



Examining the Relationship Between Artificial Intelligence Literacy, Attitudes Toward Artificial Intelligence, and Technostress Among University Students

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Article Information	ABSTRACT
<p>Received: 30.08.2025</p> <p>Accepted: 05.01.2026</p> <p>Online First: 27.04.2026</p> <p>Published: 30.04.2026</p>	<p>Artificial intelligence (AI) technologies have rapidly permeated educational contexts, influencing students' learning processes and digital experiences. This study aimed to examine the interrelationships among AI literacy, attitudes toward AI, and technostress in undergraduate students. A cross-sectional, descriptive, and correlational design was employed. Data were collected in June 2025 from 400 undergraduate students enrolled in the Faculties of Health Sciences, Education, Arts and Sciences, and Engineering at Artvin Çoruh University. Data collection instruments included a Sociodemographic Information Form, the Artificial Intelligence Literacy Scale (AALS), the General Attitudes Toward Artificial Intelligence Scale (GAAIS), and the Technostress Scale. Descriptive statistics, Pearson's correlation, and multiple regression analyses were conducted using SPSS 26.0. The results indicated that positive attitudes toward AI were significantly and positively correlated with AI literacy, whereas technostress showed negative associations with both positive attitudes and the evaluation subdimension of AI literacy. Regression analysis further revealed that academic achievement (GPA), IT competence, and positive attitudes were significant predictors of AI literacy, while negative attitudes exerted a diminishing effect. Technostress, however, did not emerge as a significant predictor. These findings highlight the multifaceted nature of AI integration in higher education. The findings of this study indicate that enhancing AI literacy is associated not only with improved technical competence but also with more positive perceptions and reduced technology-related stress. Educational strategies should therefore focus on strengthening students' AI literacy, promoting balanced and informed attitudes, and equipping learners with coping mechanisms to manage technostress. This study aims to contribute to the growing body of literature by emphasizing the importance of integrating cognitive, emotional, and psychological dimensions into AI education to support students' adaptation and academic success in the digital era.</p> <p>Keywords: Artificial intelligence literacy; attitudes toward AI; technostress; higher education; university students</p>
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1. INTRODUCTION

Artificial intelligence (AI) technologies have been rapidly developing in recent years, permeating all areas of social life and playing a transformative role in educational environments, including higher education (Long & Magerko, 2020). With AI becoming more than just a tool and evolving into an integral part of the learning process, the concept of AI literacy has emerged in the literature (Mertala et al., 2022). AI literacy is defined as a set of competencies that enable individuals to critically evaluate AI technologies, communicate and collaborate effectively with AI, and use AI as a tool online, at home, and in workplaces (Southworth et al., 2023). Considering the growing influence of AI in modern society, the importance of these competencies is greater than ever. Indeed, the ability to understand, evaluate, and use AI technologies has become a fundamental digital skill for individuals today (Ng et al., 2022; Zhai et al., 2021; Semerci Şahin et al., 2025).

To succeed in the AI era, students must be provided with learning opportunities to develop AI literacy (Yang et al., 2025). In the international literature, the development of AI literacy programs in higher education is suggested as an important step to address both the opportunities and challenges posed by the integration of AI into education (Francis et al., 2025; Sarikahya et al., 2025). In fact, AI literacy is considered a critical competency that university students should possess for their future professional careers and citizenship roles in a world increasingly dominated by AI (Hornberger et al., 2025).

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The importance of AI literacy has become even more pronounced with the rapid spread of AI in education. For example, ChatGPT, an AI chatbot introduced at the end of 2022, quickly attracted great interest among higher education students. A global study reported that 71% of university students tried ChatGPT at least once for academic purposes during its first year of release (Ravšelj et al., 2025). Students have been integrating AI tools like ChatGPT into their academic work for various purposes such as conducting research for assignments, summarizing texts, and generating new ideas. However, the rapid incorporation of such generative AI tools into education has also raised concerns regarding academic integrity and assessment methods.

Therefore, it is crucial to equip students with the necessary knowledge and skills to use AI tools consciously, ethically, and effectively that is, to raise their AI literacy levels. Some researchers, in fact, recommend that higher education institutions develop AI literacy programs for students in order to promote the responsible use of AI (Francis et al., 2025). In addition to students' AI literacy, their attitudes toward AI also emerge as a decisive factor in the acceptance and effective use of this technology in education (Fan & Zhang 2024; Zeng et al., 2025). Attitudes toward AI generally reflect individuals' cognitive evaluations and emotional orientations regarding AI technologies (Brauner et al., 2025). The literature indicates that attitudes toward AI have both positive and negative dimensions, and these can affect technology adoption in different way (Cicero et al., 2025; Makridakis, 2017). Positive attitudes reflect an optimistic outlook that highlights the potential opportunities and benefits of AI, whereas negative attitudes involve concerns such as anxiety, distrust, or fear (Schepman & Rodway, 2020, 2023). For instance, widespread misconceptions in public discourse may lead to unrealistic fears that AI will completely take over the labor market, or, conversely, to overly optimistic expectations that AI will solve all problems (Du, 2024; Rodrigues et al., 2023). Such perceptions can push individuals toward extreme positions in their attitudes toward AI. Studies have shown that positive attitudes toward AI are positively associated with students' intentions to adopt these technologies, while negative attitudes are linked to resistance and reluctance (Cave et al., 2019; Fast & Horvitz, 2017).

On the other hand, the phenomenon of "technostress," which arises from the intensive use of information and communication technologies, has regained importance with the spread of AI in education (Klimova & Pikhart 2025; Litan 2025). The concept of technostress refers to the difficulties of adaptation, anxiety, and psychological pressures that individuals experience when using new technologies (Lin & Yu, 2025; Upadhyaya & Vrinda, 2021). In the literature, technostress is often defined as a set of negative psychological conditions resulting from the cognitive and emotional burdens imposed by technology (Saleem et al., 2024). From the perspective of students, technostress can lead to outcomes that negatively affect learning processes, such as distraction, cognitive overload, and reduced motivation. Indeed, recent studies have reported that increasing levels of technostress among students negatively affect academic performance and weaken information processing and learning skills (Torales et al., 2022; Vallone et al., 2023). Especially during the COVID-19 pandemic, the accelerated shift to online learning revealed heightened technostress symptoms among many students; factors such as excessive exposure to technology, technical problems, and a lack of digital skills reduced students' learning satisfaction (Torales et al., 2022; Vallone et al., 2023). The rapid diversification and development of AI applications may similarly create an adaptation burden for students. The need to keep pace with constantly updated AI tools may increase anxiety and stress levels among individuals who lack sufficient digital literacy (Pertiwi et al., 2025). A study by Chen et al. (2024) indicated that generative AI could contribute to technostress in the workplace, as the rapid pace of change and the constant need for learning exert pressure on users (N. Chen et al., 2024). Similarly, individuals who perceive themselves as inadequate in AI are more likely to avoid or resist using such technologies (Chang et al., 2024). In short, technostress constitutes a significant barrier to the adoption of AI and plays a decisive role in individuals' ability to adapt to technology.

While the literature highlights the individual importance of AI literacy, attitudes, and technostress, understanding the interaction of these variables is considered critical, particularly in the higher education context. Individuals with higher AI literacy are better able to make sense of and adapt to new technologies, which may lead them to develop more positive attitudes toward AI and experience lower levels of anxiety regarding technological innovations. Indeed, previous studies have shown that students with solid knowledge and experience of AI approach these technologies with greater confidence and optimism, which in turn reduces their AI-related anxiety and stress (Bećirović et al., 2025; Chang et al., 2024; Jha et al., 2022). For example, a recent study conducted with university students in Middle Eastern countries found that those with higher levels of knowledge about the use and benefits of AI reported lower levels of concern about AI and were more willing to integrate AI into their future professional practice (Jha et al., 2022). Similarly, a study conducted with Chinese university students reported that digital literacy significantly predicted technostress: students with higher digital literacy experienced substantially lower levels of technology-related stress (Wang, 2024). These findings suggest that developing digital skills and AI literacy can facilitate students' adaptation to technology and reduce technostress. Conversely, students with low AI literacy or limited exposure to AI may struggle to make sense of AI technologies, which may in turn foster misconceptions, heightened anxiety, and more negative attitudes (Al Omari et al., 2024; Du, 2024; Rodrigues et al., 2023). The literature also emphasizes the need for further investigation into the relationship between digital competencies and attitudes (Cicero et al., 2025; Mena-Guacas et al., 2023; Shima & Jaupaj 2025).

Accordingly, examining the relationship among university students' AI literacy, attitudes toward AI, and technostress fills an important gap both theoretically and practically. The findings may provide valuable insights into how educational programs and support mechanisms should be designed to enhance students' academic success and overall educational experience in the AI era. In this way, interventions such as curriculum development aimed at increasing AI literacy, promoting positive and informed attitudes toward AI, and reducing sources of technological stress can be grounded on a solid scientific basis. For this

reason, this study aims to contribute to the literature by investigating the reciprocal relationships among AI literacy, attitudes, and technostress in university students.

2. METHODOLOGY

2.1. Study design

This study is a cross-sectional, descriptive, and correlational research conducted to assess university students' AI literacy, attitudes toward AI, and levels of technostress in Türkiye.

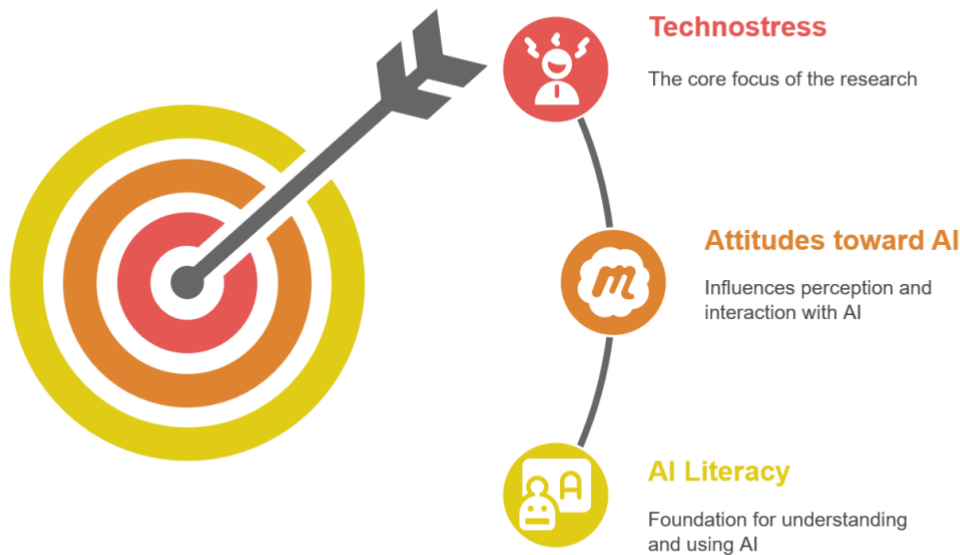


Figure 1. Framework models of the study

2.2. Participants

The study population consisted of undergraduate students enrolled in the Faculties of Health Sciences, Education, Arts and Sciences, and Engineering at Artvin Çoruh University. The university setting which integrates theoretical coursework, practical training, and digital learning resources provided an appropriate academic environment for examining students' AI literacy, attitudes toward AI, and experiences of technostress.

A convenience sampling method was used, as students who met the eligibility criteria and were accessible during the data collection period were invited to participate. This method was preferred due to practicality and feasibility in reaching a sufficiently large and diverse student population.

To determine an adequate sample size, an a priori power analysis was conducted for multiple linear regression with ten independent variables. Using G*Power software with a medium effect size ($f^2 = 0.15$), an alpha level of .05, and a statistical power of .95, the minimum required sample size was calculated as 175. In the present study, data were collected from 400 undergraduate students, exceeding the minimum requirement. This ensured adequate statistical power, enhanced the reliability of the findings, and allowed for subgroup analyses, thereby strengthening the generalizability of the results.

Inclusion criteria were based on ensuring that participants had sufficient exposure to AI-related educational environments and the digital tools necessary to complete the survey:

- Being enrolled in an undergraduate program at Artvin Çoruh University,
- Having access to a digital device (computer, smartphone, or tablet),
- Providing voluntary informed consent to complete the online survey.

Exclusion criteria were determined to ensure data accuracy and integrity:

- Providing incomplete or invalid responses,
- Inability to read or understand Turkish (the survey language),
- Voluntary withdrawal from the study at any stage.

2.3. Data Collection Instruments

2.3.1. Sociodemographic Information Form

Participants' demographic and academic characteristics were collected using a form developed by the researcher based on the relevant literature (Saleem et al., 2024; Vallone et al., 2023). To ensure clarity of the items, feedback was obtained from an expert in educational sciences. The form included items on age, gender, year of study, grade point average (GPA), prior training related to AI, and self-reported use of AI technologies.

2.3.2. Artificial Intelligence Literacy Scale (AILS)

AI literacy was measured using the AILS, developed by Wang, Rau, and Yuan (2023). The scale was adapted into Turkish and validated by Çelebi and colleagues (2023). The instrument comprises 12 items organized into four subdimensions: awareness, usage, evaluation, and ethics. Each item is rated on a 7-point Likert scale ranging from *Strongly Disagree (1)* to *Strongly Agree (7)*. Items 2, 5, and 11 are reverse-coded. Possible scores range from 12 to 84, with higher scores reflecting greater AI literacy. Reliability analyses for the original version yielded Cronbach's alpha values of 0.83 for the overall scale, and 0.73, 0.75, 0.78, and 0.73 for awareness, usage, evaluation, and ethics, respectively. In the Turkish version, Cronbach's alpha coefficients were 0.85 for the total scale, and 0.72, 0.74, 0.76, and 0.72 for the respective subdimensions. In this study, the Cronbach's Alpha coefficient was found to be 0.74.

2.3.3. General Attitudes Toward Artificial Intelligence Scale (GAAIS)

Students' attitudes toward AI were assessed with the GAAIS, originally developed by Schepman and Rodway (2023). The Turkish adaptation and validation were carried out by Kaya et al. (2024) (Kaya et al., 2024). The GAAIS includes 20 items and two subscales: positive and negative attitudes. All items are rated on a 5-point Likert scale. In the Turkish version, items 1–12 represent positive attitudes, whereas items 13–20 measure negative attitudes and are reverse-coded. On the negative attitude subscale, lower scores indicate more unfavorable orientations. The Cronbach's alpha coefficients for the Turkish version were 0.82 for the positive subscale and 0.84 for the negative subscale. In this study, the Cronbach's Alpha coefficient was found to be 0.74. In this study, the Cronbach's Alpha coefficient was found to be 0.81.

2.3.4. Technostress Scale

Technostress levels were measured using the "Technostress Levels of University Students in the Technology-Assisted Learning Environment" Scale, originally developed by Wang et al. (2008) and adapted into Turkish by Baş et al. (2021). The instrument contains 13 items scored on a 5-point Likert scale ranging from *Strongly Disagree (1)* to *Strongly Agree (5)*. Total scores range between 13 and 65, with higher scores reflecting greater levels of technostress. In the Turkish validation study, the Cronbach's alpha coefficient was reported as 0.91, and the split-half reliability was 0.93 (Baş et al., 2021). In this study, the Cronbach's Alpha coefficient was found to be 0.93.

2.4. Data Collection Process

The research data were collected in June 2025 from undergraduate students enrolled in the Faculties of Health Sciences, Education, Arts and Sciences, and Engineering at Artvin Çoruh University. Participants were recruited through student communication platforms and classroom announcements made by faculty members. In addition, with the necessary permissions obtained from the course instructors, recruitment was carried out during class hours.

At the beginning of the sessions, students were provided with detailed information regarding the aim of the study, the procedures to be followed, and ethical principles (confidentiality, voluntary participation, etc.). Questionnaires were distributed in person to students who voluntarily agreed to participate. Participants were given one week to complete the survey, and reminders were sent via e-mail and student communication groups during this period.

Prior to completing the questionnaire, students were explicitly informed that the data they provided would be used solely for scientific research purposes and that their personal information would remain confidential. Participation was based entirely on voluntariness, and informed consent was obtained from all participants prior to data collection.

2.5. Data Analysis

Data analysis was conducted using IBM SPSS Statistics for Windows, Version 26.0. Descriptive statistics (mean, standard deviation, frequency, and percentage) were employed to summarize participants' demographic characteristics, AI-related experiences, and their scores on the AILS, the GAAIS, and the Technostress Scale. Pearson's correlation analysis was performed to examine the relationships between AI literacy, attitudes toward AI, and technostress. Correlation coefficients were interpreted based on Cohen's guidelines: values of approximately .10 indicated a small effect, .30 a moderate effect, and .50 or higher a large effect (Cohen 2013).

Multiple linear regression analyses were then conducted to determine the predictive roles of AILS, GAAIS, and technostress subdimensions. Prior to regression, assumptions of multicollinearity were checked using Variance Inflation Factor (VIF), tolerance, and condition index values. Independent variables were considered acceptable when $VIF < 10$, tolerance > 0.20 , and condition index < 15 . All analyses were performed at a 95% confidence level, with results considered statistically significant at $p < .05$.

3. FINDINGS

Demographic Characteristics

A total of 400 students participated in the study, with the majority being female (60.5%). Among the participants, 56.8% were between the ages of 21 and 23, 32.3% were in their fourth year, and 29.3% were in their third year of study. The students' average academic grade point average (GPA) was 2.89 ± 0.42 . In terms of information technology proficiency, 45.8% of the participants described themselves as having a moderate level of competence (Table 1).

Table 1.
Demographic Variables and Artificial Intelligence Usage Among University Students

Variables	n	%
Demographic variables		
Gender		
Male	158	39.5
Female	242	60.5
Age		
18–20 years	123	30.7
21–23 years	227	56.8
24 and above years	50	12.5
Class		
1st year	81	20.3
2nd year	73	18.3
3rd year	117	29.3
4th year	129	32.3
Academic GPA (4.0 scale)	Mean (SD)	
Information technology proficiency	2.89 ± 0.42	
Poor	15	3.8
Moderate	183	45.8
Good	167	41.8
Very good (Advanced)	35	8.8
Artificial Intelligence Usage and Perceptions		
Knowledge of artificial intelligence		
Yes	361	90.2
No	39	9.8
Having received education about artificial intelligence		
Yes	22	5.5
No	378	94.5
Perception of artificial intelligence reliability		
Very reliable	20	5.0
Reliable	112	28.0
Not sure	242	60.5
Unreliable	21	5.3
Not reliable at all	5	1.3
Familiarity with artificial intelligence applications		
ChatGPT	374	93.5
Bard/Gemini	150	37.5
Bing	78	19.5
DeepSeek	25	6.3
Grok	16	4.0
Use of artificial intelligence tools in lessons or the educational process		
Yes	342	85.5
No	58	14.5
Purpose of using artificial intelligence		
Preparing assignments	309	77.3
Learning new information	255	63.8

Translating	226	56.5
Writing articles or reports	181	45.3
Accessing evidence-based information	133	33.3
Conducting literature review	131	32.8
Preparing presentations or training materials	110	27.5
Solving questions or practicing	110	27.5

Artificial Intelligence Knowledge and Education

The vast majority of participants (90.3%) reported that they had knowledge about AI. However, only 5.5% stated that they had received any formal education or training in this area. When asked about their perceptions of AI's reliability, 60.5% reported being uncertain, 28.0% found AI to be reliable, 5.0% considered it very reliable, 5.3% said it was unreliable, and 1.3% believed it was completely unreliable.

Familiarity with AI Applications

The AI application that students were most familiar with was ChatGPT (93.5%). This was followed by Bard/Gemini (37.5%), Bing (19.5%), DeepSeek (6.3%), and Grok (4.0%). A large majority of participants (85.5%) indicated that they had used AI tools during lessons or in educational settings.

Purposes of AI Use

When examining the purposes for which students use AI tools, it was found that the most common uses were for preparing assignments (77.3%), acquiring new knowledge (63.8%), and translating texts (56.5%). Less frequent uses included writing articles or reports (45.3%), accessing evidence-based information (33.3%), conducting literature reviews (32.8%), preparing presentations or educational materials (27.5%), and solving problems or practicing questions (27.5%) (Table 1).

Correlation Analysis

Correlation analysis revealed several significant relationships among the study variables. Technostress showed a weak but significant negative correlation with both positive attitudes toward AI ($r = -.13, p < .01$) and negative attitudes ($r = -.26, p < .01$). This indicates that higher levels of technostress are associated with more negative perceptions of AI. Additionally, there was a weak but significant negative correlation between technostress and the *Evaluation* subdimension of AI literacy ($r = -.17, p < .01$), suggesting that students with stronger evaluation skills experience less technostress.

AI literacy was moderately and positively correlated with positive attitudes toward AI ($r = .42, p < .01$). This finding indicates that as students' AI literacy increases, so do their positive attitudes. Conversely, AI literacy showed a weak but significant negative correlation with negative attitudes ($r = -.10, p < .05$), suggesting that higher literacy is associated with fewer negative perceptions.

At the subdimension level, *Awareness* ($r = .24, p < .01$), *Usage* ($r = .42, p < .01$), *Evaluation* ($r = .36, p < .01$), and *Ethics* ($r = .26, p < .01$) were all positively correlated with positive attitudes. This result indicates that students who score higher in AI literacy skills are more likely to hold favorable views of AI. On the other hand, weak but significant negative correlations were found between negative attitudes and the subdimensions of *Awareness* ($r = -.12, p < .05$), *Usage* ($r = -.13, p < .01$), and *Ethics* ($r = -.13, p < .01$). No significant relationship was observed between the *Evaluation* subdimension and negative attitudes. These results suggest that the dimensions of AI literacy support positive attitudes and that subskills like awareness and usage may also serve a protective function against negative perceptions (Table 2).

Table 2.

Correlation Matrix Among Technostress, AILS, positive GAAIS, and negative GAAIS

Variable	1	2	3	4	5	6	7	8
1. Technostress	-							
2. AILS	-.03	-						
3. Awareness	.00	.68*	-					
4. Usage	-.00	.80**	.39**	-				
5. Evaluation	-.17**	.81**	.34**	.58**	-			
6. Ethics	.08	.73**	.33**	.46**	.48**	-		
7. Positive GAAIS	-.13**	.42**	.24**	.42**	.36**	.26**	-	
8. Negative GAAIS	-.26**	-.10*	-.12*	-.13**	.04	-.13**	-.10*	-

'*' indicates $p < .05$.

'**' indicates $p < .01$.

Regression Analysis

The regression analysis presented in Table 3 examined the predictive power of age, GPA, information technology competence, technostress, and both positive and negative attitudes toward AI on AI literacy. The overall model was found to be significant, $F(6,393) = 22.01$, $p < .001$, with an R^2 value of .25, indicating that approximately 25% of the variance in AI literacy could be explained by these variables.

Further examination revealed that GPA ($B = 4.18$, $p < .001$) and information technology competence ($B = 2.71$, $p < .001$) were significant and positive predictors of AI literacy, suggesting that students with higher academic performance and stronger tech skills also had higher AI literacy levels. Positive attitudes toward AI were also found to be a strong and significant predictor ($B = 0.53$, $p < .001$), indicating that favorable perceptions of AI increase literacy scores. In contrast, negative attitudes had a significant negative impact ($B = -0.15$, $p = .036$), showing that negative views decrease AI literacy.

However, neither age ($p = .132$) nor technostress ($p = .824$) had a significant effect on AI literacy. Overall, the findings suggest that the strongest predictors of AI literacy are academic success, information technology proficiency, and positive attitudes toward AI, while negative attitudes have a diminishing effect (Table 3).

Table 3.
Regression Results for Predictors of AILS

<i>Variable</i>	<i>B</i>	<i>SE</i>	<i>95.00% CI</i>	<i>β</i>	<i>t</i>	<i>p</i>
(Intercept)	9.21	7.50	[-5.53. 23.95]		1.22	.220
Age	0.35	.23	[-0.10. 0.81]	.06	1.51	.132
GPA	4.18	1.02	[2.17. 6.19]	.18	4.09	.000
Information technology proficiency	2.71	.63	[1.47. 3.95]	.19	4.30	.000
Technostress	-.10	.04	[-0.09. 0.78]	-.01	-.22	.824
Positive GAAIS	.53	.06	[0.41. 0.65]	.39	8.66	.000
Negative GAAIS	-.15	.07	[-0.29. -0.01]	-.09	-2.10	.036

$F(6, 393) = 22.01$, $p < .001$, $R^2 = .25$

4. RESULTS, DISCUSSION AND RECOMMENDATIONS

4.1. Results and Discussion

This study revealed significant relationships between university students' AI literacy, their attitudes toward AI, and their levels of technostress. The findings indicate that especially positive attitudes and strong digital competencies contribute to higher levels of AI literacy while helping to reduce stress related to technology use. By addressing the interaction between cognitive skills (literacy), emotional tendencies (attitudes), and psychological effects (technostress) in an integrated framework, the study makes a meaningful contribution to the existing literature. It offers a deeper understanding of how higher education students adapt to emerging technologies and highlights the necessity of developing AI literacy programs that go beyond technical skills to also foster ethical awareness and emotional resilience. These findings underline the importance of designing educational programs that are multidimensional in nature to effectively support students in the process of digital transformation.

Attitudes Toward AI and Technostress

The results of this study reveal that technostress plays a significant role in shaping students' perceptions and attitudes toward AI. As technostress increases, students tend to display weaker positive attitudes and stronger negative orientations toward AI. This finding is consistent with prior research, which suggests that technostress functions as an inhibiting factor in the adoption and effective use of emerging Technologies (Saleem et al., 2024; Vallone et al., 2023). Students experiencing high levels of technostress are often reluctant to engage with new technologies, and in the case of AI, this hesitancy may hinder their willingness to learn and apply AI tools in academic contexts, potentially affecting academic performance and digital skill development.

Recent evidence underscores the buffering effect of positive attitudes toward AI on technostress. A positive orientation where students perceive AI as beneficial, useful, and manageable appears to reduce stress, whereas negative attitudes, such as fear, distrust, or avoidance, exacerbate it (Bagaskara et al., 2024; Liřan, 2025). This aligns with studies on "AI anxiety," which

demonstrate that students who approach AI applications with curiosity and optimism report lower psychological discomfort, less perceived risk, and greater willingness to adopt generative AI tools (Almaiah et al., 2022; Zhu et al., 2025). Positive attitudes are theorized to increase adaptive cognitive appraisals, thereby reducing the perception of threat when encountering AI (Ali et al., 2024; Baidoo-Anu & Ansah, 2023; Matyushok et al., 2021). Students with positive attitudes toward AI tend to view challenges as opportunities for learning, whereas those with more negative attitudes may perceive similar situations as obstacles that reinforce their concerns, leading to higher levels of stress.

Empirical studies further highlight attitudes as key predictors of AI-related anxiety. For example, a study in nursing education found that students' general attitude toward AI was the strongest predictor of AI anxiety, with negative orientations particularly driving anxiety among students who lacked prior AI exposure (Ayed et al., 2025). These findings are consistent with technology acceptance models such as TAM and UTAUT, which propose that users' attitudes, shaped by perceived usefulness and ease of use, directly influence their comfort level and stress when adopting technology (Cengiz & Peker, 2025; Venkatesh et al., 2003). Our results complement these frameworks by illustrating that negative attitudes intensify technostress, whereas cultivating positive perceptions may act as a protective factor against stress when using AI in educational settings.

At the same time, the literature highlights that attitudes toward AI are multifaceted (Fan & Zhang, 2024; Zeng et al., 2025; Brauner et al., 2025). Negative attitudes may involve both cognitive components (e.g., skepticism about AI's usefulness) and emotional reactions (e.g., fear of social or personal consequences). Both aspects heighten technostress: skeptical students may feel alienated by mandated AI use, while anxious students may experience panic when interacting with AI tools (Wang & Wang, 2022). Conversely, positive attitudes can reflect curiosity, optimism, or trust, all of which generally reduce stress. However, studies caution that extremely optimistic views may also have downsides. For instance, Sindermann et al. (2022) found that young adults with highly positive attitudes toward AI sometimes exhibited problematic digital behaviors, such as excessive reliance on AI-driven applications (Sindermann et al., 2022). This indicates that balanced positivity seeing AI as valuable but remaining realistic about its limitations is essential. Such an outlook minimizes technostress by reducing fear without creating overdependence.

Importantly, our findings resonate with integrative models that examine AI literacy, attitudes, and stress together. Hsu et al. (2023), for example, proposed a sequential mediation model in which students' positive attitudes and AI literacy mediated the relationship between AI adoption and AI anxiety. Their results suggest that merely introducing AI into education is insufficient: outcomes depend on students' attitudinal and cognitive readiness. If AI adoption is supported by literacy training and attitude cultivation, stress is minimized; without these supports, stress and anxiety are likely to increase (Hsu et al., 2023). Our findings strongly reinforce this interpretation, emphasizing that both affective (attitudes) and cognitive (literacy) dimensions must be addressed to manage technostress effectively.

AI Literacy and Technostress

This study found a negative relationship between the Evaluation dimension of AI literacy (AI literacy) and technostress. The more critically and analytically students are able to evaluate AI tools, the lower their levels of technology-related stress. Recent research also shows that AI literacy strengthens students' relationship with technology and helps reduce technostress. In short, students who have a better understanding of AI experience less stress when interacting with these tools (Chukwuere & Chukwuere, 2024; Feng & Liu, 2024).

Multinational studies conducted among university students emphasize that insufficient ICT skills are among the main causes of technostress and burnout during online learning processes (Mohd Daud, 2024). The rapid advancement of AI tools can make it difficult for students to understand these systems, leading to feelings of uncertainty. However, as students' AI literacy improves, this uncertainty decreases, and they become more resilient in the face of new technologies (Steinbauer et al., 2021).

That said, the literature also suggests that this relationship is not one-dimensional. Individuals with high AI knowledge may become more aware of complex issues such as algorithmic bias, ethical concerns, and privacy risks, and this awareness itself can become a new source of stress (Stahl & Wright, 2018; Zhan et al., 2024). Therefore, AI literacy programs should not only focus on technical skills but also include ethical awareness and emotional resilience training.

In conclusion, AI literacy offers students significant advantages in understanding technology and managing the stress that comes with it. However, developing this competency should be approached through carefully structured and supportive strategies (Long & Magerko, 2020).

AI Literacy and Attitudes Toward AI

This study identified a significant relationship between AIL and students' attitudes toward AI. The findings show that students with higher levels of AIL tend to develop more positive attitudes toward AI technologies and experience lower levels of technostress. This suggests that digital competencies shape not only technical skills but also individuals' emotional responses and attitudes toward technology (Feng & Liu, 2024; Ng et al., 2021). Students with greater knowledge of AI tend to express less fear or skepticism, while those with limited understanding are more likely to hold negative attitudes such as mistrust or anxiety.

Ng et al. (2021) observed that individuals with low AI literacy struggled to recognize or use AI-related tools effectively, indicating that a lack of knowledge and negative attitudes often co-occur. (Ng et al., 2021). Long and Magerko (2020) further emphasize that AI literacy not only enhances technical understanding but also transforms how individuals think about AI; increasing knowledge, education, and analytical ability tends to foster more positive perceptions (Long & Magerko, 2020; Steinbauer et al., 2021). Accordingly, AI literacy education should incorporate not only technical content but also critical thinking, ethical awareness, and emotional readiness.

Moreover, the relationship between attitudes and literacy may be bidirectional. Positive attitudes toward AI can motivate individuals to learn more, increasing their literacy levels (Lacity & Willcocks, 2016). This is consistent with technology acceptance models (e.g., UTAUT), which suggest that past experience and perceived usefulness significantly shape user attitudes (Cengiz & Peker, 2025; Venkatesh et al., 2003). However, having a positive attitude does not always eliminate anxiety. In a study by Ayed et al. (2025), nursing students in Palestine expressed generally positive views of AI in healthcare, but also reported high levels of AI-related anxiety (Ayed et al., 2025). This paradox reveals that superficial positivity may coexist with underlying fears, such as concerns about job displacement or feeling unprepared to use AI tools. Therefore, AI education should address both cognitive and emotional aspects, equipping students not just with knowledge but also with the confidence and coping skills needed to manage AI-related challenges.

In conclusion, AI literacy plays a critical role in shaping students' attitudes and emotional responses to technology. Yet, given the complex and dynamic nature of this relationship, AI education should adopt a holistic approach that integrates knowledge, skills, ethical sensitivity, and psychological support.

AI Literacy Predictors Among Undergraduate Students

The regression findings are consistent with the growing body of literature on students' digital competence and technology adoption. Prior research indicates that students with higher academic performance often demonstrate stronger digital and technical skills, which supports the result that higher GPA predicts greater AI literacy. Recent studies have similarly reported that digital or digital-learning literacy positively influences college grades; for example, Chen et al. (2025) found that undergraduate digital literacy significantly and positively predicts GPA. Likewise, nursing students who feel confident in their digital abilities tend to achieve higher academic outcomes (Clercq et al., 2013; Hayat et al., 2020; Ulfert-Blank & Schmidt, 2022). These findings suggest that students with well-developed academic habits may also possess effective study strategies and stronger self-efficacy, which can facilitate the acquisition of new technologies.

A contrasting pattern was reported by Mansoor et al. (2024), who observed that lower-GPA students showed higher self-reported AI familiarity; however, the authors attributed this to at-risk students' overreliance on AI tools without critical engagement. In the present study, the positive association between GPA and AI literacy aligns with the broader literature on 21st-century skills. Strong information-technology proficiency likewise augments AI literacy. Our students' tech-confidence reflects digital competence that TAM/UTAUT models identify as crucial for new-technology uptake. In other words, learners comfortable with computers and online tools tend to engage more deeply with AI. Sergeeva et al. (2025) emphasize that individuals with advanced digital literacy "exhibit greater confidence in utilizing technology," which fosters more positive attitudes toward generative AI (Sergeeva et al., 2025). Rodafinos et al. (2024) likewise found that basic ICT skills strongly predict students' intention and willingness to use learning technologies (Rodafinos et al., 2024), even if the link to grades was indirect. Taken together, these studies suggest that undergraduates who are competent with digital media and devices can more easily acquire and apply AI concepts, explaining our finding that IT proficiency is a significant AI literacy predictor.

Attitudes toward AI powerfully modulated students' literacy in our model. This too echoes prior work: positive AI attitudes are consistently linked to greater engagement and understanding. Bewersdorff et al. (2025) report that favorable attitudes toward AI substantially boost students' interest and self-efficacy around AI (Bewersdorff et al., 2025). More directly, Cengiz and Peker (2025) found that a positive attitude toward AI "can positively affect AI literacy," while negative attitudes do the opposite. In their structural model, negative AI attitudes significantly reduced AI literacy scores (Cengiz & Peker, 2025). These findings are consistent with technology-acceptance theory: students who view AI optimistically are more likely to try and learn it, whereas distrust or anxiety about AI creates a barrier to skill development.

Overall, the findings indicate that AI literacy among undergraduates is shaped by a combination of academic skills, technical competencies, and affective dispositions. This pattern aligns with evidence reported across multiple countries; for example, studies from China and Russia demonstrate that digital-literacy competencies support learning outcomes (Chen, 2025; Sergeeva et al., 2025), while Western surveys document similar associations between AI-related attitudes and efficacy (Bewersdorff et al., 2025). The contribution of the present study lies in illustrating how these factors operate simultaneously within a single regression model, suggesting that students with higher academic achievement, stronger digital backgrounds, and more positive attitudes toward AI may be better prepared for AI-integrated learning environments. These results further imply that educational programs aiming to enhance AI literacy should extend beyond teaching AI concepts to strengthening general academic skills and fostering balanced, realistic attitudes toward AI. In summary, the findings are consistent with previous research indicating that 21st-century learning depends on multifaceted digital competence (Chen, 2025; Khan et al., 2022), and they highlight that the promotion of AI literacy requires integrating both skill development and attitudinal components.

4.2. Limitations and Recommendations

This study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design restricts causal inferences. Although significant associations were identified between AI literacy, attitudes toward AI, and technostress, the directionality of these relationships cannot be determined. Longitudinal or experimental research designs are recommended to better capture causal pathways and the temporal dynamics of these variables. Second, the study was conducted at a single university in Türkiye, which may limit the generalizability of the results. Although the sample size was adequate and included students from various faculties, cultural and institutional characteristics may have influenced participants' experiences with AI. Future research would benefit from multi-center and cross-cultural studies to enhance external validity and enable international comparisons. Third, all data were collected through self-report instruments, which may introduce biases such as social desirability or inaccuracies in participants' perceptions of their digital competence and attitudes. The incorporation of mixed-methods approaches such as behavioral tracking of AI tool use, qualitative interviews, or focus groups could provide deeper insights into actual practices and subjective experiences. Fourth, the focus of the study was primarily on cognitive and attitudinal dimensions of AI integration. Other contextual factors, including institutional support, instructional strategies, and access to technological resources, were not examined. Future studies may expand the scope to include these structural variables, which are likely to play an important role in shaping students' adaptation to AI technologies.

Based on these limitations, several recommendations can be made. Higher education institutions are encouraged to develop and implement AI literacy programs that extend beyond technical training to include ethical awareness, emotional resilience, and strategies for managing technostress. Educators may support the development of balanced attitudes toward AI by emphasizing both its opportunities and potential risks, thereby preventing excessive anxiety or overreliance. Policy makers and curriculum designers should consider integrating AI-related content across disciplines to ensure that students from diverse academic fields acquire competencies necessary for future professional and civic life. Finally, collaboration among researchers, practitioners, and technology developers is essential for creating evidence-based interventions that promote students' digital well-being and academic success in the AI era.

Research and Publication Ethics Statement

The study was carried out in accordance with ethical principles governing research with human participants. Ethical approval was obtained from the Scientific Research and Publication Ethics Committee of Artvin Çoruh University prior to data collection (Approval Date: 13 June 2025, Decision No: E-18457941-050.99-181922).

Contribution Rates of Authors to the Article

The research was prepared by a single author

Statement of Interest

There is no conflict of interest.

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