



# Investigating the relationship between university students' attitudes toward artificial intelligence and their artificial intelligence literacy

Roza Sh. Akhmadieva <sup>1</sup>

 [0000-0002-1583-3975](https://orcid.org/0000-0002-1583-3975)

Regina G. Sakhieva <sup>2\*</sup>

 [0000-0003-2585-6174](https://orcid.org/0000-0003-2585-6174)

Maria A. Khvatova <sup>3,4</sup>

 [0000-0002-2156-8805](https://orcid.org/0000-0002-2156-8805)

Natalya S. Erokhova <sup>5</sup>

 [0000-0002-8061-8112](https://orcid.org/0000-0002-8061-8112)

Zhanna M. Sizova <sup>6</sup>

 [0000-0002-1242-7074](https://orcid.org/0000-0002-1242-7074)

Natalya N. Shindryaeva <sup>6</sup>

 [0000-0001-6560-2756](https://orcid.org/0000-0001-6560-2756)

<sup>1</sup> Kazan State Institute of Culture, Kazan, RUSSIA

<sup>2</sup> Kazan (Volga region) Federal University, Kazan, RUSSIA

<sup>3</sup> Bauman Moscow State Technical University, Moscow, RUSSIA

<sup>4</sup> National Research University "Moscow Power Engineering Institute", Moscow, RUSSIA

<sup>5</sup> Peoples' Friendship University of Russia (RUDN University), Moscow, RUSSIA

<sup>6</sup> Sechenov First Moscow State Medical University, Moscow, RUSSIA

\* Corresponding author: [saxievarg@mail.ru](mailto:saxievarg@mail.ru)

**Citation:** Akhmadieva, R. Sh., Sakhieva, R. G., Khvatova, M. A., Erokhova, N. S., Sizova, Z. M., & Shindryaeva, N. N. (2026). Investigating the relationship between university students' attitudes toward artificial intelligence and their artificial intelligence literacy. *Contemporary Educational Technology*, 18(2), Article ep644. <https://doi.org/10.30935/cedtech/18082>

## ARTICLE INFO

Received: 7 Sep 2025

Accepted: 16 Jan 2026

## ABSTRACT

This study aims to examine the relationship between university students' attitudes towards artificial intelligence (AI) and AI literacy levels. A quantitative research method was used using the relational survey model to determine whether students' attitudes of AI, both positive and negative, were related to their understanding and application (literacy) of AI concepts. The data were collected with the *AI attitude scale* and the *AI literacy scale*. The data were analyzed using descriptive statistics, comparative analyses, correlation analysis, and multinomial logistic regression analysis to determine the strength and nature of the relationship between AI attitudes and literacy. The results of the research determined that the students generally had a moderate level of AI literacy, their positive attitudes were high and their negative attitudes were moderate. It was determined that male students and upper-grade students had higher AI literacy and positive attitudes, while engineering and social sciences students had more positive perspectives among disciplines. Correlation analyses show that there are significant positive relationships between AI literacy and positive attitude, and negative relationships between negative attitudes. The model explains the AI literacy level with a rate of 38.6%. According to the findings of the research, it is recommended that university administrations offer course contents, workshops and certificate programs that will increase AI literacy by considering discipline-based differences. It is recommended to disseminate informative and guiding activities, especially in areas where negative attitudes are high, such as health sciences. On the other hand students should make individual efforts to learn not only the user level, but also the

---

technical, ethical and social dimensions of AI. It is important for them to evaluate technology in line with the principles of critical thinking, ethical awareness and digital responsibility.

**Keywords:** artificial intelligence, AI literacy, attitudes, university students, technology in education, digital competency

## INTRODUCTION

---

Today, with the development of technology, artificial intelligence (AI) is effective not only in the field of engineering or computer science, but also in all of social life. This transformation not only shapes the daily lives of individuals, but also affects education systems, learning processes and students' preparation for the profession (Luckin et al., 2016). University students' attitudes towards AI technologies and their level of knowledge, skills, and awareness about these technologies are critical for the development of their educational opportunities and future professional competencies (Park & Woo, 2022). AI-based learning environments provide students with personalized learning opportunities and support them to learn more deeply by reducing their cognitive load (Zawacki-Richter et al., 2019). In this context, the concept of AI literacy has become at the center of today's understanding of education and has started to shape a new educational paradigm.

University students' attitudes towards AI technologies help us understand how they perceive these technologies, to what extent they adopt them, and to what extent they use them in their daily lives (De Freitas et al., 2023). Attitude is the set of cognitive, affective, and behavioral tendencies that an individual develops towards a specific object or situation (Kerschner & Ehlers, 2016; Teo, 2011). In this context, students' positive or negative attitudes towards AI can directly affect their motivation to learn about AI technologies, their intentions to use it, and ultimately their AI literacy levels. AI literacy means that individuals can understand, evaluate, and use AI systems effectively and ethically (Long & Magerko, 2020). This competence is not only limited to technical knowledge, but also requires an understanding of the social, ethical and cultural dimensions of AI. In other words, AI literacy means that the individual develops awareness about AI, gains critical thinking skills, and interacts effectively with these technologies (Çelebi et al., 2023).

In the literature, it has been emphasized in many studies that students' attitudes towards technology are significantly related to their technological literacy levels (Li, 2017; Liu, 2010). In this context, understanding the relationship between attitudes towards AI and AI literacy can contribute to more effective design of educational policies and curricula. The integration of AI into learning-teaching processes holds many opportunities but also various challenges at the university level (Zawacki-Richter et al., 2019). However, in order for these technologies to be used effectively pedagogically, students must be able to understand these systems correctly and evaluate them critically. At this point, AI literacy is among the essential skills of the digital age. In this context, the aim of the study is to examine the relationship between university students' attitudes towards AI and their AI literacy.

### Attitude Towards Artificial Intelligence

Attitudes towards AI are the totality of cognitive (knowledge and beliefs), affective (emotions and values) and behavioral (intention and tendency to use) tendencies developed by individuals regarding AI technologies (Long & Magerko, 2020, p. 2). In this framework, the attitude towards AI reflects the individual's way of evaluating technology not only as a tool, but also with its social and cultural contexts. Especially in the context of education, this attitude emerges as a critical factor affecting students' motivation to learn and use AI (Kim & Lee, 2024). Research shows that there are many factors that shape individuals' attitudes towards AI. Among these factors, personality traits, demographic variables, education level, and individuals' past experiences with technology play an important role (Derinalp & Ozyurt, 2024; Katsantonis & Katsantonis, 2024). It can be said that individuals who are open-minded and positive towards innovations have more positive attitudes towards AI. Similarly, it has been observed that individuals with low AI anxiety show more interest in these technologies and have less difficulty in implementing them (Schepman & Rodway, 2020). In the development of attitudes towards AI, the level of exposure of individuals to AI technologies also plays a major role. Yüzbaşıoğlu (2021) states that pre-service teachers who actively use AI technologies in their educational processes develop more

positive attitudes towards these technologies. In addition, individuals who are not sufficiently exposed to AI may be more concerned about the complexity and obscurity of these technologies.

Cultural and social context has a significant impact on shaping attitudes towards AI. Kim and Lee (2024) state that different cultural values influence how individuals view the role of AI in education. While the integration of education systems with innovative technologies in developed societies may have created a more optimistic attitude towards AI, it may lead to more cautious approaches in cultures where technological infrastructure and awareness of AI are more limited (Dos Santos et al., 2019; Sindermann et al., 2021). Given that attitudes towards AI have a decisive impact on individuals' propensity to use these technologies, it can be argued that these differences need to be balanced by educational policies and programs.

A major source of negative attitudes towards AI is anxiety and distrust of these technologies. Park and Woo (2022) defined AI anxiety as the fear or anxiety that individuals feel about these technologies, emphasizing that this has a negative impact on AI adoption. This type of anxiety is often due to individuals not having enough knowledge or misunderstandings regarding these technologies. Studies conducted especially among higher education students have found that positive attitudes towards the potential benefits of AI in education are more common among students who understand and use technology (Katsantonis & Katsantonis, 2024). However, attitudes towards AI are shaped not only by knowledge or experience at the individual level, but also by the societal and cultural context (Kim & Lee, 2024). Perceptions that AI can render some professions dysfunctional or create ethical problems can lead individuals to develop a negative attitude towards these technologies. To alleviate these concerns, higher education programs need to provide clear and accurate information about AI and make students aware of the advantages and limitations of these technologies (Oksanen et al., 2023; Suh & Ahn, 2022). Attitudes towards AI are shaped not only by technological skills, but also by ethical and social awareness. Yüzbaşıoğlu (2021) stated that another reason why individuals have distrust of AI is that they believe that these technologies have ethical problems. Issues such as data privacy, algorithmic biases, and the potential effects of AI on society influence pre-service teachers' perceptions of these technologies.

### Artificial Intelligence Literacy

AI literacy is a multidimensional concept that encompasses the knowledge and skills necessary for individuals to understand, critically evaluate, and effectively use AI technologies (Jiang et al., 2024; Ndungu, 2024). In the context of education, AI literacy both increases students' and academics' awareness of these technologies and allows them to integrate them appropriately into pedagogical processes (Kong et al., 2023). It is not enough to focus solely on technical skills in defining AI literacy, it is also important for individuals to develop ethical awareness, comprehend the societal implications of AI, and use these technologies consciously (Shiri, 2024).

Technological understanding, as the first component of AI literacy, enables individuals to understand how AI systems work and how algorithms are structured (Bian et al., 2024). This includes learning how algorithmic decision-making processes work and how AI drives human decisions. Ethical assessment requires individuals to analyze the societal impacts of AI and critically evaluate the effects of these technologies on rights, privacy, and equality (Pente et al., 2022). The scope of AI literacy includes the ability of individuals to go beyond understanding technology and critically evaluate the transformations created by these technologies at the social and individual level (Celik, 2023). In the context of education, this literacy enables students not only to be equipped with technology, but also to question the limits and potentials of these technologies. While data privacy has become a priority issue in the design of AI-based tools, students are expected to adopt an ethical framework when using these tools (Ndungu, 2024). AI literacy for educators plays a critical role in both preparing students for the digital age and using AI-based tools effectively in classrooms. Therefore, increasing AI literacy in higher education has become an indispensable part of modern education. Kong and Abelson (2022) define AI literacy as a process that enhances students' conceptual understanding and makes them critical users of technology. In this context, AI literacy should not be limited to teaching the use of technological tools, it should also encourage individuals to understand the mathematical and logical processes behind these tools. Such an approach will allow college students to use AI-based tools more consciously.

An important dimension of AI literacy is ethical awareness. Shiri (2024) emphasizes the need to address ethical issues in the use of AI and the importance of sensitizing individuals to issues such as data privacy,

algorithmic biases, and societal inequalities. Higher education students' use of AI technologies in an ethical framework has a positive impact on students. For example, a user who can understand issues such as data privacy breaches can take a more informed stance against such issues and offer a safer learning environment. In addition, by gaining awareness of the societal impacts of AI, students can make more responsible decisions and guide them in the use of these technologies.

AI literacy should also be considered as an educational component that strengthens individuals' sense of social responsibility. Yetişensoy and Rapoport (2023) state that AI literacy in education enables students to contribute more consciously to the digital transformation in society. Lu et al. (2024) reveal that AI literacy improves individuals' critical thinking, problem-solving, and creative thinking skills. These skills can allow them to develop innovative teaching strategies in the educational setting. Increasing AI literacy is an important step to reduce students' anxiety about these technologies and enable them to use these tools more effectively. Park and Woo (2022) state that AI anxiety stems from individuals' lack of knowledge and inexperience with these technologies. By experiencing AI-based tools in real classroom scenarios to reduce this type of anxiety, students can better understand the potential of these tools and use them more creatively.

Education systems encourage students to adopt AI not only as a tool, but also as a framework for thinking about social, cultural, and interdisciplinary problems (Yim, 2024). Creative disciplines such as architecture, fine arts faculties, and literature offer a unique platform where AI is integrated with aesthetic and creative processes, while at the same time creating a ground for ethical and creative inquiries (Pente et al., 2022).

### **Purpose and Importance of the Research**

Related studies reveal that the relationship between university students' computer proficiency and their attitudes towards AI and AI literacy is significant and strong. In their study on the use of AI technologies in the field of health, Stewart et al. (2023) showed that the technological skills of university students directly affect their attitudes towards AI. Similarly, Kim and Lee (2024) state that individuals with a high level of computer proficiency are less concerned about AI and use these technologies more effectively and consciously. These findings show that technological competence is a fundamental factor that shapes individuals' perceptions of new generation digital technologies, thus increasing their capacity to use these technologies in education, research and professional development processes. Likewise, Kong et al. (2023) state that technological competence is a prerequisite for improving individuals' AI literacy levels. Accordingly, it has been observed that individuals with advanced technological skills can better understand AI systems, use these systems more effectively and are more successful in developing ethical awareness.

When evaluated in terms of university students, their proficiency levels regarding digital tools directly affect their attitudes towards AI technologies and how they evaluate these technologies in their education processes. AI literacy is not only limited to the ability to use tools but also plays a role as a determining factor in shaping perceptions, motivations, and attitudes towards these tools (Alemdag et al., 2020). In this context, revealing the AI literacy level of university students and their attitudes towards AI technologies can increase their ability to develop these technologies and use these technologies more consciously for academic and professional purposes. In a study of employees, Lichtenthaler (2020) found that individuals who believed AI had the potential to improve their daily workflows showed less resistance to the use of AI. Similarly, studies among students have shown that if AI is seen as a tool to facilitate learning processes, students develop a more positive attitude towards these technologies (Kim & Lee, 2024).

Educators and curricula also have a significant impact on students' attitudes towards AI. A study by Yue et al. (2024) reveals that how teachers introduce AI technologies within the framework of technological pedagogical content knowledge plays a decisive role in students' attitudes towards these technologies. Thus, it can be said that attitudes towards AI are not only individual but also related to the general structure and culture of education systems. There may be differences between the attitudes of students from different disciplines towards AI and their literacy levels. In this study, comparisons can be made especially between students studying science, engineering, social sciences and education faculties. Thus, suggestions can be developed for the interdisciplinary dissemination of AI education and increasing its applicability in different fields.

In addition, the research will also analyze how students perceive AI technologies in terms of ethical, cultural and societal aspects, providing important clues about the level of critical awareness required for the sustainable use of these technologies. This awareness is of great importance in terms of developing digital responsibility awareness not only at the individual level but also at the societal level. In this context, examining the relationship between university students' attitudes towards AI and their AI literacy allows us to better understand the relationship between individuals and technology in the digital age. The results of the research will both guide higher education policies and facilitate students' adaptation to technological transformation. Therefore, the findings of this research have the potential to guide the design of future education systems.

The aim of this study is to examine the relationships between university students' attitudes towards AI and their AI literacy. In this context, answers to the following questions were sought:

1. What is the level of AI literacy and AI attitudes?
2. Do AI literacies and AI attitudes differ according to the gender of students?
3. Do AI literacies and AI attitudes differ by grade level?
4. Do AI literacies and AI attitudes differ according to the discipline in which the student is studying?
5. Is there a relationship between university students' AI literacy and AI attitudes?
6. Do demographic variables and AI attitude scores affect students' high, medium and low AI literacy levels?

## METHOD

### Model of the Research

In this study, relational survey model, one of the quantitative research methods, was used. This model is used to determine the relationship between two or more variables without any intervention. Thanks to this approach, potential relationships between variables can be analyzed and predictions can be made in line with the data obtained (Creswell, 2012).

### Universe and Sample

The population of the study is students who continue their university education in the Eurasian Region in the 2024-2025 academic year. In this context, a total of 386 students studying at 2 different universities and responding to online forms were included in the study (14 of the students who were sent the form did not fill in). Demographic information about the students is presented in **Table 1**.

According to **Table 1**, looking at the age distribution of 386 university students, it was determined that 28.8% were in the 18-20 age range, 23.3% were in the 21-23 age range, 23.1% were in the 24-26 age range and 24.9% were 27 years and over. When the gender variable is examined, it is seen that 51.6% of the participants are female and 48.4% are male. When the distribution of the participants in the fields they received training was examined, 19.2% of them are studying science, 23.3% of them are studying social sciences, 19.2% of them are studying health sciences, 19.4% of them are studying engineering sciences and 18.9% of them are studying in other sciences.

When the distribution by grade level is examined, it is seen that 28.5% of the participants are 1<sup>st</sup> grade students, 23.6% are 2<sup>nd</sup> year students, 25.1% are 3<sup>rd</sup> year students, and 22.8% are 4<sup>th</sup> year students. In the evaluation made in terms of the technological tools used by the participants, it was found that 33.4% of them used smartphones, tablets and computers together, 26.7% had smartphones and computers, 17.9% have smartphones and tablets, it was determined that 13.7% used only computers and 8.3% only smartphones. According to the findings on the most used AI tools, 24.6% of the participants prefer ChatGPT, 15.5% prefer Google Gemini (Bard), and 12.4% prefer Microsoft Copilot. Although the usage rates of other tools are relatively low, it is understood that many different AI applications are actively used by students.

### Data Collection Tools

In the study, personal information form, AI attitude scale and AI literacy scale were used as data collection tools.

**Table 1.** Demographic information of the sample

Variable	Category	Frequency (N)	Percentage (%)
Age	18-20 years old	111	28.8
	21-23 years old	90	23.3
	24-26 years old	89	23.1
	27 years and older	96	24.9
Gender	Female	199	51.6
	Male	187	48.4
Student discipline	Science	74	19.2
	Social sciences	90	23.3
	Health sciences	74	19.2
	Engineering sciences	75	19.4
	Other sciences	73	18.9
Grade level	Grade 1	110	28.5
	Grade 2	91	23.6
	Grade 3	97	25.1
	Grade 4	88	22.8
Technology tool used	Smartphone, tablet, computer	129	33.4
	Smartphone, computer	103	26.7
	Smartphone, tablet	69	17.9
	Computer	53	13.7
	Smartphone	32	8.3
AI tools*	ChatGPT	127	24.6
	Google Gemini (Bard)	80	15.5
	Microsoft Copilot	64	12.4
	Midjourney	48	9.4
	DALL·E	44	8.6
	Grammarly	40	7.6
	Notion AI	37	7.3
	Canva AI	33	6.5
	Jasper AI	21	4.2
Claude (Anthropic)	20	3.9	

\* Since a participant can specify more than one AI tool, the total number of uses is greater than the number of students

### Personal information form

It is a form developed by the researcher in which the purpose of the research and data security are explained to the participants and voluntary participation is specified. In addition, information about the age, gender, field of education, grade level, vehicle used and the most frequently used AI tools of the participants were asked in this section.

### AI attitude scale

The *AI attitude scale*, developed by Schepman and Rodway (2020), consists of 20 items divided into two sub-dimensions. Positive attitudes (12 items) and negative attitudes (8 items) are scored on a 5-point Likert scale. The highest score that can be obtained from a positive attitude is 60 and the lowest score is 12. The highest score that can be obtained from a negative attitude is 40 and the lowest is 8. No total score is taken from the scale. The internal consistency reliability coefficients of the scale were 0.88 for positive attitudes and 0.83 for negative attitudes.

### AI literacy scale

The second tool is the *AI literacy scale*, developed by Laupichler et al. (2023). It contains 31 items and three sub-dimensions. These are technical understanding (14 items), critical evaluation (10 items) and practical application (7 items). Items are rated on a 7-point Likert scale, with higher scores indicating higher AI literacy. Reliability coefficients of scale range from 0.97 to 0.98 for the sub-dimensions and 0.99 for the overall scale.

### Data Collection and Analysis

The data were collected in the form of an online form in the spring semester of the 2024-2025 academic year. After the data collection process was completed, before the data obtained were analyzed electronically,

**Table 2.** Descriptive statistics of AI literacy scale and AI attitude scale

Scale	N	M	SD
AI literacy	386	2.82	0.32
Scale of attitude towards AI			
Positive attitude towards AI	386	3.72	0.82
Negative attitude towards AI	386	3.20	0.84

**Table 3.** Findings on the difference in AI literacy and attitude according to the gender variable

	Gender	N	M	SD	t	p
AI literacy	Male	187	2.89	0.25	5.06	0.00*
	Female	199	2.63	0.23		
Positive attitude towards AI	Male	187	3.76	0.88	2.65	0.02*
	Female	199	3.57	0.81		
Negative attitude towards AI	Male	187	3.25	0.86	1.42	0.16
	Female	199	3.17	0.84		

it was checked whether the scale forms were filled in appropriately. The analysis of the data collected with scale forms was analyzed with the help of SPSS for Windows 26.0 program. For the study, firstly, the reliability level of the scales was tested and evaluated with the Cronbach's alpha coefficient and it was determined that the coefficient was above 0.70 and it was found to be at an adequate level (George & Mallery, 2003). As a result of the analysis made to show that the distribution of the scales is normal, it was determined that the kurtosis and skewness coefficients were sufficient. These values meet the reference values in the range of -2 to +2 recommended by HahsVaughn and Lomax (2020). In order to determine the relationship between the scales and the independent variables, the students participating in the study were analyzed and compared with the parametric tests, independent sample t-test and ANOVA test. In addition, the relationships between students' AI literacy and AI attitude scores were tested by Pearson correlation analysis. In the study, university students' AI literacy levels were low, medium and high level literacy groups (low between 1.0-3.4, medium between 3.4-5.2 and high between 5.2-7.0) (Elçiçek, 2024). The predictive powers of predictive variables to be in one of the literacy groups were examined by multi-categorical logistic regression analysis.

## RESULTS

In this section, the findings obtained by analyzing the data obtained from the AI literacy and attitude scales towards AI applied to the university students participating in the research are included. The mean (M) and standard deviation (SD) values of the answers given to the applied scales are shown in **Table 2**.

According to **Table 2**, it was seen that the overall average of the AI literacy scale was 2.82. Within the scope of the AI attitude scale, the average positive attitude of the students was at a high level with 3.72, while the average negative attitude was found to be 3.20. The findings show that students generally have a positive outlook on AI, but there are also some negative perceptions and concerns.

The findings on whether there was a significant difference in students' AI literacy and attitude scores according to the gender variable were presented in **Table 3**.

According to **Table 3**, when AI literacy scores are analyzed by gender, it is seen that the M score of male students (M = 2.89) is significantly higher than that of female students (M = 2.63) ( $t = 5.06, p < .001$ ). Similarly, in the dimension of positive attitudes towards AI, the M of male students (M = 3.76) was significantly higher than that of female students (M = 3.57) ( $t = 2.65, p < .05$ ). However, there was no statistically significant difference between male (M = 3.25) and female (M = 3.17) students in the dimension of negative attitudes towards AI ( $t = 1.42, p > .05$ ).

The findings on whether there was a significant difference in students' AI literacy and attitude scores according to the class variable were presented in **Table 4**. According to **Table 4**, AI literacy scores differed significantly by grade level ( $F = 3.32, p < .001$ ). When the average scores are examined, it is seen that the AI literacy levels of 4<sup>th</sup> grade students are significantly higher than both 1<sup>st</sup> grade (M = 2.57) and 2<sup>nd</sup> grade (M = 2.61) students (M = 3.14). In addition, the average score (M = 3.01) of 3<sup>rd</sup> grade students is higher compared to 1<sup>st</sup> grade and 2<sup>nd</sup> grade students. These findings reveal that students' AI literacy levels increase significantly as the grade level progresses.

**Table 4.** Findings on difference in AI literacy scale and AI attitude scale scores in terms of grade level variable

	Learning discipline	N	M	SD	F	p	Direction of difference
AI literacy	Grade 1	110	2.57	0.45	3.32	0.00*	4 <sup>th</sup> grade > 1. class
	Grade 2	91	2.61	0.54			4 <sup>th</sup> grade > 2. class
	Grade 3	97	3.01	0.61			3 <sup>rd</sup> grade > 1. class
	Grade 4	88	3.14	0.72			3 <sup>rd</sup> grade > 2. class
Positive attitude towards AI	Grade 1	110	3.42	0.65	2.75	0.04*	4 <sup>th</sup> grade > 1. class
	Grade 2	91	3.74	0.84			4 <sup>th</sup> grade > 2. class
	Grade 3	97	3.81	0.93			3 <sup>rd</sup> grade > 1. class
	Grade 4	88	3.89	0.71			
Negative attitude towards AI	Grade 1	110	3.17	0.66	1.15	0.12	-
	Grade 2	91	3.26	0.77			
	Grade 3	97	3.23	0.78			
	Grade 4	88	3.16	0.62			

\* p &lt; 0.05

**Table 5.** Findings on difference in AI literacy scale and AI attitude scale scores in terms of discipline variable

	Grade level	N	M	SD	F	p	Direction of difference
AI literacy	Science	74	2.70	0.29	4.23	0.00*	Social sciences > health sciences
	Social sciences	90	2.92	0.33			Social sciences > other sciences
	Health sciences	74	2.66	0.30			Engineering sciences > health sciences
	Engineering sciences	75	2.96	0.36			Engineering sciences > other sciences
	Other sciences	73	2.69	0.32			Engineering sciences > natural sciences
Positive attitude towards AI	Science	74	3.78	0.80	3.97	0.00*	Engineering sciences > health sciences
	Social sciences	90	3.83	0.83			Engineering sciences > other sciences
	Health sciences	74	3.65	0.78			Social sciences > other sciences
	Engineering sciences	75	3.89	0.89			Natural > health sciences
	Other sciences	73	3.60	0.76			Science > other sciences
Negative attitude towards AI	Science	74	3.15	0.82	3.12	0.03*	Health sciences > others
	Social sciences	90	3.18	0.86			
	Health sciences	74	3.35	0.88			
	Engineering sciences	75	3.17	0.83			
	Other sciences	73	3.22	0.85			

A significant difference was also found in the dimension of positive attitudes towards AI according to grade level ( $F = 2.75$ ,  $p < .05$ ). According to the M values, 4<sup>th</sup> grade students ( $M = 3.89$ ) have a higher level of positive attitudes than both 1<sup>st</sup> grade ( $M = 3.42$ ) and 2<sup>nd</sup> grade ( $M = 3.74$ ) students. Likewise, the M score of the 3<sup>rd</sup> grade students ( $M = 3.81$ ) was significantly higher than the 1<sup>st</sup> grade students. This result shows that students develop a more positive attitude towards AI as the learning process progresses. On the other hand, there was no statistically significant difference in terms of negative attitude scores towards AI by grade level ( $F = 1.15$ ,  $p > .05$ ). This finding suggests that negative attitudes remain consistent throughout the learning process.

The findings on whether AI literacy and AI attitudes differ according to the discipline (field of study) of the student are presented in **Table 5**.

As can be seen in **Table 5**, according to the results of ANOVA and post-hoc test, AI literacy scores differed significantly according to students' learning areas ( $F = 4.23$ ,  $p < .001$ ). When the average scores were examined, it was determined that the AI literacy levels of the students studying in the field of engineering sciences ( $M = 2.96$ ) were significantly higher than the students studying in the fields of health sciences ( $M = 2.66$ ), science ( $M = 2.70$ ) and other sciences ( $M = 2.69$ ). Similarly, it is seen that social sciences students ( $M = 2.92$ ) have higher AI literacy compared to students in health sciences and other sciences. These findings reveal that students, especially those studying in the field of engineering and social sciences, are more competent in understanding and using AI technologies.

Positive attitude scores towards AI also differ significantly according to the discipline variable ( $F = 3.97$ ,  $p < .001$ ). It was found that students of engineering sciences ( $M = 3.89$ ) had a higher level of positive attitude than students in health sciences ( $M = 3.65$ ) and other sciences ( $M = 3.60$ ). Similarly, students of social sciences ( $M = 3.83$ ) and natural sciences ( $M = 3.78$ ) have more positive attitudes compared to students in other sciences and health sciences. This shows that interdisciplinary differences affect perceptions and approaches to AI. A

**Table 6.** Findings on relationship between AI literacy scale and AI attitude scale scores of university students

Variables	AI literacy	Positive attitude towards AI	Negative attitude towards AI
AI literacy	1		
Positive attitude towards AI	.642**	1	
Negative attitude towards AI	-.534**	-.287*	1

\* p < .05  
 \*\* p < .01



**Figure 1.** Heatmap on the relationship between AI literacies and AI attitudes (Figure created by the authors)

**Table 7.** Model likelihood values

	-2 log likelihood	Chi-square	Sd	p
Constant	716.845			
Finale	585.363	101.482	40	0.000*

statistically significant difference was found in the dimension of negative attitudes towards AI according to the learning areas ( $F = 3.12, p < .05$ ). In particular, health sciences students ( $M = 3.35$ ) have a higher level of negative attitude towards AI compared to students in other fields. No significant differences were identified between other areas. This finding shows that health sciences students' concerns and reservations about AI applications are higher than other disciplines.

The results of the correlation analysis for the relationship between AI literacy and AI attitudes of university students are presented in **Table 6**.

The results of the correlation analysis in **Table 6** show that there is a positive and strong relationship between AI literacy and positive attitude towards AI ( $r = .642, p < .01$ ). In addition, a significant and negative relationship was found between AI literacy and negative attitudes towards AI ( $r = -.534, p < .01$ ). Finally, a significant negative relationship was found between positive attitude and negative attitude towards AI ( $r = -.287, p < .05$ ).

**Figure 1** shows the heatmap on the relationship between AI literacies and AI attitudes.

The last research question, students' high, medium and low AI literacy levels, was examined with Multinomial Logistic Regression for the effect of demographic variables and AI attitude scores. The likelihood ratio test is used to measure the significance of an independent variable in the logistic regression model.

As can be seen in **Table 7**, the -2log likelihood (-2log likelihood) fit index shows the predicted model fit. This value is 716.845 in constant and 585.363 in final. According to Hair et al. (2006), -2ln in the evaluation of the possibility difference of log, the difference between the initial (constant) and final likelihood values should be evaluated. Looking at **Table 7**, it is seen that this difference is significant ( $\chi^2 [40] = 101,408, p < .01$ ). In this

**Table 8.** Corrected R<sup>2</sup> values

Type	Value
Cox and Snell	0.386
Nagelkerke	0.348

**Table 9.** Multiple categorical logistic regression results

Level	Introductory features	B	Standard error	Wald	SD	p	Exp (β)	
Low-level literacy	Constant	-1.856	0.692	7.190	1	0.007		
	Age	18-20	-0.799	0.610	1.719	1	0.190	0.450
		21-23	1.090	0.563	3.740	1	0.043	0.336
		24-26	0.851	0.487	3.051	1	0.081	0.427
		27+	0	-	-	0	-	-
	Gender	Female	-1.253	0.337	13.863	1	0.000	3.501
		Male	0	-	-	0	-	-
	Discipline	Science	0.241	0.467	0.267	1	0.606	1.273
		Social sciences	0.580	0.454	1.631	1	0.202	1.785
		Health sciences	0.243	0.350	2.484	1	0.048	2.276
		Engineering sciences	0.580	0.454	1.631	1	0.202	1.785
		Other sciences	0	-	-	0	-	-
	Class	Grade 1	-0.261	0.423	0.412	1	0.024	1.024
		Grade 2	-0.193	0.351	0.304	1	0.581	0.824
		Grade 3	0.148	0.611	0.058	1	0.809	1.159
		Grade 4	0	-	-	0	-	-
High-level literacy	Constant	-2.002	0.695	8.301	1	0.004		
	Age	18-20	-0.958	0.563	2.896	1	0.089	0.384
		21-23	1.125	0.509	4.874	1	0.027	0.325
		24-26	1.409	0.473	8.856	1	0.003	0.244
		27+	0	-	-	0	-	-
	Gender	Female	-1.452	0.337	18.543	1	0.000	4.273
		Male	0	-	-	0	-	-
	Discipline	Science	0.283	0.440	1.206	1	0.272	1.621
		Social sciences	0.402	0.488	0.171	1	0.039	2.224
		Health sciences	0.195	0.335	0.338	1	0.561	1.215
		Engineering sciences	1.734	0.351	24.455	1	0.000	5.663
		Other sciences	0	-	-	0	-	-
	Class	Grade 1	-0.040	0.349	0.013	1	0.910	0.961
		Grade 2	0.878	0.565	2.413	1	0.120	2.407
		Grade 3	0.829	0.457	3.298	1	0.046	2.291
		Grade 4	0	-	-	0	-	-

Note. Reference variable: Intermediate literacy

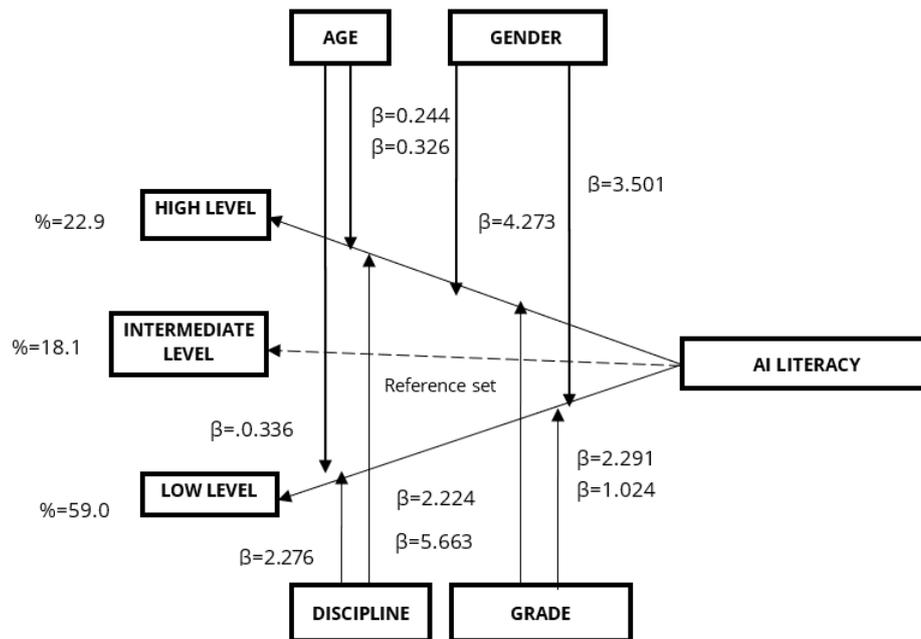
context, it can be said that the predictive variables in the intended model have made a significant contribution to the improvement of the fit of the predicted model.

The Cox and Snell R<sup>2</sup> and Nagelkerke R<sup>2</sup> values in **Table 8** are similar to multiple R<sup>2</sup> statistics on a probability basis. They are values that indicate the amount of variance of the dependent variable. It represents the estimation of the variance explained in the dependent variable in two different ways. The Nagelkerke R<sup>2</sup> value is the modified form of the Cox and Snell R<sup>2</sup> coefficients. The height of these values indicates good harmony (Field, 2005). According to **Table 8**, the fact that this value is 0.386 means that the model created with the dependent variable explains the independent variables with a 38.6% variance estimation.

The results of multinomial logistic regression are presented in **Table 9**.

According to **Table 9**, for low-level literacy, those in the 21-23 age group were 66.4% more likely to have low literacy compared to the 27 and older group (p = 0.043, odds ratio [OR] = 0.336). Similarly, those in the 24-26 age group were 57.3% more likely to have low literacy (p = 0.081, OR = 0.427). In terms of gender, women were about 3.5 times more likely than men to have low literacy (p = 0.000, OR = 3.501). Looking at the disciplines, the probability of low literacy in the field of health sciences was 127.6% higher than other disciplines (p = 0.048, OR = 2.276). The effect of grade levels on low literacy was not found to be significant.

In high-level literacy, the probability of high literacy in the 21-23 age group was 67.5% lower than in the 27 and over age group (p = 0.027, OR = 0.325). In the 24-26 age group, this rate increases to 75.6% (p = 0.003, OR



**Figure 2.** Variables influencing AI literacy groups (Figure created by the authors)

= 0.244). In terms of gender, women were about 4.3 times less likely to have high literacy compared to men ( $p = 0.000$ , OR = 4.273). The probability of high literacy in disciplines, especially in the field of engineering sciences, increased by 466.3% compared to other fields ( $p = 0.000$ , OR = 5.663). In the grade variable, the probability of high literacy of third-grade students increased approximately 2.3 times ( $p = 0.046$ , OR = 2.291).

The variables affecting AI literacy groups and their impact values are presented in **Figure 2**.

## DISCUSSION AND INTERPRETATION

In this study, the relationship between university students' AI literacy and their attitudes towards AI was examined. According to the descriptive findings, it was seen that the AI literacy levels of the students were at a medium level. This shows that university students have basic knowledge and usage skills related to AI, but these skills are not advanced. This result can be associated with the fact that AI education at the higher education level has not yet been systematically and widely integrated into the curriculum. Although students interact intensively with technological tools, they do not reach a deepened level of knowledge about the conceptual, algorithmic and ethical dimensions of AI.

The high level of positive attitudes towards AI indicates that students see technology as a useful, functional and open tool for development. In particular, the fact that university-age individuals, as natural users of the digital age, show less resistance in the adaptation process to AI and are more open to developing innovative ways of thinking towards these technologies may be effective in shaping these attitudes. However, students' negative attitudes at a certain level can be explained by factors such as technological uncertainties, ethical issues, data security concerns, and AI's perception of threat to human labor (Hornberger et al., 2023).

In terms of the gender variable, the findings revealed that male students scored significantly higher than female students in both AI literacy and positive attitude levels. This finding may be explained by the effect of gender-based social roles towards technology and the fact that male individuals interact with digital tools more frequently and intensively from an early age. Similarly, in the literature, it is stated that male individuals are more inclined towards technical issues and develop more self-efficacy in these areas (Silagan & Tumapon, 2025). In female students, the cautious approach to AI technologies may be related to a lower perception of competence (Bewersdorff, et al., 2025). It also coincides with a study conducted by Stohr et al. (2024) that examined students' perceptions of AI chatbots, in which men reported using AI more, exhibiting more positive attitudes, and being less anxious. This gender gap also coincides with social and cultural factors that limit women's interaction with technology (Cheryan et al., 2017).

Differences by grade level show that the learning process has a decisive effect on the level of knowledge and attitudes towards AI. The fact that both AI literacy and positive attitude levels are higher, especially in senior students can be explained by the fact that students are more exposed to technology and their application experience increases with the advancement of academic life. This is also consistent with learning-experience theories, as individuals' experience with technology increases, their knowledge deepens and their attitudes towards these technologies become more positive.

Interdisciplinary differences are also striking. The fact that students studying in engineering and social sciences have a higher level of AI literacy and positive attitudes compared to other fields can be associated with more opportunities to interact directly with technology in these fields. Engineering students' early acquaintance with areas such as algorithmic thinking, software, and data analysis allows them to evaluate AI in a more functional framework. In social sciences, discussions on the social, political and economic effects of AI increase the awareness levels of students in these fields and support the development of a positive perception with critical attitudes. However, the higher negative attitudes of students studying in the field of health sciences towards AI may be due to reservations about the direct applicability of these technologies in human-oriented professions. The fact that decision-making processes in the field of health require ethical sensitivity and AI has a limited perception of trust in this context increases students' anxiety levels and feeds negative attitudes. This result reveals the importance of field-based informative and confidence-building interventions in the technological adaptation process. In addition, this result is in line with previous research (Mercader & Gairín, 2020; Stohr et al., 2024). This points to a possible disconnect between AI training efforts and non-technical fields. This group's skepticism towards AI may stem from the perception that AI is unrelated to their discipline and lies beyond their individual initiative (Bewersdorff et al., 2025).

The findings obtained from the correlation analysis show that there is a strong and positive relationship between AI literacy and positive attitude. This finding coincides with Hidi and Renninger's (2006) model of interest development. According to this model, new stimuli that are attention-grabbing or intriguing trigger individual attention. As the level of knowledge of individuals on a subject increases, their positive evaluations and behavioral tendencies towards this subject also increase. At the same time, the negative correlation between AI literacy and negative attitudes reveals that lack of knowledge and lack of awareness can feed distrust of technology.

In the study, it was determined how low and high literacy levels differed according to demographic variables in university students. In terms of low literacy, it is observed that university students in the 21-23 age group tend to have low literacy compared to the group of students aged 27 and over. Similarly, students in the 24-26 age group are also more likely to have low literacy. This finding suggests that younger college students tend to have a lower level of literacy in a particular subject. This can be explained by the academic knowledge, university experiences and cognitive maturation processes acquired with age. The fact that younger students are less exposed to the relevant conceptual framework or that their skills for interpreting and synthesizing information are not yet fully developed may be one of the main reasons for this difference (Baxter & Jacks, 2017).

In terms of gender, female college students are significantly more likely to have low literacy than male students. When looking at high literacy levels, university students in younger age groups are less likely to have high literacy than older age groups. The accumulation of experience, academic specialization and continuous learning processes gained during university education may have enabled older students to acquire more in-depth knowledge and skills in the relevant field. It can be observed that students, especially in the last years of undergraduate education or at the graduate level, increase the depth of knowledge in their discipline (Smith & Jones, 2019).

In interdisciplinary differences, university students in the field of health sciences were more likely to have low literacy than other disciplines, while the probability of high literacy in the field of engineering sciences increased significantly compared to other fields. This difference is strongly tied to the nature of the type of literacy being measured. If literacy involves more analytical, problem-solving, or numerical skills, it is expected that engineering students will be more proficient in these subjects. In contrast, health sciences students focusing on a different set of knowledge and skills may result in them performing relatively poorly on this type of literacy measure. This clearly demonstrates the impact of discipline-specific training curricula and

focused competencies on certain literacy levels (Johnson & Lee, 2018). The fact that the effect of grade level on low literacy is found to be insignificant, but the probability of high literacy of third grade students increases, shows that students' knowledge deepens, especially in the later stages of undergraduate education, and thus they can reach higher literacy levels.

Although this research aims to determine the relationship between university students' AI literacy and their attitudes towards AI, it also includes some limitations that should be considered in the interpretation and generalization process of the findings. First, the relational survey model was adopted in the research, which limits the establishment of cause-effect relationships, it is not enough to reveal whether the relationships obtained are linear or unidirectional. Therefore, supporting the findings with experimental or mixed-design studies may strengthen the causality interpretations of the relationships.

In addition, the sample of the study is limited to 386 students studying at two universities. This limits the level of representation of the sample and makes it difficult to generalize the results to university students. Furthermore, because the research is limited to the Eurasian region, the effects of regional cultural and educational differences may have been underestimated. Another limitation is that the data were collected by self-report method. Respondents' social likability tendencies, perceived expectations, or subjective assessments may influence their responses to the scales. This may lead to the risk of bias, especially in the measurement of cognitive and affective characteristics such as attitude.

In the study, only students' perceptions, knowledge levels and attitudes were evaluated. However, criteria such as behavioral outputs, frequency of use, scenario-based skill performances or observational qualitative data for the educational use of AI applications were not included in the study. This means that AI literacy reflects only the cognitive and affective components, while the behavioral dimensions are left out. In the light of these limitations, the findings of the study should be interpreted in their own context, before generalizing, it should be considered that it should be supported by different samples, methods and measurement tools.

## CONCLUSIONS AND RECOMMENDATIONS

The findings obtained from the study revealed that AI literacy and attitudes showed significant differences according to student characteristics and that there were strong relationships between these two variables. Based on descriptive statistics, it was determined that the AI literacy levels of the students were generally at a medium level, while the levels of positive attitudes towards AI were high and the levels of negative attitudes were moderate. This indicates that students generally have a positive outlook on AI technologies; however, it shows that they have a certain degree of anxiety, reservations or insecurity about these technologies.

When evaluated in terms of gender variable, it was seen that male students' positive attitude scores towards both AI literacy and AI were significantly higher than female students. However, there was no significant difference by gender in terms of negative attitude levels towards AI. Regarding the grade level, it shows that both AI literacy and positive attitude levels increase significantly as the grade level of the students increases. In particular, the fact that 4<sup>th</sup> grade students have higher AI literacy and positive attitude scores compared to 1<sup>st</sup> grade and 2<sup>nd</sup> grade students shows that interaction with technology increases during university education and this situation is reflected in student perceptions. On the other hand, there was no significant difference according to grade level in terms of negative attitudes towards AI.

In the findings examined according to the learning areas of the students, significant differences were found in their AI literacy levels and positive attitudes. Students studying in the fields of engineering and social sciences exhibit a higher level of AI literacy and positive attitudes than students in other fields. On the other hand, students studying in the field of health sciences have higher levels of negative attitudes towards AI compared to other fields. This situation reveals that interdisciplinary differences are decisive on the level of knowledge and perceptions about AI, and a more positive approach has been developed, especially in areas that are intensely related to technical knowledge. One of the most striking findings of the research is the relationship between AI literacy and attitudes. According to the correlation analysis, a strong and positive relationship was found between AI literacy and positive attitude, and a significant and negative relationship was found between negative attitude. These findings show that as students' knowledge and awareness of AI increases, they develop positive approaches to technology and their negative judgments decrease. As a result, this research revealed that university students' AI literacy and attitudes are interrelated, these relationships

differ significantly depending on demographic variables, and students generally have a positive approach to AI technologies. In this context, various suggestions have been developed for researchers, university administrations and university students.

The scope of research on the individual, pedagogical and ethical effects of AI technologies in the context of higher education should be expanded. In particular, the knowledge, skills and attitudes of students in different disciplines towards AI should be considered comparatively, discipline-specific AI literacy profiles should be created. In addition, the dynamics of male and female students' interaction with technology should be examined in more detail through in-depth qualitative research in the context of gender differences. Educational interventions to increase AI literacy should be developed, and the impact of such practices should be tested with experimental designs. Finally, the factors at the source of negative attitudes towards AI (ethical concerns, insecurity, technology anxiety, etc.) should be investigated with multidimensional measurement tools.

University administrations should organize course contents, certificate programs and workshops that will increase AI literacy in order to enable students to use AI technologies effectively and consciously. These programs should be structured by considering discipline-based differences, the high awareness of AI in engineering and social sciences should be encouraged to spread to other fields. A learning ecosystem should be established that supports students' positive attitudes towards AI, at the same time, interdisciplinary education models that develop ethical awareness and critical perspective should be included. In addition, especially in areas where negative attitudes towards AI are higher, such as health sciences, there is a need to increase informative and guiding activities aimed at reducing students' anxiety.

Students should make an individual effort not only to get to know AI tools at the user level, but also to learn the working principles, ethical limits and social effects of these technologies. They should improve their own AI literacy levels by taking advantage of open access resources, online trainings, and academic publications related to AI. In addition, they should take care to maintain their critical thinking skills while maintaining their positive attitude, they should not forget that technology is not only a benefit-oriented field, but also a field that requires responsibility. It is of great importance that they show sensitivity to basic principles such as ethical awareness, privacy and security, especially when evaluating the large number of AI applications they will encounter during the learning process.

**Author contributions:** **RSA:** conceptualization, methodology, investigation, writing – original draft, writing – review & editing; **RGS:** conceptualization, methodology, supervision, project administration, writing – review & editing; **MAK:** data curation, formal analysis, validation, writing – review & editing; **NSE:** investigation, resources, visualization, writing – review & editing; **ZMS:** software, data curation, formal analysis, writing – review & editing; **NNS:** validation, resources, supervision, writing – review & editing. All authors contributed equally to this work and approved the final version of the manuscript.

**Funding:** The authors received no financial support for the research and/or authorship of this article.

**Ethics declaration:** The study protocol was reviewed and approved by the Ethics Committee of Kazan Federal University in January 2025. All participants provided written informed consent prior to participation in the study. Participation was voluntary, and participants were informed about the purpose of the research, procedures, potential risks and benefits, and their right to withdraw at any time without penalty. All sensitive and confidential personal data were kept strictly private and handled in accordance with applicable data protection regulations. Identifiable information was anonymized and stored securely with restricted access limited to the research team.

**AI statement:** No generative AI or AI-based tools were used in the design, data collection, analysis, interpretation, or writing of this manuscript.

**Declaration of interest:** The authors declared no competing interest.

**Data availability:** Data generated or analyzed during this study are available from the authors on request.

## REFERENCES

- Alemdag, E., Cevikbas, S. G., & Baran, E. (2020). The design, implementation and evaluation of a professional development programme to support teachers' technology integration in a public education centre. *Studies in Continuing Education*, 42(2), 213-239. <https://doi.org/10.1080/0158037X.2019.1566119>
- Baxter, P., & Jacks, R. (2017). *Understanding quantitative research in education*. SAGE.

- Bewersdorff, A., Hornberger, M., Nerdel, C., & Schiff, D. S. (2025). AI advocates and cautious critics: How AI attitudes, AI interest, use of AI, and AI literacy build university students' AI self-efficacy. *Computers and Education: Artificial Intelligence*, 8, Article 100340. <https://doi.org/10.1016/j.caeai.2024.100340>
- Bian, Q., Ling, X., & Yan, S. (2024). Bridging the algorithmic divide: Refocusing faculty artificial intelligence literacy in higher education. *Education as Change*, 28. <https://doi.org/10.25159/1947-9417/17983>
- Çelebi, C., Demir, U., & Karakuş, F. (2023). Analysis of studies on artificial intelligence literacy using systematic compilation method. *Necmettin Erbakan University Ereğli Faculty of Education Journal*, 5(2), 535-560.
- Celik, I. (2023). Exploring the determinants of artificial intelligence (AI) literacy: Digital divide, computational thinking, cognitive absorption. *Telematics and Informatics*, 83, Article 102026. <https://doi.org/10.1016/j.tele.2023.102026>
- Cheryan, S., Plaut, V. C., Handron, C., & Hudson, L. (2013). The stereotypical computer scientist: Gendered media representations as a barrier to inclusion for women. *Sex Roles*, 69(1-2), 58-71. <https://doi.org/10.1007/s11199-013-0296-x>
- Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Pearson.
- De Freitas, J., Agarwal, S., Schmitt, B., & Haslam, N. (2023). Psychological factors underlying attitudes toward AI tools. *Nature Human Behaviour*, 7(11), 1845-1854. <https://doi.org/10.1038/s41562-023-01734-2>
- Derinalp, P., & Ozyurt, M. (2024). Adaptation of the student attitudes toward artificial intelligence scale to the Turkish context: Validity and reliability study. *International Journal of Human-Computer Interaction*, 41(8), 4653-4667. <https://doi.org/10.1080/10447318.2024.2352921>
- Dos Santos, D. P., Giese, D., Brodehl, S., Chon, S. H., Staab, W., Kleinert, R., Maintz, D., & Baeßler, B. (2019). Medical students' attitude towards artificial intelligence: A multicentre survey. *European Radiology*, 29(4), 1640-1646. <https://doi.org/10.1007/s00330-018-5601-1>
- Elcicek, M. (2024). A study on students' artificial intelligence (AI) literacy. *Journal of Information and Communication Technologies*, 6(1), 24-35. <https://doi.org/10.53694/bited.1460106>
- Field, A. (2005). Exploring data. In *Discovering statistics using SPSS* (vol. 2, pp. 63-106). SAGE.
- George, D., & Mallery, P. (2003). *Using SPSS for windows step by step: A simple guide and reference* (4th ed.). Pearson.
- Hahs-Vaughn, D. L., & Lomax, R. G. (2020). *Statistical concepts – A second course*. Routledge. <https://doi.org/10.4324/9780429277825>
- Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (6th ed.). Pearson/Prentice Hall.
- Hornberger, M., Bewersdorff, A., & Nerdel, C. (2023). What do university students know about Artificial Intelligence? Development and validation of an AI literacy test. *Computers and Education: Artificial Intelligence*, 5, Article 100165. <https://doi.org/10.1016/j.caeai.2023.100165>
- Jiang, Z., Abedin, B., & Marjanovic, O. (2024). Understanding the components of AI literacy at the individual, group and organisational level: An organisational learning perspective. In *Proceedings of the ACIS 2024*.
- Johnson, A., & Lee, B. (2018). *Discipline-specific literacy: Examining the role of educational programs*. Routledge.
- Katsantonis, A., & Katsantonis, I. G. (2024). University students' attitudes toward artificial intelligence: An exploratory study of the cognitive, emotional, and behavioural dimensions of AI attitudes. *Education Sciences*, 14(9), Article 988. <https://doi.org/10.3390/educsci14090988>
- Kerschner, C., & Ehlers, M. H. (2016). A framework of attitudes towards technology in theory and practice. *Ecological Economics*, 126, 139-151. <https://doi.org/10.1016/j.ecolecon.2016.02.010>
- Kim, S. W., & Lee, Y. (2024). Investigation into the influence of socio-cultural factors on attitudes toward artificial intelligence. *Education and Information Technologies*, 29(8), 9907-9935. <https://doi.org/10.1007/s10639-023-12172-y>
- Kong, S., Cheung, W. M., & Zhang, G. (2023). Evaluating an artificial intelligence literacy programme for developing university students' conceptual understanding, literacy, empowerment and ethical awareness. *Educational Technology & Society*, 26(1), 16-30. [https://doi.org/10.30191/ETS.202301\\_26\(1\).0002](https://doi.org/10.30191/ETS.202301_26(1).0002)
- Kong, S.-C., & Abelson, H. (2022). *Computational thinking education in K-12: Artificial intelligence literacy and physical computing*. MIT Press. <https://doi.org/10.7551/mitpress/13375.001.0001>

- Laupichler, M. C., Aster, A., Meyerheim, M., Raupach, T., & Mergen, M. (2024). Medical students' AI literacy and attitudes towards AI: A cross-sectional two-center study using pre-validated assessment instruments. *BMC Medical Education*, 24(1), Article 401. <https://doi.org/10.1186/s12909-024-05400-7>
- Li, L. (2017). Students' attitudes toward technology and their learning performance in an online course. *International Journal of Technology Enhanced Learning*, 9(2-3), 109-124.
- Liu, S. H. (2010). Factors related to pedagogical beliefs of teachers and technology integration. *Computers & Education*, 55(4), 1202-1212.
- Long, D., & Magerko, B. (2020). What is AI literacy? Competencies and design considerations. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1-16). <https://doi.org/10.1145/3313831.3376727>
- Lu, K., Zhu, J., Pang, F., & Shadiev, R. (2024). Understanding the relationship between colleges students' artificial intelligence literacy and higher order thinking skills using the 3P model: The mediating roles of behavioral engagement and peer interaction. *Educational Technology Research and Development*, 73, 693-716. <https://doi.org/10.1007/s11423-024-10434-1>
- Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. Pearson.
- Mercader, C., & Gairín, J. (2020). University teachers' perception of barriers to the use of digital technologies: The importance of the academic discipline. *International Journal of Educational Technology in Higher Education*, 17(1), Article 4. <https://doi.org/10.1186/s41239-020-0182-x>
- Ndungu, M. W. (2024). Integrating basic artificial intelligence literacy into media and information literacy programs in higher education: A framework for librarians and educators. *Journal of Information Literacy*, 18(2), 122-139. <https://doi.org/10.11645/18.2.641>
- Oksanen, A., Cvetkovic, A., Akin, N., Latikka, R., Bergdahl, J., Chen, Y., & Savela, N. (2023). Artificial intelligence in fine arts: A systematic review of empirical research. *Computers in Human Behavior: Artificial Humans*, 1(2), Article 100004. <https://doi.org/10.1016/j.chbah.2023.100004>
- Park, J., & Woo, S. E. (2022). Who likes artificial intelligence? personality predictors of attitudes toward artificial intelligence. *The Journal of Psychology*, 156(1), 68-94. <https://doi.org/10.1080/00223980.2021.2012109>
- Pente, P., Adams, C., & Yuen, C. (2022). Artificial Intelligence, ethics, and art education in a posthuman world. In A. D. Knochel, & O. Sahara (Eds.), *Global media arts education: Mapping global perspectives of media arts in education* (pp. 197-211). Springer. [https://doi.org/10.1007/978-3-031-05476-1\\_12](https://doi.org/10.1007/978-3-031-05476-1_12)
- Schepman, A., & Rodway, P. (2020). Initial validation of the general attitudes towards artificial intelligence scale. *Computers in Human Behavior Reports*, 1, Article 100014. <https://doi.org/10.1016/j.chbr.2020.100014>
- Shiri, A. (2024). Artificial intelligence literacy: A proposed faceted taxonomy. *Digital Library Perspectives*, 40(4), 681-699. <https://doi.org/10.1108/DLP-04-2024-0067>
- Silagan, B. L., Tumapon, T. (2025). Technological competence, training and support, attitude towards AI, and teachers' acceptance. *Psychology and Education: A Multidisciplinary Journal*, 36(8), 941-964. <https://doi.org/10.70838/pemj.360809>
- Sindermann, C., Sha, P., Zhou, M., Wernicke, J., Schmitt, H. S., Li, M., Sariyska, R., Stavrou, M., Becker, B., & Montag, C. (2021). Assessing the attitude towards artificial intelligence: Introduction of a short measure in German, Chinese, and English language. *KI-Künstliche Intelligenz*, 35(1), 109-118. <https://doi.org/10.1007/s13218-020-00689-0>
- Smith, J., & Jones, K. (2019). *Age and expertise: A developmental perspective on knowledge acquisition*. Academic Press.
- Stewart, J., Lu, J., Gahungu, N., Goudie, A., Fegan, P. G., Bennamoun, M., Sprivulis, P., & Dwivedi, G. (2023). Western Australian medical students' attitudes towards artificial intelligence in healthcare. *PLoS ONE*, 18(8), Article e0290642. <https://doi.org/10.1371/journal.pone.0290642>
- Stohr, A., Ollig, P., Keller, R., & Rieger, A. (2024). Generative mechanisms of AI implementation: A critical realist perspective on predictive maintenance. *Information and Organization*, 34(2), Article 100503. <https://doi.org/10.1016/j.infoandorg.2024.100503>
- Stöhr, C., Ou, A. W., & Malmström, H. (2024). Perceptions and usage of AI chatbots among students in higher education across genders, academic levels and fields of study. *Computers and Education: Artificial Intelligence*, 7, Article 100259. <https://doi.org/10.1016/j.caeai.2024.100259>

- Suh, W., & Ahn, S. (2022). Development and validation of a scale measuring student attitudes toward artificial intelligence. *Sage Open*, 12(2), Article 21582440221100463. <https://doi.org/10.1177/21582440221100463>
- Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers & Education*, 57(4), 2432-2440. <https://doi.org/10.1016/j.compedu.2011.06.008>
- Yetişensoy, O., & Rapoport, A. (2023). Artificial intelligence literacy teaching in social studies education. *Journal of Pedagogical Research*, 7(3), 100-110. <https://doi.org/10.33902/JPR.202320866>
- Yue, M., Jong, M. S., & Ng, D. T. K. (2024). Understanding K-12 teachers' technological pedagogical content knowledge readiness and attitudes toward artificial intelligence education. *Education and Information Technologies*, 29(15), 19505-19536. <https://doi.org/10.1007/s10639-024-12621-2>
- Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education—Where are the educators? *International Journal of Educational Technology in Higher Education*, 16, Article 39. <https://doi.org/10.1186/s41239-019-0171-0>

