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Research Article

Navigating AI-self-efficacy: Mediating student attitudes and AI literacy

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Artificial intelligence (AI) is a new frontier that is gradually affecting our daily lives. With the advent of the newest and most sophisticated technology, AI represents a new frontier that is increasingly influencing our daily lives. With the recent advancements in 21st-century technology, the potential for its application is limitless, particularly among students. However, the relationship between student attitudes towards AI (SATAI) and AI literacy (AIL) remains unclear. Additionally, there is a lack of literature regarding the mediating role of AI self-efficacy (AISE) in the connection between SATAI and AIL. To address this gap, this study explored these relationships and aimed to provide foundational knowledge regarding these variables. A cross-sectional research design was employed, involving 1,301 voluntary participants selected through purposive sampling. The data collected during the second semester of the 2024-2025 academic year underwent descriptive and inferential analysis using statistical tools, including mean, standard deviation, and regression analysis with Hayes' Process Macro model 4. The study found that students exhibited moderate agreement in their attitudes towards AI. Furthermore, students demonstrated a moderate level of AIL and moderate AISE. Notably, the study established a connection between SATAI and AIL. It also confirmed that AISE plays a mediating role in the relationship between SATAI and AIL. Based on these findings, the study offers some relevant recommendations for the use and regulation of AI among students.

Keywords: Artificial intelligence, AI self-efficacy, AI literacy, Hayes' process macro model 4, mediation analysis, student attitude towards AI

1. Introduction

In the era of rapid technological advancement, AI has emerged as a transformative force impacting various aspects of society, including education. Jiang et al. (2022) believe that AI is one of the major drivers of the socio-economical lives of everyone. AI-based methodologies support manufacturers and industries in predicting their maintenance needs and reducing downtime (Ahmed et al., 2022). Understanding how students perceive and interact with AI is critical for the effective integration of AI technologies in educational settings. Korteling et al. (2021) argued that relevant discussions on topics related to human-like intelligence are a gold standard for AI. The technological revolution accelerated the widespread application of a new generation of information and communication technologies (Zhang & Lu, 2021). AI chatbots and ChatGPT are excellent tools for scientific writing, as they can assist researchers and scientists in organizing their materials, generating drafts, and even proofreading (Salvagno et al., 2023). Nevertheless, according to Zhang et al. (2023), AI cannot replicate human behavior by relying solely on one paradigm. To develop a novel AI technology that is safe, reliable, and extensible, establishing a new theory of explainable AI is essential.

Student attitudes towards AI play a significant role in shaping their willingness to engage with AI technologies in learning environments. Huynh-The et al. (2023) claimed in their survey that AI plays a significant role in enhancing immersive experiences and enabling the human-like intelligence of virtual agents. Positive attitudes can foster a conducive environment for the adoption and utilization of AI tools. In contrast, negative attitudes may hinder the development of AI literacy among students. Xu et al. (2021) sought to illuminate emerging research trends in the integration of AI across various scientific disciplines. Based on their findings, their research aims to

motivate researchers to gain a deeper understanding of the state-of-the-art applications of AI in fundamental sciences. AI literacy, on the other hand, refers to the knowledge and skills necessary to comprehend, assess, and effectively utilize AI technologies. Su et al. (2023) noted that AI literacy is an emerging area of research in digital literacy education.

Based on AI self-efficacy, Mah and Grob (2024) investigated the AI self-efficacy of faculty and revealed greater equity in education as AI's most significant benefit, while student and faculty members' insufficient AI literacy was among the most significant challenges in the past paper of Oran (2023), which investigated if there was literature to show a link between teachers' self-efficacy and AI literacy found none. Thus, the paper suggested future research investigation. Using AI effectively improves learners' enjoyment, self-efficacy, and resilience (Ismail & Alharkan, 2024). In an AI literacy course conducted by Kong et al. (2021) and Kong et al. (2022), the participants made significant progress in understanding the concept of AI and felt empowered to work with it.

Since previous studies have not established any mediation analysis regarding the three variables, this concept makes this study unique and novel in its own right. At the same time, this study took place in a higher education institution where AI is still not well explored and established. With these in mind, this prompted and motivated the researcher to investigate the phenomena and establish a baseline foundation of the matter.

The primary purpose of this study is to investigate the mediating effect of AI self-efficacy on the relationship between student attitudes toward AI and AI literacy. AI self-efficacy refers to an individual's confidence in their ability to utilize and adapt to AI technologies effectively. By examining how AI self-efficacy influences the relationship between students' attitudes toward AI and their AI literacy, this research aims to provide valuable insights into the mechanisms driving students' engagement with AI in educational settings.

Understanding the mediating role of AI self-efficacy can inform the development of strategies to enhance students' AI literacy and foster a positive attitude toward AI. Thus, this investigation contributes to the growing literature on AI in education and shares some practical concepts for educators, policymakers, and stakeholders seeking to leverage AI technologies to enhance learning outcomes for students.

2. Literature Review

2.1. Student Attitude towards AI and AI Literacy

The introduction of AI in the education system is gaining momentum already in some institutions in the country. However, in the country, students have yet to become -quite immersed in the idea that they are already using AI technologies in their studies. Nevertheless, Yuzbasioglu (2020), Scott et al. (2021), and Mehta et al. (2021) believed that students, including postgraduate students, shared optimistic and positive views and thoughts that AI would have a positive impact on their future professions. Hopcan et al. (2023) and Chan and Hu (2023) also support the idea that students and postgraduate students from different disciplines, ages, and genders do not have concerns about learning about AI and have a positive attitude towards AI in teaching and learning. Another idea, also shared by Sit et al. (2020) and Buabbas et al. (2023), is that students believe AI will play an important role in the healthcare field. However, Firincioglulari (2024) revealed that some students demonstrated diminished confidence in AI. Nevertheless, Al Saad et al. (2022) believe that students can benefit from understanding the importance of AI in their field and its impact on their careers. Nankova et al. (2024) also revealed that studies expressed a willingness to use AI but still got some reservations.

Several studies have also identified factors that influence students' attitudes toward AI. For instance, Kim and Lee (2023) shared that gender and experience affect students' attitudes toward AI. Polesie et al. (2020) also noted that an increased level of knowledge of AI is associated with a positive student attitude. Meshari et al. (2022) mentioned that students believed AI would revolutionize and enhance their practice in the future.

In the case of learning and other aspects of educational processes for students, the literature also revealed some compelling findings. Curong (2024) found out that students prefer integrating AI into their language exercises. Buabbas et al. (2023) found that students believed learning AI would benefit their careers and that they should receive AI teaching and training. In the recent paper by Nankova et al. (2024), students see positive advantages to the use of AI in their educational learning but still have some reservations about the replacement of lecturers with AI. Nevertheless, Marx et al. (2023) still noted a gap in developing research instruments for mental models and insufficient research on the impact of AI on learning interventions.

Positive attitudes towards AI, as evidenced by various studies, are associated with an openness to learning about AI recognizing its potential benefits in future professions and educational practices. Students who view AI positively are more likely to be interested in integrating AI into their learning experiences, believing that AI literacy will enhance their career prospects and educational outcomes. Factors such as gender, experience, and knowledge levels have been shown to influence students' attitudes toward AI, suggesting that a higher level of AI literacy is associated with a more positive perception of AI.

H1: Student Attitude toward AI [SATAI] has a significant influence on AI Literacy [AIL].

2.2. Student Attitude towards AI and AI Self-Efficacy

Students benefit from AI tools and other technologies to enhance their academic achievements in school. For instance, Lee et al. (2022) and Chang et al. (2021) both reported that the use of AI chatbots by students aided them in their learning process and academic work. Regarding these findings, Shahzad and colleagues (2024) also reported the impact of AI technologies on students' learning performance through self-efficacy. Parsakia (2023) also claimed that chatbots improve self-efficacy in an experimental setup.

Other works also claim that AI has a significant impact and role on their self-efficacy (Erito, 2023) and intention to learn AI (Chai et al., 2021). In a recent paper by Chen et al. (2024), the authors demonstrated that consumers have a positive attitude towards AI-generated ads, and task self-efficacy mediated this positive result. Then, from a previous article, AI-based human-machine interaction technology and self-efficacy affect organizational performance and employee satisfaction (Lin et al., 2022). Kwak et al. (2022) also reported that factors affecting the behavioral intention of students included a positive attitude toward AI and self-efficacy.

From a different perspective, Hong (2022) mentioned that educational level and income affected the intention to adopt AI technology through AI self-efficacy. Fryer et al. (2020) also disclosed that only human-human task interest directly predicted future course self-efficacy. At the same time, Al Darayseh (2023) demonstrated that the high acceptability of AI use was undoubtedly linked to self-efficacy. Another study showed that creative self-efficacy emerged after the use of an AI application (Saritepeci & Durak, 2024).

The relationship between student attitude toward AI and AI self-efficacy is a crucial aspect in understanding how students perceive and interact with AI technologies. Optimistic attitudes towards AI are often associated with higher levels of AI self-efficacy. When students hold optimistic views about AI, believing in its potential benefits and applications, they are more likely to develop confidence in their skills to utilize AI tools and systems. This positive attitude towards AI can enhance students' self-efficacy in using AI for various tasks, such as learning, problem-solving, and decision-making. Conversely, negative attitudes towards AI may lead to lower AI self-efficacy, as students may feel less confident or capable of engaging with AI technologies.

H2: Student Attitude toward AI has a significant influence on AI self-efficacy [AISE].

2.3. AI Self-Efficacy and AI Literacy

To utilize technology, one must possess the necessary knowledge and literacy regarding it. For students at a higher level of learning, technology has evolved into a tool that enhances their academic pursuits. To support this argument, AI literacy is a key aspect that predicts the intention to learn AI technology (Chai et al., 2021). Additionally, Casal-Otero et al. (2023) noted that AI

literacy facilitates enhanced learning opportunities through its integration into the teaching process.

Although research on AI literacy has not been widely published (Ng et al., 2021), current studies on AI literacy in the literature may not adequately meet the needs of young students (Chiu et al., 2024). The lack of AI literacy can impact an individual's ability to exercise judgment and discern right from wrong (Benton, 2023). Celik (2023) also highlighted the critical role of the digital divide in influencing AI literacy. Nevertheless, AI literacy is advocated to be a pragmatic and helpful tool for AI education (Faruqe et al., 2021) as well as a new competency skill set for individuals (Ng et al., 2022). However, one particular competence that needs to be acquired for AI literacy is metacognition, which involves accurate knowledge and the effort to anticipate an uncertain future (Yi, 2021). This idea influences the educational program from the learner's perspective, particularly in terms of AI ethics, as it relates to educational programs focused on AI literacy (Lee, 2021). In a recent paper, Salhab (2024) argued that college instructors' perception of AI literacy remains weak in the curriculum. Thus, AI literacy tools were crucial for understanding and promoting its development (Lintner, 2024) since AI literacy influences the AI orientation and AI implementation capacity of institutions (Pinski et al., 2024).

The connection between AI self-efficacy and AI literacy is also essential in understanding how individuals perceive and engage with AI technologies. Higher levels of AI literacy, which encompass knowledge and understanding of AI concepts, algorithms, and applications, are often associated with increased AI self-efficacy. When individuals are well-versed in AI principles and applications, they are more likely to feel confident in their ability to interact with AI technologies, troubleshoot issues, and adapt to new AI tools. Conversely, individuals with lower levels of AI literacy may experience reduced AI self-efficacy, as they may lack the necessary knowledge and skills to engage meaningfully with AI systems.

H3: AI Self-Efficacy has a significant effect on AI literacy.

2.4. Mediating Role of AI Self-Efficacy in the Relationship between Student Attitude towards AI and AI Literacy

The interplay between student attitudes towards AI, AI literacy, and AI self-efficacy is underscored by various studies. Dai et al. (2020) highlighted that the impact of AI literacy on students is mediated by their confidence and perception of AI relevance, indicating that self-confidence and understanding the significance of AI play crucial roles in shaping AI literacy. Fan and Zhang (2024) expanded on this, demonstrating that AI literacy indirectly affects learners' continuance intention by mediating learners' attitudes and perceptions within the context of foreign language education. Additionally, Jia and Tu (2024) emphasized how AI can enhance cognition, with self-efficacy and motivation acting as mediators in this cognitive process, suggesting that confidence and drive play key roles in leveraging AI for learning. Furthermore, Jeon and Kim (2022) found that digital literacy and self-efficacy mediate the relationship between online learning attitudes and eHealth literacy, underscoring the importance of self-efficacy in various domains of literacy. Sufyan Ghaleb and Alshiha (2023) explored the relationship between AI in learning, students' self-management skills, and self-efficacy, finding that AI's integration in education can enhance students' management skills and self-efficacy, with self-efficacy acting as a mediating factor in the learning process. By integrating these findings, it becomes evident that self-efficacy plays a crucial mediating role in the relationship between attitudes toward AI, AI literacy, and their practical applications in diverse educational contexts.

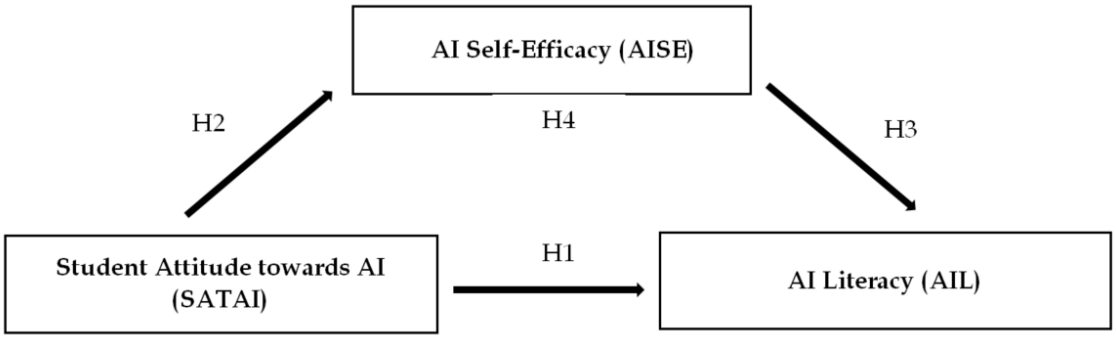
Positive attitudes towards AI can lead to higher levels of AI self-efficacy, as students who view AI positively are more likely to believe in their ability to understand and effectively utilize AI tools. This increased self-efficacy can facilitate the development of AI literacy by empowering students to engage more confidently with AI concepts and applications. On the other hand, negative attitudes towards AI may hinder the development of AI self-efficacy, thereby impacting the level of AI literacy that students attain. By bolstering AI self-efficacy through targeted interventions, educators and institutions can enhance students' confidence in their ability to

effectively engage with AI technologies. This, in turn, can positively influence their AI literacy, leading to a more comprehensive understanding of AI principles and applications. Therefore, recognizing the mediating role of AI self-efficacy in the relationship between student attitudes towards AI and AI literacy is crucial for designing effective strategies to promote AI education and proficiency among students.

H4: AI Self-Efficacy mediates the relationship between Student Attitude toward AI and AI Literacy.

Figure 1 summarized the proposed structure.

Figure 1
Proposed Framework of the Study



3. Methodology

3.1. Research Design

This study employed a cross-sectional research design with mediation analysis using Hayes' Process Macro Model 4 (Hayes, 2013) to investigate the intricate dynamics surrounding the interplay between student attitudes towards AI, their level of AI literacy, and their level of AI self-efficacy. A cross-sectional design analyzes data from a sample population at a single point in time (Wang & Cheng, 2020). On the other hand, a mediation analysis using Process Macros is a bootstrapping statistical tool used to examine the effect of one or more mediating variables on the relationship between the independent and dependent variables (Abu-Bader & Jones, 2021). The utilization of a cross-sectional and mediation approach allowed for a snapshot of these relationships, shedding light on the potential pathways through which student attitudes towards AI may influence their AI literacy, mediated by their self-perceived efficacy in engaging with AI technologies. Central to this investigation was the examination of how AI self-efficacy operates as a mediating factor within this relationship.

3.2. Participants

In this particular study, the participants were students from a tertiary higher education institution in Olongapo City, Philippines. With the help of a simple random sampling technique, the proponent secured 1,301 students from various colleges and departments of the participating institution (see Table 1). According to Ahmed (2024), simple random sampling is a probability sampling technique that is an effective method where every member of the population has an equal chance of being selected. Since the study considered this idea, the sampling technique used in the endeavor was applied. To be considered a participant in the study, one must fit the following inclusion criteria: (a) a bona fide student of the participating institution; (b) a regular full-time student; (c) currently enrolled during the semester that this study was on-going; and (d) voluntarily participated in the online survey. As for the exclusion criteria, (a) students from other schools, (b) irregular students, (c) not enrolled during the data gathering, and (d) not willing to participate in the online survey.

Table 1
Demographic Characteristics of the Participants

Characteristics	*Frequency*	*Percentage*
Sex		
Female	746	57.3
Male	555	42.7
Year Level		
First Year	437	33.6
Second year	323	24.8
Third Year	261	20.1
Fourth Year	280	21.5
Age		
Less than 20 years old	711	54.6
21-25 years old	538	41.4
26-30 years old	26	2.0
More than 31 years old	26	2.0
Total	1,301	100.0

Based on the online survey, the study revealed 746 (57.3%) female and 555 (42.7%) male participants. In terms of year level, there were 437 (33.6%) first-year, 323 (24.8%) second-year, 261 (20.1%) third-year, and 280 (21.5%) fourth-year participants. Regarding age, 711 (54.6%) participants were under 20 years old, 538 (41.4%) participants were aged 21-25 years old, 26 (2.0%) participants were aged 26-30 years old, and 26 (2.0%) participants were 31 years old and above.

Furthermore, the data gathering observed strict data privacy and confidentiality to safeguard the information obtained from the students. The investigator first secured consent prior to the participant's participation. The survey is purely voluntary. If the students ever refused to participate, they were free to do so without facing repercussions, such as harm or threats.

3.3. Measures

To obtain the appropriate data for the study, the proponent employed two types of measures. The first measure originated from a study by Suh and Ahn (2022), in which they developed and validated a scale to measure students' attitudes toward AI. The validated scale consisted of 26 items, divided into three dimensions: cognitive, emotional, and behavioral attitudes. It can be answered by a five (5) point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scores of these items can be summed to represent a student's attitude towards AI. This scale has been validated, yielding a final construct reliability of between .907 and .943, which indicates validity. A Cronbach's alpha result range of .905 to .956 indicates excellent internal consistency among the items.

For the second measure of the study, the researchers used the paper by Carolus et al. (2023), which explored the aspects of AI literacy and AI self-efficacy. Specifically, the AI literacy contained 19 items, whereas the AI self-efficacy had six items. In particular, AI literacy has four subdimensions, namely, use and apply of AI (Cronbach's alpha = .93), know and understand AI (Cronbach's alpha = .87), Detect AI (Cronbach's alpha = .77), and AI ethics (Cronbach's alpha = .75). As for the AI self-efficacy, the Cronbach alpha was .84. All of these results show good internal consistency for the study's measure.

As for the responses of the respondents, a Likert scale ranging from one (1) to five (5) was assigned with the following descriptive interpretation for student attitude towards AI: (1) strongly disagree, (2) disagree, (3) moderately agree, (4) agree, and (5) strongly agree. Moreover, for the AI literacy and self-efficacy, the study assigned (1) very low, (2) low, (3) moderately high, (4) high, and (5) very high.

To be sure, the modified instrument of the study also underwent pilot testing. Based on the Cronbach's Alpha Analysis test, the modified tool generated an overall coefficient of .980, which is highly reliable.

Prior to data collection, this study obtained permission from the institution and consent from the participants. After receiving approval from the relevant authorities, data gathering commenced through the various research coordinators of the different colleges via an online Google form. The online survey ran from January to February 2024.

3.4. Statistical Analysis

The data underwent a series of statistical analyses, which included mean and standard deviation measurements for descriptive analysis and Hayes' Process Macro Model 4 for inferential analysis, particularly the mediation calculation for the model. As mentioned earlier, a mediation analysis using Process Macro is a bootstrapping statistical tool wherein researchers use it to examine the effect of one or more mediating variables on a test of a relationship. According to Egbert and Plonsky (2021), bootstrapping is a statistical technique that enables the measurement of the accuracy and reliability of sample estimates and is often used for small samples and samples with unknown or non-normal distributions. Since the process macro employed a bootstrapping technique in the computation, the normality test no longer applies. The study employed the Statistical Package for Social Sciences [SPSS] version 23 for the accurate and reliable computation for the statistical treatment of the data.

3. Results

The objective of this study is to investigate whether AI self-efficacy mediates the relationship between students' attitudes toward AI and their AI literacy. The succeeding tables summarize the results and discussion.

Table 2
Mean, Standard Deviation Values, and Correlation Analysis

Variables	*Mean*	*SD*	*1*	*2*	*3*
1. Student Attitude Toward AI	3.16	0.732	1		
2. AI Literacy	3.07	0.719	.622*	1	
3. AI Self-Efficacy	3.04	0.788	.653*	.734*	1

Note. $*p < .05$

Table 2 displays the means and standard deviations for the variables Student Attitude Toward AI, AI Literacy, and AI Self-Efficacy. The means for Student Attitude Toward AI, AI Literacy, and AI Self-Efficacy are 3.16 (SD = 0.732), 3.07 (SD = 0.719), and 3.04 (SD = 0.788), respectively. These scores, in general, correspond to a moderate degree of student attitude, moderate AI anxiety, and moderate AI self-efficacy. Despite this moderate perspective from the participants, there are still viable options to accept AI as part of their daily learning routine.

Furthermore, the table includes correlation coefficients between these variables. The correlation between Student Attitude Toward AI and AI Literacy was r = .622, with a corresponding p value < .001. The correlation between Student Attitude Toward AI (SATAI) and AI Self-Efficacy (AISE) was r = .653 with a p-value of . < .001. Lastly, the correlation between AI Literacy (AIL) and AI Self-Efficacy is r = .734, demonstrating a p-value of < .001. Based on the obtained p-values, one can determine that all of the three variables correlated to each other significantly.

Overall, the results suggest that there are significant correlations among the variables studied, indicating that student attitudes toward AI are positively associated with AI Literacy and AI Self-Efficacy. Moreover, the correlation between AI Literacy and AI Self-Efficacy is notably strong. These findings offer valuable insights into the interconnectedness of attitudes, anxiety, and self-efficacy regarding AI among students.

Table 3
Mediation Estimates for the Student Attitude toward AI, AI Self Efficacy, and AI Literacy

Effect	*Label*	*β*	*Estimate*	*SE*	*95% Confidence*	
					Lower	*Upper*
Indirect	SATAI*AISE	0.333*	0.330	0.0236	0.2852	0.384
Direct	AIL	0.320*	0.317	0.0222	0.2732	0.3602
Total	AIL+SATAI*AISE	0.653*	0.646	0.0208	0.6055	0.6872

Note. SATAI: Student Attitude toward AI; ASE: AI Self-Efficacy; AIL: AI Literacy; *$p < .05$

Table 3 presents the results of the mediation analysis and provides answers to the hypotheses (H1, H2, and H4) of the study. In general, the mediation analysis revealed significant effects in the study. The indirect effect of the interaction between Student Attitude toward AI and AI Self Efficacy (β = 0.333, SE = 0.0236, 95% CI [0.2852, 0.384]) was found to be statistically significant (H2), indicating that this interaction plays a mediating role in the relationship under investigation. Similarly, the direct effect of AI Literacy (β = 0.320, SE = 0.0222, 95% CI [0.2732, 0.3602]) was also significant, suggesting a direct influence on the outcome variable (H1).

Moreover, the total effect of AIL and the interaction between Student Attitude toward AI and AI Self Efficacy (β = 0.653, SE = 0.0208, 95% CI [0.6055, 0.6872]) was statistically significant (H4), indicating the combined impact of both direct and mediating factors on the dependent variable. These findings, derived from 5000 bootstrapped samples, provide compelling evidence supporting the hypothesized mediation model, where AISE significantly mediates the relationship between Student Attitude toward AI and AI Literacy (AIL) (all $p < .05$).

Overall, the results support the presence of both direct and indirect pathways through which the independent variables influence the outcome variable, providing valuable insights into the underlying mechanisms at play in the studied relationship.

Table 4
Path Estimates of the Student Attitude toward AI, AI Self-Efficacy, and AI Literacy

Path	*β*	*Estimate*	*SE*	*95% Confidence*	
				Lower	*Upper*
SATAI → AISE	0.622*	0.675	0.0236	0.6292	0.7217
AISE → AIL	0.535*	0.488	0.0204	0.4480	0.5282
SATAI → AIL	0.320*	0.317	0.0222	0.2732	0.3602

Note: * $p < .05$

The analysis of pathways among the variables SATAI, AISE, and AIL yielded significant findings, as shown in Table 4. The results present key insights into the relationships between the outcome variables AISE, AIL, and the total effect, thereby providing answers to the hypotheses of the study (H1-H3). Firstly, the path from Student Attitude toward AI to AI Self Efficacy (H2) demonstrated a substantial positive relationship (β = 0.622, Estimate = 0.675, SE = 0.0236, 95% CI [0.6292, 0.7217]. For AI Self Efficacy, a correlation coefficient of 0.6224 suggests a moderate positive relationship with the predictor variables, with a coefficient of determination indicating that approximately 38.74% of the variance in AISE can be explained by these predictors. The model's statistical significance (F (1, 1299) = 821.579, $p < .001$) underscores the substantial predictive impact of the predictors on AI Self Efficacy. Similarly, for AI Literacy, a correlation coefficient of 0.7753 indicates a strong positive association with the predictor variables, with an R-squared value of 0.60, which signifies a significant explanatory power. The highly significant model (F(2, 1298) = 977.882, $p < .001$) highlights the collective influence of the predictors on AIL. Regarding the total effect, a correlation coefficient of 0.6526 and an R^2 of 42.59% demonstrate a moderate positive relationship and significant impact of the predictors on the total effect, supported by a statistically significant model (F (1, 1299) = 963.690, $p < .001$). These results emphasize the predictive strength of the predictor variables in explaining variations in AI Self Efficacy, AI Literacy, and the overall total effect within the analyzed model indicating that increases in SATAI are associated with

corresponding increases in AISE. Secondly, the path from AI Self Efficac to AI Literacy (H3) showed a significant positive association (β = 0.535, Estimate = 0.488, SE = 0.0204, 95% CI [0.4480, 0.5282], $p < .001$), suggesting that higher values of AISE are linked to elevated levels of AIL. Lastly, the direct path from Student Attitude toward AI to AI Literacy (H1) also displayed a significant positive relationship (β = 0.320, Estimate = 0.317, SE = 0.0222, 95% CI [0.2732, 0.3602], $p < .001$), indicating a direct influence of SATAI on AIL. All reported relationships are statistically significant at $p < .05$, based on 5,000 bootstrapped samples. These results emphasize the interconnectedness and directional influences among Student Attitude toward AI, AI Self Efficacy, and AI Literacy, shedding light on the relationships within the studied model.

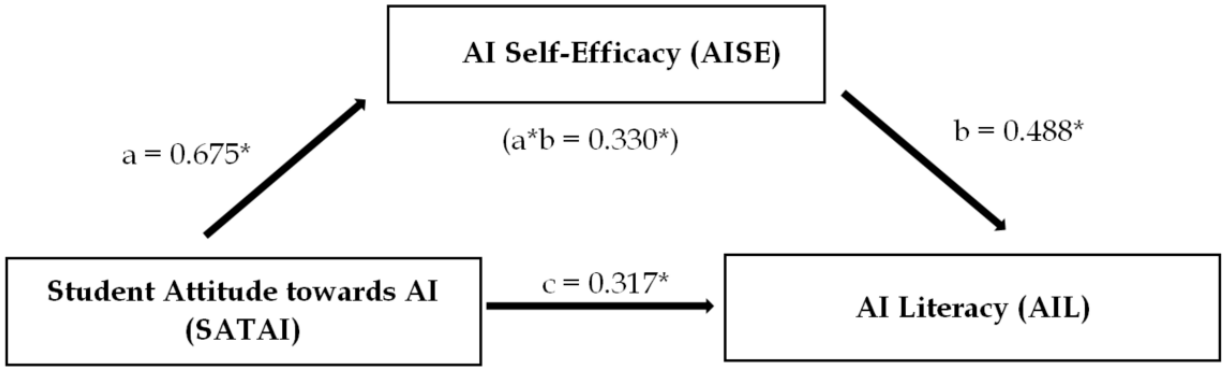
Table 5
Model Summary for the AI Self-Efficacy and AI Literacy on Student Attitude Towards AI

Outcome Variable	*R*	R^2	*F*	*df1, df2*
AISE	0.6224*	0.3874	821.579	1, 1299
AIL	0.7753*	0.6011	977.882	2, 1298
Total Effect	0.6526*	0.4259	963.690	1, 1299

Note. *$p < .05$

The model summary in Table 5 presents key insights into the relationships between the outcome variables AI Self Efficacy, AI Literacy, and the total effect. the model summary provides compelling evidence for the predictive relationships among student attitude toward AI, AI self-efficacy, and AI literacy, with all estimates derived using bootstrapping procedures based on 5,000 resamples to enhance the robustness and reliability of the findings. For AI Self Efficacy, a correlation coefficient of 0.6224 suggests a moderate positive relationship with the predictor variables, with a coefficient of determination indicating that approximately 38.74% of the variance in AI Self Efficacy can be explained by these predictors. The model's statistical significance ($F(1, 1299) = 821.579$ $p < .001$) underscores the substantial predictive impact of the predictors on AI Self Efficacy. Similarly, for AI Literacy, a correlation coefficient of 0.7753 indicates a strong positive association with the predictor variables, with an R-squared value of 0.60, which signifies significant explanatory power. The highly significant model ($F(2, 1298) = 977.882$, $p < .001$) highlights the collective influence of the predictors on AI Literacy. Regarding the total effect, a correlation coefficient of 0.6526 and an R^2 of 42.59% demonstrate a moderate positive relationship and significant impact of the predictors on the total effect, supported by a statistically significant model ($F(1, 1299) = 963.690$, $p < .001$). These results emphasize the predictive strength of the predictor variables in explaining variations in AI Self Efficacy, AI Literacy, and the overall total effect within the analyzed model.

Figure 2
Conceptual Model for the Mediating Effect of AISE between SATAI and AIL



4. Discussion

The primary objective of this study is to determine whether AI self-efficacy plays a mediating role in the relationship between students' attitudes toward AI and their AI literacy. The findings presented in this paper reveal some interesting discoveries.

To start with, students shared a moderate degree of attitude toward AI. Additionally, participants exhibit a moderate level of AI literacy, as well as a moderate perception of their self-efficacy. Several recent studies have shed light on the intersection of AI and education, which aligns with the results of the current study. For instance, Kim and Lee (2023) highlighted that students facing challenges influenced by socio-cultural factors displayed a more favorable stance towards AI when exposed to AI education. However, Nazari et al. (2021) emphasized the efficacy of AI-powered tools in enhancing learning behavior and fostering a positive attitude toward technology acceptance, which contradicts the students' moderate attitude towards AI. To support this, Mehta et al. (2021) and Hopcan et al. (2023) both underscore the emergence of ethical, social, and employment concerns among students regarding the increasing role of AI in society. Nevertheless, Marx et al. (2023) emphasized the prevalent focus in the literature on students' attitudes toward AI and the moderation of various factors. Then, Kashive et al. (2020) emphasized the crucial role of AI in creating personalized learning environments.

Furthermore, the result of the Process-Macro computation also revealed interesting findings for the study. Initially, the study established a significant association between the student attitude toward AI and AI literacy. The same finding also applied to the other component of the analysis. Chan and Wu (2023) advocated for the integration of GenAI technologies into higher education to establish informed guidelines for the responsible implementation of AI. Lee et al. (2022) and Chang et al. (2021) explored the positive impact of AI-based chatbots on student engagement and self-efficacy. Chen et al. (2024) and Liang et al. (2023) delved into the intricate relationship between AI self-efficacy, anxiety, and usage patterns among learners. Dai et al. (2020) found that AI literacy alone might not predict readiness for AI integration. Kwak et al. (2022) stressed the importance of fostering positive attitudes and self-efficacy towards AI within educational frameworks. Ododo et al. (2024) advocated for the incorporation of AI tools in programming education to enhance teaching practices. Benton (2023) and Faruqe et al. (2021) emphasized the importance of AI literacy as a crucial component of democratic engagement and skill development. Salhab (2024) recommended integrating AI literacy into higher education curriculum design across diverse disciplines.

Moreover, the study also highlighted the mediating effect of AI self-efficacy on the link between student attitudes towards AI and AI literacy. This interesting result suggests that the combination of student attitude toward AI and AI self-efficacy is an essential aspect of the AI literacy of students. In relation, Singh et al. (2024) explored the link between AI literacy, usage, learning outcomes, and academic performance, while Pinski et al. (2024) examined how AI literacy impacts implementation ability, particularly in startup environments. These results coincide with the findings of the current study. Lastly, Yuzbasioglu (2020) also noted the participants' eagerness to enhance their AI knowledge despite existing gaps in understanding, underscoring the growing enthusiasm for AI education and literacy.

5. Conclusion

The investigation revealed a moderate level of agreement among respondents regarding their student attitude towards AI, as well as moderate AI literacy and moderate AI self-efficacy. In addition, inferential analysis also revealed a compelling association between student attitudes towards AI and AI literacy. Regarding the main objective of the investigation, whether AI self-efficacy mediates the relationship between SATAI and AIL, the current study provides sufficient evidence to demonstrate its significant mediating effect. Thus, this study has achieved its primary objective and endorses these findings to the research community to challenge and scrutinize.

6. Recommendations

Based on the results and conclusions of the investigation, several recommendations are presented to support the enhancement of AI literacy and student attitudes toward AI. Educational institutions should integrate AI-related content across various disciplines to strengthen understanding and emphasize its relevance. To foster more positive attitudes, it is advisable to develop learning modules or seminars that showcase real-world applications of AI, with a focus on ethical implications, career opportunities, and societal benefits. Given that AI self-efficacy mediates the relationship between students' attitudes toward AI (SATAI) and AI literacy (AIL), institutions should implement hands-on workshops, coding boot camps, and project-based learning to improve students' confidence in using AI tools. Learning experiences should be designed to gradually increase in complexity, allowing students to build foundational knowledge before progressing to advanced concepts, which in turn enhances both AI literacy and self-efficacy. It is also crucial to invest in faculty training to ensure educators are well-prepared to teach AI concepts and support student learning. Providing access to AI tools, platforms, and datasets can further enable students to explore and learn independently, reinforcing both literacy and confidence. Finally, future research should explore other psychological or contextual factors—such as interest in technology, prior experience, and gender differences—that may influence the relationship between students' attitudes toward AI and their AI literacy.

7. Limitation of the Study

Like any other investigation, this study also has several limitations that can serve as a basis for a more in-depth investigation, theory development, and hypothesis testing. The first limitation is related to locality. Since this paper only covered a specific city in the country, future researchers can extend their study to multiple localities. Second, the current study only used tertiary students. For better analysis, future researchers may also employ students from lower levels, such as secondary school students in junior or senior high schools, to establish a more comprehensive comparison. Third, another overlooked limitation was the institution; the study only used one. Since quantitative studies would benefit from more participants, multiple institutions are also highly advised in the future. Lastly, the research design, a mixed-methods approach, is highly plausible; a more advanced Structural Equation Modelling may be used for future research.

Data availability: The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declaration of interest: No conflict of interest is declared by author.

Ethics statement: Author declares that the proponent observed all of the necessary ethical considerations during the process of data gathering and other essential procedures and protocols as well as the Data Privacy concerns of the respondents were also taken into account. The proponents also emphasize that informed consent were provided prior to the data gathering and the study's purpose, procedures, and their rights to withdraw at any time without consequences were reiterated. This is to protect the respondents to all kinds of threats and harm due to their voluntary participation in the said study. No additional document was required.

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