

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AI in classrooms. This study aims to fill this gap by specifically focusing on preservice teachers' attitudes toward AI, providing essential insights that can shape future educational strategies and AI integration efforts.

RELATED LITERATURE

Artificial Intelligence in Education

Artificial intelligence (AI) is a branch of computer science focused on developing systems capable of emulating human cognitive processes, such as learning, reasoning, and self-correction.[25] Recent evidence indicates that AI is increasingly being adopted and utilized in education by various institutions.[26] AI is characterized by four key attributes. First, AI can make decisions or support decision-making processes. Second, AI decision-making involves synthesizing human intelligence attributes, including perception, problem solving, reasoning, and language learning.[27] Third, AI systems integrate data from diverse sources, take action based on comprehensive analyses, and distinguish themselves from preprogrammed responses. Finally, AI's decision-making process allows for continuous feedback, facilitating ongoing system improvement and refinement.

The advent of AI in education has introduced the concept of personalized learning, where AI algorithms analyze individual student data to tailor educational content.[28] This adaptability caters to diverse learning styles and paces, fostering a more engaging and effective learning environment.[29] As students interact with AI-driven platforms, the technology continuously refines its understanding of their strengths and weaknesses, providing targeted support for academic improvement.

Intelligent tutoring systems (ITS) represent a notable application of AI in the educational landscape. These systems leverage machine learning to assess student progress, identify areas of difficulty, and offer personalized interventions.[30] By providing real-time feedback and adapting instructional strategies based on individual needs, an ITS enhances the learning experience, supplementing traditional teaching methods.

Administrative processes within educational institutions also benefit significantly from AI applications. Automated administrative tasks, such as grading and scheduling, reduce the burden on educators and administrators, allowing them to focus on more strategic aspects of education.[31] Predictive analytics, another facet of AI, aids institutions in forecasting enrollment trends, optimizing resource allocation, and making informed decisions.[32] This efficiency not only streamlines operations but also contributes to better resource utilization.

Artificial intelligence (AI) is revolutionizing education by offering personalized learning experiences through adaptive algorithms, such as intelligent tutoring systems (ITS). These systems enhance student engagement and academic performance by tailoring interventions based on real-time data analysis. Additionally, AI streamlines administrative tasks, such as grading and scheduling, improving operational efficiency in educational institutions. Despite these advancements, there is a critical gap in understanding how preservice teachers perceive and embrace AI, which is essential for its responsible integration in education. This study aims to fill this gap by investigating the attitudes of preservice teachers toward AI, providing insights crucial for the effective implementation of AI in educational settings.

Attitudes toward Artificial Intelligence in Education

Attitudes toward AI in education are crucial for understanding and overcoming challenges related to its adoption and use. A positive attitude, as highlighted by Elias et al.[33], is instrumental in fostering intrinsic motivation, behavioral changes, and increased engagement with new tools. Self-determination theory (SDT) by Ryan and Deci[34,35] further emphasizes the importance of psychological factors such as autonomy, competence, and relatedness. Autonomy allows educators to independently address teaching challenges, fostering self-reliance.[36] Similarly, competence development, supported by teacher encouragement and student proficiency in AI, significantly enhances intrinsic motivation,[37] while relatedness strengthens teacher–student bonds and facilitates innovative lesson planning.[38,39]

Despite generally favorable attitudes toward AI, its actual integration in classrooms remains limited, with only a fraction of surveyed teachers incorporating AI tools into their instructional practices. Barriers such as AI apprehension, ethical concerns, and financial costs contribute to this subdued adoption rate.[7,40] Addressing these challenges through targeted training and skill development is imperative to foster broader and more effective use of AI in education.[41,42]

AI holds substantial potential to transform educational environments by serving as collaborative peers and personal tutors rather than mere tools.[43] Designing AI-supported systems that empower both students and educators can enhance decision-making processes and support mutual monitoring, thereby enhancing educational outcomes. Research indicates that students generally exhibit a positive attitude toward AI, recognizing its capacity to enrich learning experiences and cater to varying cognitive levels.[44,45] However, perceived risks and the absence of structured educational practices can negatively impact these attitudes, highlighting the necessity for clear and interactive AI education.[46]

Investigating attitudes toward AI in education is crucial for understanding and overcoming challenges related to its adoption and use. Clear and interactive AI education can equip educators and students to effectively

leverage its benefits, ensuring seamless integration into teaching and learning paradigms.

Attitudes toward Artificial Intelligence in Education, Gender, and Age

Research exploring attitudes toward artificial intelligence (AI) in education has revealed significant gender differences. According to Sindermann et al.[47], who used the ATAI scale across participants from Germany, China, and the UK, men generally hold more positive attitudes toward AI than women. This finding is consistent with research on technology acceptance.[17] Similarly, a comprehensive study by Galindo-Domínguez et al.[6] involving 445 Spanish teachers across various educational stages revealed that greater digital competence is linked to a more positive attitude toward AI, regardless of gender. However, despite a high willingness to use AI, both male and female educators exhibit a gap in personal experience with AI, suggesting the need for increased exposure and training.

Regarding age, the relationship between education and attitudes toward AI is multifaceted. While some studies suggest that younger individuals are more likely to have positive attitudes toward AI,[17,48] others show inconsistent findings.[49] Galindo-Domínguez et al.[6] discovered that greater digital competence is associated with positive attitudes toward AI among Spanish teachers, regardless of age. This suggests that competence in digital tools, rather than age alone, may be the critical factor influencing attitudes. Therefore, fostering digital competence across all age groups is crucial for enhancing the acceptance and effectiveness of AI in educational settings.

Studies on attitudes toward AI in education highlight the importance of understanding and addressing gender and age differences. By acknowledging these differences, educators and policymakers can develop tailored strategies to promote more inclusive and effective integration of AI in educational settings. Additionally, these findings underscore the significance of digital competence in shaping attitudes toward AI, emphasizing the need for ongoing training and skill development. Overall, conducting such studies is vital for guiding efforts to enhance digital literacy and promote positive attitudes toward AI, ultimately leading to its more effective and equitable use in education

METHOD

Research design

This study utilized a cross-sectional descriptive survey employing a quantitative nonexperimental method to investigate prospective teachers' attitudes toward artificial intelligence (AI) integration in the educational context. This focused on examining preservice teachers' perspectives on the adoption of AI tools for teaching and learning. The research was conducted to gather information among preservice teachers at a single point in time, classifying it as cross-sectional, following the approach outlined by Stockemer.[50] Additionally, the study was descriptive, as it systematically captured the attitudes of preservice teachers regarding the integration of AI in education using numeric codes. The approach involved analyzing variables and interpreting the meaning that participants provided based on their responses to the adapted tool.[51] This method is deemed appropriate because it involves collecting quantifiable data, which are coded, tallied, tabulated, computed, statistically treated, and presented, aligning with the principles outlined by Leedy and Ormrod.[52]

Respondents of the study

Researchers utilized random sampling to select participants, initially identifying 603 respondents from the total population across two state-managed institutions. However, as the data collection method involved an online survey created using Google Forms, 618 individuals accessed the survey link. Among these, 5 respondents declined to participate, and a few did not meet the inclusion criteria.

The demographic characteristics of the participants are presented below. All participants were prospective teachers pursuing education degrees at state-managed institutions. In terms of gender, the majority of respondents were female, accounting for 79,0 % (476) of the total sample, while males accounted for 21,0 % (127). This gender distribution is consistent with findings indicating that men are the minority in teacher education programs.[53,54] Additionally, when grouped by age, approximately 61,0 % (368) of respondents were adults aged 20 and above, while 39,0 % (235) were adolescents aged 18 to 19 years.

Research tool

The researchers employed the General Attitudes toward Artificial Intelligence Scale (GAAIS), developed by Schepman and Roadway,[17] comprising 20 items. This scale uses a five-point Likert scale ranging from 5 (strongly agree) to 1 (strongly disagree). The instrument in this study is heterogeneous, containing twelve positive statements in items 1, 2, 4, 5, 7, 11, 12, 13, 14, 16, 17, and 18. For the negative statements, there are eight items: 3, 6, 8, 9, 10, 15, 19 and 20. To capture relevant independent variables, the scale was modified to include a demographic section addressing gender and age.

Prior to administering the questionnaire, a pilot test was conducted with prospective teachers from other institutions in the region offering similar education programs. This step ensured the broader applicability

and effectiveness of the questionnaire. The collected data were analyzed using Cronbach's alpha, which indicated a value exceeding 0,60, specifically 0,767. This result confirms the questionnaire's "acceptable" internal consistency, enhancing its credibility and reliability for the broader cohort of education degree-seeking individuals in the region.

Data gathering procedure

Before commencing the data collection, the researchers obtained permission from the institution. This step was essential to ensure adherence to beneficence and nonmaleficence principles, prioritizing the well-being of the respondents. Once approval was obtained, the researchers coordinated with the research sites to schedule the data collection, which was communicated to the respondents.

The data collection process began with the researchers personally visiting the research sites, where they had all the required documents prepared. They initiated the process with a courtesy call to the heads of the offices, explaining the study's purpose and nature. Subsequently, they approached prospective teacher respondents, administering the research instrument along with the attached informed consent form. For those who preferred to participate online, the researchers provided a QR code leading to the Google Form link. This meticulous approach ensured transparency, ethical conduct, and effective communication throughout the data collection process.

Data analysis procedure

The collected data were analyzed using both descriptive and inferential statistics to address the research questions. For the first research question regarding the attitudes of prospective teachers toward AI use in education, frequency counts and weighted means were calculated. To address the second and third research questions, parametric tests were employed, specifically an independent sample t test. The researchers justified the use of this test based on the central limit theorem (CLT), which states that the distribution of sample means tends to be normal as the sample size increases, regardless of the original population distribution. This theorem ensures that the distribution of sample means approximates a normal distribution, even if the population distribution is nonnormal.[55]

RESULTS AND DISCUSSION

Preservice teachers' attitudes toward AI use in education

To analyze the respondents' attitudes toward AI use in education, descriptive statistics were employed, focusing on calculating the mean and standard deviation. The statements were categorized as either positive or negative, and descriptive analysis was conducted accordingly. The results of this analysis are presented in Figures 1 and 2. Additionally, the overall mean score was calculated and is discussed further.

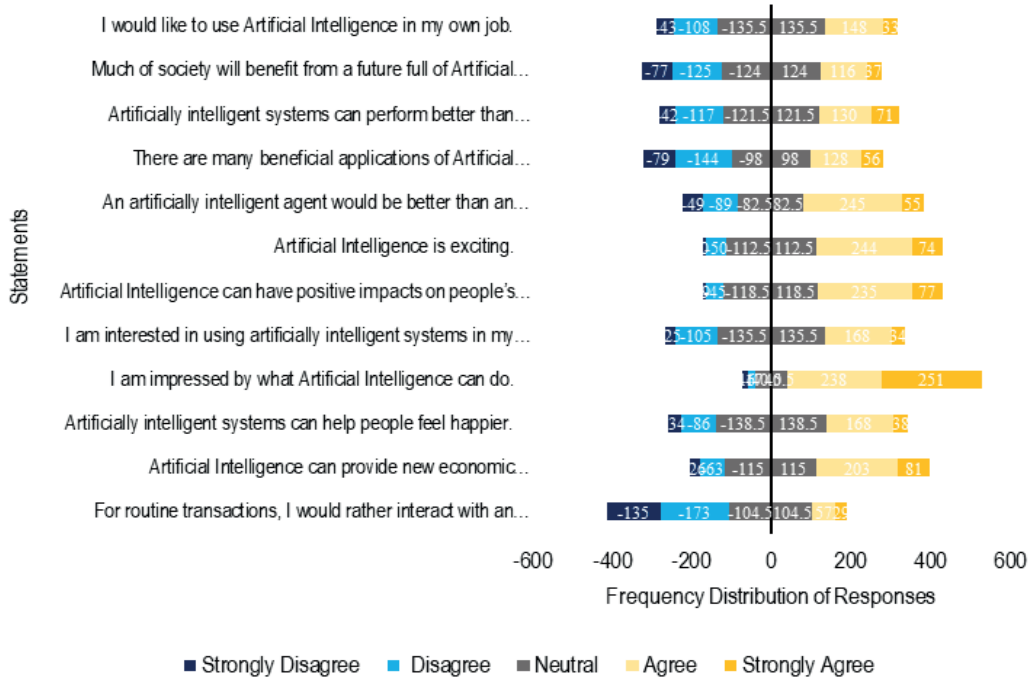

Figure 1. Descriptive responses across positive items of the research tool

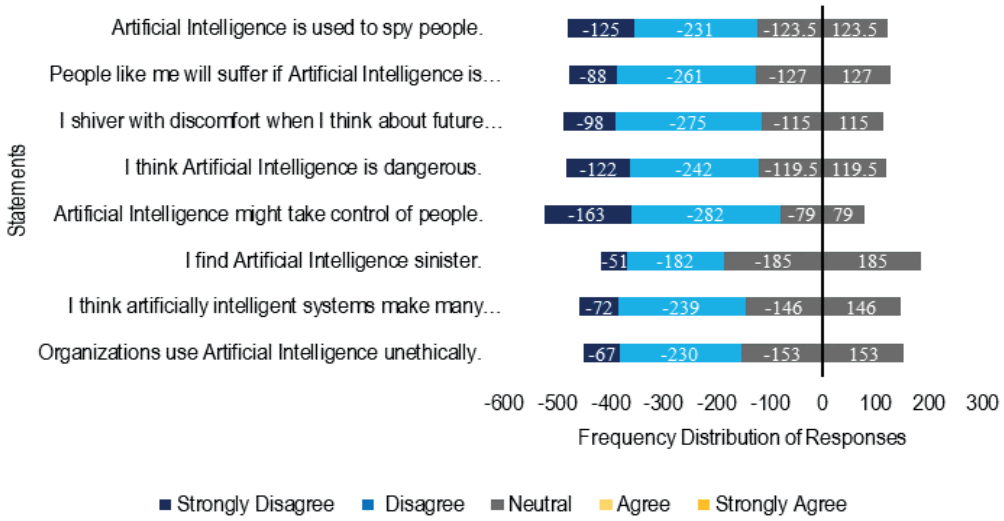

Figure 2. Descriptive responses across positive items of the research tool

Figures 1 and 2 depict the attitudes of prospective teachers toward the use of AI in education. The results indicate a level of uncertainty among prospective teachers regarding their preference for AI over human interaction in routine transactions. This ambivalence is consistent with previous findings suggesting that individuals often have mixed feelings about the integration of AI into daily life.[56] A considerable proportion of participants showed positive attitudes (M=3,41) toward AI contributing to new economic opportunities, reflecting the economic optimism associated with technological advancements.[57] This positive attitude is significant because educators play a crucial role in preparing students for evolving job markets.

A significant number of participants (M=3,15) held a neutral attitude toward the idea that AI can help people feel happier, which aligns with the perspective that technology can enhance emotional experiences.[58,59] However, if fully enforced, this attitude could encourage the exploration of AI applications for emotional support in educational settings. Similarly, there was a neutral attitude (M=3,13) toward the interest in using AI in daily life, indicating a cautious approach among prospective teachers. On the other hand, there were positive sentiments toward the belief that participants are impressed by what AI can do (M= 4,15) and in the belief in the positive impacts of AI on well-being (M=3,54).

The high levels of excitement (M=3,53) in using AI in daily life and jobs suggest a potential willingness among prospective teachers to incorporate AI tools. This finding is in line with the idea that positive attitudes can drive technology adoption.[60] Despite these positive attitudes, the significant neutral stance regarding routine transactions (35,0 %) suggests a need for targeted education and awareness programs. This aligns with the notion that neutrality often stems from a lack of understanding or exposure to the technology.[61]

However, there are also concerns and negative perceptions regarding AI. Concerns about unethical use (M=2,40) resonate with the ethical discourse surrounding AI.[57] Addressing these concerns is crucial for fostering a positive attitude toward AI adoption in education. The belief that AI systems make errors (M=2,36) and are dangerous (M=2,19) indicates reservations similar to those highlighted by Brynjolfsson and McAfee.[57] Overcoming these perceptions requires robust evidence of AI reliability and safety in educational contexts. The discomfort (M=2,22) and fear associated with AI taking control and future uses reflect concerns about the societal impact of AI.[60] Understanding and addressing these fears are crucial for fostering a positive and supportive environment.

Prospective teachers generally exhibit neutral attitudes (M=2,84) toward AI. While they acknowledge the potential for AI to create new economic opportunities and enhance societal well-being, including its ability to make people happier and perform tasks more efficiently than humans, many express interest in integrating AI into their daily lives and professional roles. However, reservations exist, with some prospective teachers perceiving AI as prone to errors and susceptible to unethical use by organizations. This ambivalence extends to a sense of unease and discomfort about AI's future implications, with concerns that its increasing prevalence might result in adverse impacts on individuals such as themselves.

Prospective teachers' attitudes toward AI use in education across genders

To ascertain whether a significant difference existed in the respondents' attitudes toward AI use in education across the independent variables of gender, inferential statistical analysis was conducted using the t test for independent samples. The results of this analysis are presented in table 1.

Table 1. Independent sample t tests were used to test differences in the attitudes of prospective teachers toward AI use in education when the data were grouped according to gender

	Gender	N	Mean	Std. Deviation	df	t	p value	Interpretation
Attitude toward AI use in Education	Female	476	2,8163	0,35844	601	-2,660	0,008*	Significant
	Male	127	2,9114	0,35658				

Note: * The p value is significant at the 0,05 level.

Table 1 displays the results of the independent sample t test, which examined differences in prospective teachers' attitudes toward AI use in education when the data were categorized by gender. The findings indicated that male respondents had a mean score of 2,91, which was higher than that of female respondents (M=2,91). Independent sample t tests revealed a t value of -2,66 and a p value of 0,008, both of which are below the α value of 0,05, indicating statistical significance. This suggests that, on average, male prospective teachers exhibit more positive attitudes toward AI use in education than do their female counterparts. This outcome is consistent with prior research that has identified gender differences in attitudes and perceptions related to technology.[61]

Consequently, the null hypothesis, which posited no significant difference in attitudes toward AI use in education when the data are grouped by gender, was rejected. This rejection suggests that gender plays a meaningful role in shaping prospective teachers' attitudes toward AI integration in education. The significant gender-based disparities in positive attitudes highlight the necessity of considering gender-specific factors when planning and implementing AI initiatives in educational contexts. Future research could further explore the underlying reasons for these gender differences and explore strategies to promote a more equitable and inclusive integration of AI in education.

The implications of these findings are substantial for educational institutions and policymakers. Understanding the gender differences in attitudes toward AI can help institutions develop targeted interventions and support mechanisms to encourage more equitable participation and engagement with AI technologies among all genders. Additionally, these findings underscore the importance of promoting diversity and inclusivity in AI development and implementation processes. By addressing gender disparities in attitudes toward AI, educators and policymakers can create a more inclusive and supportive environment for integrating AI technologies in education, ultimately enhancing learning outcomes for all students.

Table 2. Independent sample t tests were used to test differences in the attitudes of prospective teachers toward AI use in education when the data were grouped according to age group

	Age Group	N	Mean	Std. Deviation	df	t	p value	Interpretation
Attitude toward AI use in Education	18≤age≤19 years old	235	2,7987	0,37291	601	-2,056	0,040*	Significant
	20≤age and above	368	2,8603	0,34966				

Note: * The p value is significant at the 0,05 level.

The analysis showed that adults (aged 20 and above) had a mean attitude score of 2,86, which was higher than the mean score of 2,80 for adolescent respondents (aged 18 to 19 years old). The independent sample t test indicated a significant difference, with a t value of -2,05 and a p value of 0,040, both of which are below the α value of 0,05. This suggests that adult prospective teachers tend to have more positive attitudes toward AI use in education than their adolescent counterparts. The results imply that both age groups generally hold favorable views of integrating AI in educational practices. This finding is in line with research suggesting that younger individuals, such as adolescents, may not always exhibit more positive attitudes toward technology than older individuals.[62]

The results challenge the assumption that younger individuals, particularly adolescents, are more inclined to embrace technological advancements in education. However, age group differences significantly influence prospective teachers' attitudes toward AI use. These findings highlight the need for educational policymakers and practitioners to avoid making broad generalizations based solely on age and to adopt a more nuanced approach when implementing AI initiatives in educational settings.

The implications of these findings are substantial for educational institutions and policymakers. Understanding the influence of age group on attitudes toward AI can inform the development of targeted interventions and strategies to promote more equitable engagement with AI technologies among different age groups. Additionally, these findings underscore the importance of considering age diversity in AI implementation processes to ensure that initiatives are inclusive and meet the needs of all prospective teachers.

CONCLUSIONS

This study employed a cross-sectional descriptive survey to explore prospective teachers' attitudes toward AI integration in education. Random sampling was used to select 603 respondents from state-managed institutions, with 618 individuals accessing the survey link. Most respondents were females (79,0 %), and adults aged ≥20 years constituted 61,0 % of the sample.

The findings indicate a level of uncertainty among prospective teachers regarding their preference for AI over human interaction in routine transactions. While there is enthusiasm for AI contributing to new economic opportunities, there is a neutral stance on AI's potential to make people happier. Concerns about unethical use, errors, and danger associated with AI were also noted.

Significant gender differences were observed, with male respondents exhibiting more positive attitudes toward AI use in education than females. Age group differences were also significant, with adults showing more positive attitudes than adolescents. These results challenge assumptions about gender and age group predispositions to embracing technology.

Future research could explore the reasons for these differences and develop strategies to promote more equitable engagement with AI technologies. Educational policymakers and practitioners should consider these findings to create inclusive environments for AI integration in education, ultimately enhancing learning outcomes

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