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Investigation into the Influence of Socio-Cultural Factors on Attitudes toward Artificial Intelligence

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Abstract
In this study, the influence of socio-cultural factors on attitudes toward artificial intelligence (AI) was investigated. In total, 1,677 Korean middle school students were selected to participate, and a test tool was used to measure the attitude toward AI. As a result, according to socio-cultural factors, middle school students' attitudes toward AI were affected differently by gender- or AI-related experiences. In particular, students experiencing difficulties because of socio-cultural factors showed a more positive attitude toward AI if they had an AI education. On the other hand, interest toward AI and programming experience had a significant effect on attitudes toward AI and was not affected by socio-cultural factors. In particular, students with high interest toward AI or experience with block- and text-based programming languages showed significantly positive attitudes toward AI. Hence, the disparity in middle school students' attitude toward AI according to socio-cultural factors was found.

Keywords Artificial intelligence · Attitude · Socio-cultural · Disadvantaged · Digital disparity · Middle school student

1 Introduction

At the start of the Industrial Revolution, steam engines were introduced to replace human labor and innovatively improve work efficiency, which drastically changed the form of industry and promoted the development of new technologies. At the World Economic Forum in 2016, a fourth industrial revolution was announced as being underway, and artificial intelligence (AI) was presented as the

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technology-leading change (Xu et al., 2018). AI was first termed by Alan Turing in 1950 (Turing, 1950), and at the Dartmouth Conference led by John McCarthy, the field of AI research was established. Although AI has suffered from the so-called AI winter, it has recently emerged as a key technology-leading innovation in various fields (Haenlein & Kaplan, 2019).

When technologies such as computers and robots were first introduced, people had trouble using them because they were unfamiliar with the technology (Scherer et al., 2019; Marangunić & Granić, 2015). In some cases, such as the Luddite movement, new technologies were negatively perceived, being seen as an obstacle to individuals' lives (Shin et al., 2017, 2018). Therefore, technology acceptance models, technostress, and the efficacy for technology for users have been studied (Boyer-Davis, 2020; Huffman et al., 2013; Holden & Rada, 2011; Kim, 2022; Scherer et al., 2019; Shin et al., 2017, 2018; Syvänen et al., 2016); here, studies have been conducted to analyze attitudes toward technology itself (Haring et al., 2014; Nomura et al., 2006). In the education related to these technologies, the importance of attitudes toward specific technologies was further emphasized (Charters et al., 2014; Haring et al., 2014; Kim and Lee, 2016a, b; Nomura et al., 2006; Selwyn, 1997; Shashaani, 1993).

Prior research underscores the significance of learners' attitudes toward technology, noting that these attitudes play a pivotal role in their capacity to assimilate or engage with technological tools (Mancini et al., 2010; Serholt et al., 2014). Notably, a negative disposition towards technology is linked with diminished interest for tech-based learning and adverse perceptions of technological tools. Such sentiments act as barriers to effective technology utilization, thereby impeding the learning process (Hashim et al., 2021; Jong, 2020; Kim et al., 2022; Kpolovie et al., 2014). Furthermore, in the context of education aimed at fostering technology-driven competencies like computational thinking and artificial intelligence literacy, the attitudes of learners toward technology are crucial. Negative stances on technology can detrimentally influence their willingness and efficiency in using technological platforms (Hooshyar et al., 2021; Kim & Lee, 2020a, b, c; Zaineldeen et al., 2020). Therefore, when a new technology is introduced, it is necessary to investigate attitudes toward that technology while exploring the factors influencing these attitudes (Mancini et al., 2010; Serholt et al., 2014). Unlike computers and robots, AI is an intangible algorithm that does not have a form; indeed, it is like a black box (Castelvecchi, 2016; Milne & Rowe, 2002; Tan et al., 2009). AI is increasingly used in everyday life, but it is difficult for users to clearly understand what AI is and how it can help them. Therefore, there is a need for research to analyze the attitudes toward AI and identify those factors affecting individuals' attitudes.

Various factors affect attitudes toward technology, and socio-cultural factors are representative of these factors. Because of socio-cultural factors, disadvantaged groups have different levels of access to digital technologies, such as AI (National Information society Agency in Korea (NIA), 2022). In the literature review, disadvantaged people (those experiencing difficulties because of socio-cultural factors) have seen a gap in the accessibility, use, and application of digital technologies (Korean Educational Development Institute (KEDI), 2012; Lee et al., 2009; NIA, 2022; Park, 2009). However, in a report investigating the digital divide published by the NIA in Korea in 2022, it was found that there is almost no difference in accessibility because of socio-cultural factors and that there is a gap in the use or application of AI (NIA, 2022).

Gaps in access or exposure can engender disparities in competencies like computational thinking and AI literacy between the broader populace and disadvantaged groups. Such disparities can manifest in differential technology usage in daily routines, fostering varied attitudes, perceptions, and beliefs about technology. Over time, these divergences can culminate in substantial discrepancies in career trajectories, income levels, and more (Na et al., 2022; Shih et al., 2011). In response, South Korea has been proactively examining the digital divide among its marginalized populations. To mitigate this chasm, the nation has initiated AI education camps, after-school programs for students, and educational projects targeting the broader community. These results show that, although people can encounter AI in daily life, regardless of socio-cultural factors, Socio-cultural factor can affect AI literacy or AI problem solving, here depending on socio-cultural factors. Therefore, to solve the AI disparity according to socio-cultural factors, it is necessary to investigate attitudes toward AI and analyze the influence of socio-cultural factors on these attitudes (Kim & Lee, 2020c; Kim et al., 2021; Lee, 2020; NIA, 2022).

Therefore, in the present study, Korean middle school students were surveyed for their attitude toward AI, and the differences in their attitudes according to socio-cultural factors were analyzed. For the current study, a test tool was used to investigate attitudes toward AI for general students (GS) and disadvantaged students (DS). According to the NIA (2022), DS is anticipated to harbor more negative attitudes towards AI compared to GS among Korean middle school students. This study endeavors to ascertain if this expectation aligns with actual research findings. Historically, attitudes towards robots have been a notable area of international comparative research, where scholars have scrutinized variances rooted in sociocultural nuances (Bartneck et al., 2005a; Bartneck et al., 2005b; Haring et al., 2014; Hinz et al., 2019; Nomura et al., 2006). These investigations have yielded insights into the design and deployment of humanoid robots, tailoring them to specific sociocultural contexts of countries (Haring et al., 2014; Hinz et al., 2019).

With the increasing ubiquity of artificial intelligence in human lives, underscored by advancements in generative AI, there's an amplified imperative to study attitudes towards AI. Such research can guide the design and delivery of AI-based products and services (Long & Magerko, 2020). Although our findings are contextual to Korea, they hold potential as a springboard for broader international comparative studies, akin to those on robot attitudes. The outcomes can help strategize ways to bridge the digital divide across nations and can be instrumental in shaping the discourse around AI education in schools, where socio-cultural determinants play a pivotal role (Van Steensel, 2006).

2 Related works

2.1 Attitude toward artificial intelligence

Previous studies in the field of education have focused only on cognitive domain about objects or content, but it has been found that the influencing factors were affected not only by knowledge, but also by affective characteristics, such as attitude. Remmers and Gage (1955) stated that attitude is an emotionalized tendency formed psychologically through the experiences of reacting positively or negatively to an object (Remmers & Gage, 1955). Guilford (1959) showed that attitudes are the positive or negative tendencies of individuals toward social objects, behaviors, or opinions (Guilford, 1959). Using component theory, Triandis (1971) found that attitude is composed of cognitive (thinking), affective (emotion), and behavioral elements, and attitude is a factor determining behavior by reflecting human emotions and thoughts (Triandis, 1971). Fishbein and Ajzen (1977) stated that attitudes are not innately determined and unchanging factors but can be changed through learning (Fishbein & Ajzen (1977).

Rosenberg et al. (1960) said that attitudes are related to factors such as personal belief, self-confidence, and self-expectations such as self-efficacy and that attitudes are not innate factors but can be changed and learned through education (Rosenberg et al., 1960; Triandis, 1979). Studies have shown that attitude affects a positive or negative belief, perception, or tendency toward a specific object and is a factor determining behavior toward a specific object. Therefore, if the attitude toward, for instance, a robot is negative, anxiety or stress will be caused when trying to use the robot (Haring et al., 2014; Kim and Lee, 2016a, b; Nomura et al., 2006; Syvänen et al., 2016); this will affect the behavior to be inhibited or behavioral expectations to be low (Boyer-Davis, 2020; Holden & Rada, 2011; Huffman et al., 2013; Syvänen et al., 2016). In addition, attitude toward a specific object or content (e.g. Science, AI, robot) makes consistent behavior appear, but attitude is not an innate factor; instead, it is a factor that can be changed through education or experience (Rosenberg et al., 1960; Triandis, 1979). In line with this, a study on the ways to positively change learners' attitudes was conducted (Kim & Lee, 2016b). In addition, research was conducted to identify the factors that affect learners' attitudes. Kim and Lee (2016b) confirmed that learners' attitude toward robots changed positively when a project using robots was conducted.

New technologies are unfamiliar to users, so users may find it difficult to understand and utilize them. Therefore, when new technology is introduced, research is needed to investigate the attitude toward the technology and analyze the factors that affect individuals' attitudes. Accordingly, studies have analyzed the attitudes toward computers and robots. For example, studies have been conducted to investigate attitudes towards computers or robots by subject, and to analyze differences in attitudes due to cultural or social factors and educational plans for changing attitudes (Mancini et al., 2010; Serholt et al., 2014). AI is a term that has been used since the 1950s, but it was only after 2010 that it was actively introduced and used in everyday life. In this sense, AI can be recognized as new technology, and research to analyze attitudes toward AI is needed.

In line with this need for more research, Kim and Lee (2020c) developed a test tool that can be used for analyzing middle school students' attitudes toward AI. Because Korea developed a new AI curriculum in 2020, a test tool was needed to investigate the attitudes toward AI, which could affect AI education. Therefore, a test tool that can measure attitudes toward AI was developed using a self-report questionnaire (Kim & Lee, 2020c). And Kim and Lee (2020b) was conducted to analyze high school students' attitude toward AI according to school level (Kim & Lee, 2020b, 2021). As a follow-up study of these studies, no study has been conducted to identify the factors that affect attitudes toward AI.

2.2 Disadvantaged students

Unlike GS, DS are students whose educational opportunities are relatively limited because of difficulties arising from their social and cultural factors (Lee et al., 2009; Park, 2009). To overcome the gap between DS and GS caused by these socio-cultural factors, a project is being conducted to support DS' studies and provide various opportunities in education (Park et al., 2016; Ryu & Kim, 2017).

DS in Korean can be divided into groups that include economic factors, cultural factors, geographic factors, physical factors, and family–environmental factors. Economic factors refer to when these students are below a certain level compared with the average level of income. Cultural factors refer to those belonging to a special situation in Korea. Representatively, it means a multicultural family or a person who is North Korean but lives in South Korea. Geographical factors refer to people who do not live in cities but instead live in rural areas, fishing villages, and generally inaccessible areas. Finally, family–environmental factors refer to people who are affected by family factors, such as single-parent families, or environmental factors, such as adoptive families (Park et al., 2016; Ryu & Kim, 2017). Because of these factors, DS have a lower level of cognitive, social, and emotional development than GS, along with having general lower self-control, self-efficacy, interest toward educational achievement, and attitudes (Mcloyd, 1998; Park et al., 2016; Ryu & Kim, 2017).

The present study has aimed to analyze the differences in attitudes toward AI among Korean middle school students based on their socio-cultural factors. Therefore, DS and GS were asked to participate. By comparing attitudes toward AI between DS and GS, the influence of socio-cultural factors on attitudes toward AI was identified. In the present study, all students who met the Korean DS criteria were not selected as research subjects, and GS who were not affected by socio-cultural factors were excluded (e.g., geographic factors, physical factors, and family–environmental factors).

3 Materials and methods

3.1 Overview

The current study investigated attitudes toward AI among GS and DS. Therefore, GS and DS were recruited to participate, and a test tool was used for the participating middle school students. The analysis examined the differences between GS and DS, focusing on the factors that affect attitudes toward AI. Through this, the influence of socio-cultural factors on attitudes toward AI were derived.

3.2 Participants

In the present study, 1,677 middle school students participated. Among them, 1,327 (79.13%) were GS and 350 (20.87%) DS. According to the Education Statistics Service, as of 2022, there were 1,348,428 middle school students (Korea Educational Statistics Service, 2022). DS are not disclosed because of personal information, but in a study in 2012, DS in Korea accounted for 8.6% of the total student population (KEDI, 2012). Therefore, the number of DS in middle school was expected to be 113,162, or 8.6%, of the total middle school students. Park et al. (2010) stated that the minimum sample size should be 200 or more because the statistical analysis results are affected by the sample size (Krejcie & Morgan, 1970; Park et al., 2010). In the present study, because both GS and DS reached more than 300 participants, the sample condition of Krejcie and Morgan was met (Krejcie & Morgan, 1970). And, Kim (2013) posits that data can be considered normally distributed and meeting the criteria for normality if the sample size exceeds 300, skewness is less than 2, and kurtosis is less than 7. In this study, the GS group exhibited a skewness of .54 and a kurtosis of 1.50, whereas the DS group displayed a skewness of .25 and a kurtosis of .06. These statistics demonstrate that both groups meet the criteria for normality.

The ratio of females (65.26%) was higher than that of males (34.74%) in GS, but in DS, the ratios of the two groups were similar. In experience related to AI, more than 90% of students had experienced of indirect experience with AI in both groups. More than 80% of the students responded that they had direct experience with AI. Hence, most of the middle school students had direct or indirect experiences with AI. Therefore, the proportion of students who encountered AI in everyday life was very high.

On the other hand, 60% of GS responded that they had experience with AI education, but 40% of disadvantaged students responded that they had experience. Therefore, although there was no difference in Korean middle school students' direct and indirect experience of AI based on socio-cultural factors, there were differences in education when it came to understanding and utilizing AI. Similar to Korea's digital divide by socio-cultural, there was no difference in accessibility, but socio-cultural factors affect the ability to utilize AI (NIA, 2022).

In terms of grade, 30% of seventh-grade students were in both groups, but 70% of the GS students were in eighth grade. On the other hand, in the DS group, eighth graders accounted for 40%, and ninth graders accounted for 30%. In terms of the types of programming languages experienced, 50–60% of students experienced block-based programming languages, about 5% experienced text-based programming languages, 20% of students had no experience, and between 10% and 20% of the students experienced both text- and block-based languages.

There was a difference between groups in interest toward AI, here according to socio-cultural factors. In GS, 35% of the students responded that they were "interested" (very interested, very interested) toward AI, and 22% of all students in GS responded they were "not interested" (not interested, very uninterested). On the other hand, for the DS group, almost 70% of the students answered "interested," and only 7% responded that they were "not interested." Among the DS group, students who participated were

Table 1 Characteristics of participants

	GS		DS		Total	
Gender						
Male	461	(34.74)	185	(52.85)	646	(38.52)
Female	866	(65.26)	165	(47.14)	1031	(61.48)
Indirect experiences with AI						
Yes	1220	(91.94)	338	(96.57)	1558	(92.90)
No	107	(8.06)	12	(3.34)	119	(7.10)
Direct experiences with AI						
Yes	1006	(75.81)	281	(80.29)	1287	(76.64)
No	321	(24.19)	69	(19.71)	390	(23.26)
Experiences of AI education						
Yes	752	(56.67)	128	(36.57)	880	(52.47)
No	575	(43.33)	222	(63.43)	797	(47.53)
Grade						
7th	363	(27.35)	99	(28.28)	462	(27.54)
8th	939	(70.76)	141	(40.29)	1080	(64.40)
9th	25	(1.88)	110	(31.43)	135	(8.05)
Experience with programming language type						
None	310	(23.36)	61	(17.43)	371	(22.12)
Block based programming language	764	(57.57)	174	(49.71)	938	(55.93)
Text based programming language	78	(5.88)	23	(6.57)	101	(6.02)
Both	175	(13.19)	92	(26.29)	267	(15.92)
Interest toward AI						
Not very interested	81	(6.10)	2	(.57)	83	(4.94)
Not interested	206	(15.52)	24	(6.86)	230	(13.71)
Neutral	583	(43.93)	81	(23.14)	664	(39.59)
Interested	325	(24.49)	150	(42.86)	475	(28.32)
Very interested	132	(9.95)	93	(26.57)	225	(13.42)

highly interested or highly motivated in studying, so they may have had a high interest toward AI. However, the ratio of students responding that they were interested toward AI in DS and GS was almost double. It has been shown that DS have a high interest toward AI but have not been provided with education on AI (Kim & Lee, 2020c; Kim et al., 2021). The characteristics of the study subjects are shown in Table 1.

3.3 Measurement

In this study, the Negative Attitude toward Artificial Intelligence Scale (NAAIS) developed by Kim and Lee (2020c) was used to measure attitude toward AI (Kim & Lee, 2020c). As technologies such as computers and robots have developed, research related to the introduction of technology and human acceptance has been conducted (Haring et al., 2014; Kim & Lee, 2016a, b; Selwyn, 1997; Shashaani, 1993). Typically, in the technology acceptance model (TAM), behavioral intention to use affects actual system use, which then affects the attitude toward technology use (Marangunić & Granić, 2015; Scherer et al., 2019). Therefore, attitude toward AI is a factor that indirectly affects the use or application of AI.

The NAAIS consists of five subfactors: social influence of AI, communication with AI, situations of interaction with AI, emotions in interaction with AI, and characteristics of AI. There are 17 items in the test, and responses are based on a 5-point Likert scale. The Cronbach α values of the test tools have been shown to range from .778 to .623 (Kim & Lee, 2020c). The test items used in the present study are given in Appendix 1 Table 9.

In addition to attitude toward AI, a test item was also used to investigate the characteristics of the research subject. Here, AI-related experiences (indirect, direct, education, programming), gender, grade, and interest toward AI were examined (Kim & Lee, 2020b, 2020c, Kim et al., 2021; Lee, 2013; Shin & Kim, 2009).

3.4 Analysis

To examine the influence of socio-cultural factors on attitudes toward AI, the results of a survey on attitudes toward AI among Korean middle school students were analyzed by dividing them into GS and DS. In addition, the factors investigated as the characteristics of the study subject were examined. For analysis, an independent sample t-test or ANOVA was used. In addition, post-hoc test in ANOVA utilized Bonferroni.

4 Results

4.1 Effects of socio-cultural factors on attitudes toward AI

To examine the influence of socio-cultural factors on attitudes toward AI, the participating Korean middle school students were divided based on their socio-cultural factors. Korean middle school students' attitude toward AI was higher among GS (M = 2.86, SD = .50) than DS (M = 2.56, SD = .54), and the difference was statistically significant, t = 10.03, $p < .01$(as shown in Table 2). Therefore, it was confirmed that GS had a more negative attitude toward AI than DS. In summary, socio-cultural factors affect Korean middle school students' attitudes toward AI, and it was confirmed that their attitude toward AI was positive, despite difficulties in socio-cultural factors.

4.2 Attitudes toward AI according to gender

Looking at the difference in attitude toward AI by gender among GS, males (M = 2.79, SD = .51) had a more positive attitude toward AI than females (M = 2.90, SD = .49). Also, the difference according to gender was statistically significant, t = 3.96, $p< .01$. Although there was no significant difference in other

Table 2 Socio-Cultural Factors on Attitudes Toward AI

Factor*	Group	*M*	*SD*	*t*	*p*
SIAI	GS	3.19	.88	2.51	.01*
	DS	3.06	.91		
CAI	GS	2.88	.60	7.53	.00*
	DS	2.61	.67		
IAI	GS	2.44	.76	11.05	.00*
	DS	1.94	.69		
EIAI	GS	3.23	.81	7.67	.00*
	DS	2.85	.83		
CHAI	GS	2.47	.84	3.89	.00*
	DS	2.26	1.17		
Total	GS	2.86	.50	10.03	.00*
	DS	2.56	.54		

*$p < .05$

SIAI: Social influence of AI, CAI: Communication with AI, IAI: Situations of interaction with AI, EIAI: Emotions in interaction with AI, CHAI: Characteristics of AI

factors, there was a significant difference between males (M = 2.95, SD = .91) and females (M = 3.32, SD = .84) only when it came to the social influence factor of AI, t = -7.32, $p < .01$.

Within the DS group, there was no difference in attitudes toward AI between males and females, t = -.47, p= .64. Regarding the other factors, there was a significant difference only in the social influence of AI, t = -2.54, $p= .01$. Even among DS, males (M = 2.94, SD = .96) had a more positive attitude toward the social impact of AI than females (M = 3.19, SD = .82) (as shown in Table 3).

4.3 Attitudes toward AI based on indirect experiences with AI

Among GS, students with indirect experiences of AI (M = 2.85, SD = .50) had lower attitudes toward AI those without experience (M = 3.02, SD = .43), and the difference between the two groups was statistically significant, t = -3.34, $p< .01$. Regarding the factors, there were significant differences in all other factors except for situations of interaction with AI (t = -1.51, $p = .13$). Regarding the social influence of AI, students with indirect experience of AI (M = 3.21, SD = .87) had a more negative attitude toward AI than students without experience (M = 2.97, SD = .99). On the other hand, the more experienced the remaining three factors, the more positive the attitude toward AI.

Among DS, students with indirect experience (M = 2.55, SD =.55) had a more positive attitude toward AI than students without experience (M = 2.73, SD =.40). However, the difference in attitude toward AI based on indirect experience was not statistically significant, t = -1.09, $p = .27$. There was no difference according to indirect experience for all factors (as shown in Table 4).

Table 3 Middle school students' attitudes toward AI according to gender

Group	Factor	Group	*M*	*SD*	*t*	*p*
GS	SIAI	Male	2.95	.91	-7.32	.00*
		Female	3.32	.84		
	CAI	Male	2.86	.62	-1.02	.31
		Female	2.90	.59		
	IAI	Male	2.39	.79	-1.45	.15
		Female	2.46	.75		
	EIAI	Male	3.19	.83	-1.24	.22
		Female	3.25	.80		
	CHAI	Male	2.51	.96	1.19	.23
		Female	2.45	.76		
	Total	Male	2.79	.51	-3.96	.00*
		Female	2.90	.49		
DS	SIAI	Male	2.94	.96	-2.54	.01*
		Female	3.19	.82		
	CAI	Male	2.66	.68	1.67	.10
		Female	2.54	.66		
	IAI	Male	1.97	.72	1.05	.29
		Female	1.90	.65		
	EIAI	Male	2.84	.85	-.35	.73
		Female	2.87	.80		
	CHAI	Male	2.21	1.21	-.71	.48
		Female	2.30	1.14		
	Total	Male	2.54	.57	-.47	.64
		Female	2.57	.51		

$^{*}p< .05$

4.4 Attitudes toward AI according to direct experiences with AI

Among GS, students with direct experience of AI (M = 2.82, SD = .51) had lower attitudes toward AI than students without experience (M = 2.99, SD = .43), and the difference in attitude was statistically significant, t = -5.36, *p*< .01. Regarding the factors, statistically significant differences were found in all factors except for the social influence of AI (t = -.55, *p* = .58). In addition, students with direct experience had a more positive attitude toward AI than students without experience.

Among DS, students with direct experience (M = 2.53, SD = .55) had a lower attitude toward AI than those without experience (M = 2.66, SD = .50), but the difference between the two groups was not statistically significant, t = -1.76, *p* = .08. Regarding the factors, there was a significant difference only in communication with AI (t = -3,35, *p*< .01), and no significant differences were found for the other factors. Therefore, for DS, there was no difference based on the direct experience of AI because of socio-cultural factors (as shown in Table 5).

Table 4 Middle school students' attitudes toward AI according to indirect experiences with AI

Group	Factor	Experience	*M*	*SD*	*t*	*p*
GS	SIAI	Yes	3.21	.87	2.71	.01*
		No	2.97	.99		
	CAI	Yes	2.86	.60	-5.86	.00*
		No	3.21	.57		
	IAI	Yes	2.43	.76	-1.51	.13
		No	2.54	.86		
	EIAI	Yes	3.21	.80	-2.87	.00*
		No	3.45	.89		
	CHAI	Yes	2.42	.81	-7.47	.00*
		No	3.04	.95		
	Total	Yes	2.85	.50	-3.34	.00*
		No	3.02	.43		
DS	SIAI	Yes	3.06	.91	-0.02	.98
		No	3.06	.90		
	CAI	Yes	2.59	.67	-1.86	.06
		No	2.96	.45		
	IAI	Yes	1.94	.69	-0.21	.83
		No	1.98	.61		
	EIAI	Yes	2.85	.83	-0.62	.54
		No	3.00	.74		
	CHAI	Yes	2.24	1.18	-1.23	.22
		No	2.67	1.05		
	Total	Yes	2.55	.55	-1.09	.27
		No	2.73	.40		

*$p < .05$

4.5 Attitudes toward AI according to experiences of AI education

Among GS, students with experience with AI education (M = 2.85, SD = .48) had a more positive attitude toward AI than students without experience (M = 2.88, SD = .52). However, there was no significant difference in the attitude toward AI (t = -.88, $p < .38$).

Looking at the factors, there was no difference in the social impact of AI based on experience of education (t = 1.53, $p = .13$). Significant differences were found in communication with AI (t = -4.11, $p < .01$), situations of interaction with AI (t = 2.26, $p = .02$), emotions in interaction with AI (t = -2.67, $p = .01$), and characteristics of AI (t= -2.07, $p = .04$). Students with AI education experience had more negative interactions with AI, but communication with AI, emotions in interaction with AI, and characteristics of AI were more positive if they had educational experience.

Among DS, students with experience with AI education (M = 2.46, SD =.59) had a more positive attitude toward AI than those without (M = 2.61, SD = .51). Moreover, attitudes toward AI according to experience were statistically significant, t =

Table 5 Middle school students' attitudes toward AI according to direct experiences with AI

Group	Factor	Experience	*M*	*SD*	*t*	*p*
GS	SIAI	Yes	3.18	.90	-.55	.58
		No	3.21	.84		
	CAI	Yes	2.84	.61	-5.26	.00*
		No	3.04	.55		
	IAI	Yes	2.39	.78	-3.72	.00*
		No	2.57	.71		
	EIAI	Yes	3.18	.82	-3.93	.00*
		No	3.38	.77		
	CHAI	Yes	2.40	.83	-5.83	.00*
		No	2.70	.81		
	Total	Yes	2.82	.51	-5.36	.00*
		No	2.99	.43		
DS	SIAI	Yes	3.06	.91	.21	.83
		No	3.04	.88		
	CAI	Yes	2.55	.67	-3.35	.00*
		No	2.84	.61		
	IAI	Yes	1.91	.67	-1.73	.08
		No	2.07	.75		
	EIAI	Yes	2.85	.86	-.39	.70
		No	2.89	.71		
	CHAI	Yes	2.22	1.21	-1.01	.31
		No	2.38	1.00		
	Total	Yes	2.53	.55	-1.76	.08
		No	2.66	.50		

*$p < .05$

-2.58, p = .01. Regarding the factors, there was a statistically significant difference between AI and communication (t = -2.64, p = .01) and AI emotional exchange (t = -3.38, p =.01). In particular, there were statistically significant differences in communication with AI (t = -2.64, p =.01) and emotions in interaction with AI (t = -3.38, p< .01), and students with educational experience had a more positive attitude (as shown in Table 6).

Unlike direct and indirect experiences, there was no difference in attitude among GS but a difference in attitude among DS. Among DS, students with experience in AI education cultivated a positive attitude toward AI.

4.6 Attitudes toward AI according to interest toward AI

Among GS, the higher the interest toward AI, the more positive the attitude toward AI, and there was a difference in attitude toward AI based on the degree of interest toward AI, F(4, 1322) = 54.08, p< .01. In the post-hoc test, attitude toward AI according to interest toward AI in GS was divided into four group that responded "not very interested" (M = 3.12, SD = .52) and "not interested" (M = 3.08, SD = .41), the group that responded "neutral" (M = 2.93, SD =. .42), the group that responded "I am interested" (M = 2.70, SD= .47), and the group that responded "I am very interested" (M = 2.48, SD = .65), and significant differences were found between the groups. In summary, GS had different attitudes toward AI based on their degree of interest toward AI, and the higher the interest toward AI, the more positive the attitude toward AI. In the detailed factors of attitude toward AI, the results of the post-hoc test were different for each factor. Generally, detailed factor in attitude toward AI was divided into a group that responded "no interest toward AI", "neutral", "interested", "very interested", and there was a difference in attitude toward AI between the groups. In addition, the higher the interest toward AI, the more positive the attitude toward AI was.

Among DS, In DS, as interest toward AI increased, the attitude toward AI was positive, $F(4, 345) = 10.93$, $p < .01$. In the post-hoc test results, DS were divided into three groups—the group that responded "not interested" (M = 2.93, SD = .53) and "neutral" (M = 2.75, SD = .46), the group that responded "interested" (M =

Table 6 Middle school students' attitudes toward AI according to experiences of AI education

Group	Factor	Experience	*M*	*SD*	*t*	*p*
GS	SIAI	Yes	3.22	.88	1.53	.13
		No	3.15	.89		
	CAI	Yes	2.83	.59	-4.11	.00*
		No	2.96	.61		
	IAI	Yes	2.48	.76	2.26	.02*
		No	2.38	.77		
	EIAI	Yes	3.18	.79	-2.67	.01*
		No	3.30	.83		
	CHAI	Yes	2.43	.81	-2.07	.04*
		No	2.52	.87		
	Total	Yes	2.85	.48	-.88	.38
		No	2.88	.52		
DS	SIAI	Yes	2.98	.93	-1.14	.25
		No	3.10	.89		
	CAI	Yes	2.48	.72	-2.64	.01*
		No	2.68	.63		
	IAI	Yes	1.90	.71	-.70	.49
		No	1.96	.67		
	EIAI	Yes	2.79	.91	-1.07	.28
		No	2.89	.78		
	CHAI	Yes	1.98	1.16	-3.38	.00*
		No	2.41	1.16		
	Total	Yes	2.46	.59	-2.58	.01*
		No	2.61	.51		

*$p < .05$

2.54, SD = .51), and the group that responded “very interested” (M = 2.32, SD =.54); the difference between the groups was statistically significant, F(4, 345) = 10.93, p < .01(as shown in Table 7). Participants indicating "Not very interested" reported an average attitude score towards AI of M= 2.53, SD= .83. Unexpectedly, the data suggests that participants who expressed lower interest demonstrated a more positive attitude toward AI compared to their counterparts who were interested. Previous findings intimated a positive correlation between increasing interest in AI and a favorable attitude toward it; however, the results for the "Not very interested" category deviated from this trend. This inconsistency might be attributed to the limited sample size: only two participants in the DS category marked "Not very interested." Such a small dataset could have inadvertently skewed the results. Consequently, future research should consider a larger sample size when investigating the relationship between interest in AI and attitudes toward it, ensuring a more comprehensive analysis.

The higher the interest toward AI, the more positive the attitude toward AI. These results were the same for both GS and DS. Hence, it was confirmed that middle school students’ interest toward AI influenced their attitude toward AI and that interest toward AI should be increased to positively change their attitude toward AI. In addition, the degree of interest toward AI affected the attitude toward AI, regardless of socio-cultural factors.

4.7 Attitudes toward AI according to experience with programming language type

GS showed a significant difference in attitude toward AI according to experience of programming language type. Attitude toward AI was the highest among students who had no experience with programming languages (M = 2.97, SD = .42), followed by students who had experience with text-based programming languages (M = 2.93, SD = .36) and students who had experience with block-based programming language (M= 2.86, SD = .50). Finally, students who had experience with both block and text (M= 2.65, SD = .61) had the lowest attitude toward AI. Also, the difference between the groups was statistically significant, F(3, 1322) = 16.90, p< .01.

In the post-hoc test, students who had no experience with programming languages and those who had experience with text-based programming languages had more negative attitudes than those who had experience with block-based programming languages, and those with experience with both languages had the most positive attitudes(M= 2.65, SD= .61). Regarding the factors, significant differences were found in all factors except for the social influence of AI (F(3, 1322) = 1.95, p =.12). The post-hoc tests showed that there were differences depending on the factors, but students who had experience with both block and text had the most positive attitudes toward AI, and students who did not experience programming languages had the most negative attitudes.

DS also showed a significant difference in attitude toward AI according to the type of programming language experience, F(3, 1322) = 5.55, p< .01. Students who had experience with block and text-based programming languages (M = 2.43, SD = .57) had the most positive attitude toward AI. Students with experience with text-based programming languages (M = 2.46, SD = .45), students with experience with block-based programming languages (M = 2.56, SD =.54), and students without programming experience (M = 2.78, SD = .46) showed negative attitudes. In the post-hoc test, students who experienced block- and text-based programming languages had a significantly more positive attitude than those who had experience with block-based programming languages and those who did not have experience with programming languages.

Regarding the factors, significant differences were found in communication with AI ($F(3, 1322) = 6.24$, $p< .01$), situations of interaction with AI ($F(3, 1322) = 5.79$, $p< .01$), and emotions in interaction with AI, $F(3, 1322) = 2.79$, p =.04. In

Table 7 Middle school students' attitudes toward AI according to interest toward AI

Group	Factor	Group	*M*	*SD*	*F*	$p^{(post\text{-}hoc)}$
GS	SIAI	Not very interested	3.16	1.26	3.78	.00* (b>e)
		Not interested	3.35	.81		
		Neutral	3.21	.79		
		Interested	3.14	.85		
		Very interested	2.99	1.14		
	CAI	Not very interested	3.26	.67	57.93	.00* (a,b>c>d>e)
		Not interested	3.14	.47		
		Neutral	2.96	.48		
		Interested	2.69	.58		
		Very interested	2.40	.79		
	IAI	Not very interested	2.40	.94	14.72	.00* (b,c>d,e)
		Not interested	2.59	.74		
		Neutral	2.55	.67		
		Interested	2.25	.70		
		Very interested	2.17	1.03		
	EIAI	Not very interested	3.81	.95	40.56	.00* (a,b>c>d>e)
		Not interested	3.57	.76		
		Neutral	3.24	.70		
		Interested	3.06	.71		
		Very interested	2.71	1.04		
	CHAI	Not very interested	3.15	1.11	54.43	.00* (a>b,c>d>e)
		Not interested	2.70	.71		
		Neutral	2.59	.71		
		Interested	2.19	.74		
		Very interested	1.86	.96		
	Total	Not very interested	3.12	.52	54.08	.00* (a,b>c>d>e)
		Not interested	3.08	.41		
		Neutral	2.93	.42		
		Interested	2.70	.47		
		Very interested	2.48	.65		

Table 7 (continued)

Group	Factor	Group	*M*	*SD*	*F*	$p^{(post\text{-}hoc)}$
DS	SIAI	Not very interested	2.00	1.41	1.90	.11
		Not interested	3.29	.94		
		Neutral	3.20	.87		
		Interested	3.00	.86		
		Very interested	2.99	.97		
	CAI	Not very interested	3.25	1.06	12.82	.00* (b,c>d,e)
		Not interested	2.97	.66		
		Neutral	2.89	.61		
		Interested	2.59	.60		
		Very interested	2.28	.68		
	IAI	Not very interested	1.75	1.06	2.79	.03*
		Not interested	2.21	.72		
		Neutral	2.08	.64		
		Interested	1.90	.66		
		Very interested	1.81	.72		
	EIAI	Not very interested	3.33	.47	11.13	.00* (b>c,d>e)
		Not interested	3.56	.73		
		Neutral	3.01	.76		
		Interested	2.88	.79		
		Very interested	2.48	.81		
	CHAI	Not very interested	2.50	.71	4.49	.00* (b,c>e)
		Not interested	2.67	1.10		
		Neutral	2.51	1.09		
		Interested	2.29	1.18		
		Very interested	1.87	1.18		
	Total	Not very interested	2.53	.83	10.93	.00* (b,c>d>e)
		Not interested	2.93	.53		
		Neutral	2.75	.46		
		Interested	2.54	.51		
		Very interested	2.32	.54		

a: Not very interested; b: Not interested; c: Neutral; d: Interested, e: Very interested.

*$p < .05$

the post-hoc test, students who did not have experience with programming in common had more negative attitudes than those who experienced block- and text-based programming languages. Students who had programming experience and who experienced both block and text had a more positive attitude toward AI, which was true among both GS and DS (as shown in Table 8).

4.8 Discussion

The NIA (2022) stated that the digital divide between GS and DS occurs because of socio-cultural factors and that the digital divide does not exist in accessibility but in competency or application (NIA, 2022). According to TAM, GS and DS have a gap in the use or utilization of AI, so there could be a difference in attitude, which would be an influencing factor. According to the NIA (2022), GS had a higher level of use (competency) or application of digital devices than DS. Therefore, GS should have a more positive attitude toward AI than DS (Marangunić & Granić, 2015; NIA, 2022; Scherer et al., 2019). However, in the results of the present study, DS had a more positive attitude toward AI than GS.

Park and Shin (2017) conducted a study on Korean students' perceptions of AI technology across different school levels. The study revealed that elementary school students perceived AI as a convenient technology, whereas middle and high school students perceived it as either a scary technology or one that varied depending on its purpose of use (Park & Shin, 2017). Consequently, the study found that elementary school students were more receptive to technologies such as robots and AI than middle and high school students (Shin & Kim, 2007; Park & Shin, 2017).

Shin et al. (2018) analyzed students' perceptions of AI by examining their images of AI. The study showed that students' relationship representations of AI were divided into servant, enemy, and friend, while form representations included human, household item, machine, computer, chip or brain, and algorithm. Students who perceived AI as a friend believed that the form of AI was closer to humans. Conversely, students who perceived AI as a servant saw AI as a household item or a machine, whereas those who perceived AI as an enemy viewed it as a computer, chip, or brain (Shin et al., 2018). The study confirmed that the more students experience AI education, the more they perceive AI as a computer or source code, leading to negative attitudes and perceptions toward AI (Shin et al., 2018; Ryu & Han, 2017). GS had more experience with AI education than DSs in this study. Therefore, the results were similar to previous studies, indicating that AI education paradoxically creates negative feelings and attitudes toward AI.

Thus, it is crucial to explore the necessary approach to prevent the formation of negative emotions and attitudes toward AI. Shin et al. (2018) found that when participants perceived AI as human, they perceived AI as a friend (Shin et al., 2018). Kim (2022) conducted a metaphor analysis to examine Korean students' perceptions of AI. The study identified AI as a function, possibility, emotion, tool, and operation through the analysis of the students' metaphorical expressions. Attitudes toward AI were more positive when examining metaphor types such as "human" and "friend" functions and possibilities like "life" and "mind" (Fast & Horvitz, 2017; Kim, 2022). These studies highlight the need for anthropomorphism in AI. Anthropomorphism of computers and robots has been studied since before AI, and it has been demonstrated that the more people perceive a technology to be similar to humans, the more they interact with and utilize it (Nass et al., 1999; Pelau et al., 2021). Therefore, it is confirmed that anthropomorphism in technologies such as intelligent robots impacts not only attitudes toward the technology but also interactions and behaviors (Hancock et al., 2011).

Prior to the current utilization of AI technology, students formed their perceptions and images of AI through movies and media, leading them to perceive AI in the form of cyborgs (Kim, 2022; Shin et al., 2018; Park & Shin, 2017). With the development of AI technology, AI is now perceived as a social actor like conventional computers through chatbots and AI speakers (Epley et al., 2007; Nass et al., 1993).

However, as AI education in Korea typically involves comprehending the abstract principles of AI and practicing technology-oriented exercises, students' attitudes and perceptions of AI have changed negatively (Kim, 2022; Shin et al., 2018; Cho et al., 2022). Thus, it is necessary to introduce various outputs in AI education, increase familiarity with AI, and understand how to use AI in a human-centered way (Cho

Table 8 Middle school students' attitudes toward AI according to experience with programming language type

Group	Factor	Experience	*M*	*SD*	*F*	$p^{(post\text{-}hoc)}$
GS	SIAI	None	3.17	.87	1.95	.12
		Block	3.24	.87		
		Text	3.12	.87		
		Both	3.07	.97		
	CAI	None	3.02	.55	16.74	$.00^{(a>b,c>d)}$
		Block	2.89	.58		
		Text	2.90	.51		
		Both	2.63	.72		
	IAI	None	2.54	.79	9.59	$.00^{(c>b,a>d)}$
		Block	2.42	.73		
		Text	2.66	.81		
		Both	2.21	.79		
	EIAI	None	3.35	.82	5.70	$.00^{(a,b>d)}$
		Block	3.23	.80		
		Text	3.19	.66		
		Both	3.04	.87		
	CHAI	None	2.77	.82	29.27	$.00^{(a,c>b>d)}$
		Block	2.40	.78		
		Text	2.73	.82		
		Both	2.13	.89		
	Total	None	2.97	.42	16.90	$.00^{(a,c>b>d)}$
		Block	2.86	.50		
		Text	2.93	.36		
		Both	2.65	.61		

Table 8 (continued)

Group	Factor	Experience	M	SD	F	$p^{(post\text{-}hoc)}$
DS	SIAI	None	3.25	.72	1.44	.23
		Block	3.01	.98		
		Text	2.87	.73		
		Both	3.07	.91		
	CAI	None	2.83	.67	6.24	$.00^{(a,b>d)}$
		Block	2.66	.63		
		Text	2.48	.49		
		Both	2.39	.72		
	IAI	None	2.18	.77	5.79	$.00^{(a>d)}$
		Block	1.93	.64		
		Text	2.12	.61		
		Both	1.75	.67		
	EIAI	None	3.11	.70	2.79	$.04^{(a>d)}$
		Block	2.84	.78		
		Text	2.71	.92		
		Both	2.75	.94		
	CHAI	None	2.42	1.06	1.72	.16
		Block	2.32	1.18		
		Text	1.91	.62		
		Both	2.11	1.32		
	Total	None	2.78	.46	5.55	$.00^{(a,b>d)}$
		Block	2.56	.54		
		Text	2.46	.45		
		Both	2.43	.57		

a: None; b: Block; c: Text; d: Both

$^{*}p < .05$

et al., 2022). It is imperative to incorporate the aforementioned contents not only in AI education but also in the development of AI products. During the utilization of AI products, it is vital to design them in a way that facilitates users in recognizing AI as a helpful and amiable entity, thereby preventing the formation of technostress, fear, or hostility towards AI.

There is a gender gap in computer science education or coding education, and research has been conducted to solve this problem (Aivaloglou & Hermans, 2019; Beyer et al., 2003; Fan & Li, 2005; Lee, 2013; McBroom et al., 2020; Wang et al., 2015). In addition, previous studies related to attitudes toward computers and robots have also shown that there was a gap because of gender (Comber et al., 1997; Kim et al., 2021; Lee, 2013; Lee et al., 2009; Shashaani, 1993; Shin & Kim, 2009). In the present study, significant gender differences were found only among GS. Hence, gender was influenced by socio-cultural factors in attitudes toward AI. When experiencing difficulties because of socio-cultural factors, students' attitudes toward AI were not affected by gender but were influenced by other factors instead (Kim et al., 2021; Lee et al., 2009; Shin & Kim, 2009).

Looking at the experiences related to AI, GS had a difference in attitude toward AI according to direct and indirect experiences with AI, and those with experience had a more positive attitude toward AI. Therefore, it has been confirmed that providing relevant experiences in AI education for middle school students can induce the cultivation of positive attitudes toward AI (Kim & Lee, 2016a, b, 2018; Kim et al., 2021; Lee, 2013, 2020; Shin & Kim, 2009). On the other hand, in DS, there was no difference between the direct and indirect experiences related to AI.

Unlike robots, in the real world, AI exists as intangible algorithms. Therefore, there were cases where students who lacked an understanding of AI considered robots and AI as being same concept (Shin et al., 2017, 2018). Because DS have a gap in experiencing the use or application of AI (NIA, 2022), these students could not distinguish AI from non-AI software or even when a user was using an AI-embedded device if that device had AI (Haring et al., 2014; Kim and Lee, 2016a, b, 2020b; Long & Magerko, 2020; Ng et al., 2021; Nomura et al., 2006).

On the other hand, in experience with AI education, there was no difference in attitude among GS but there was a difference in attitude among DS. In DS, students with an AI education experience had a positive attitude toward AI. DS had a smaller percentage of students who experienced AI education than GS, and the students who experienced AI education had a significantly positive attitude toward AI. Therefore, students experiencing difficulties because of socio-cultural factors can cause significant changes in their attitude toward AI through AI education. Hence, experiences related to AI are influenced by socio-cultural factors.

Based on the literature review, interest toward AI was the main factor causing the difference in attitude toward AI, and the higher the interest toward AI, the more positive the attitude toward AI was (Kim & Lee, 2020b; Kim et al., 2021). Similarly, in the present study, as interest toward AI increased, middle school students' attitudes toward AI became more positive, and these results were the same among GS and DS. Through this, interest toward AI was not affected by socio-cultural factors and was a factor that had a significant impact on the attitude toward AI of all students. As interest toward AI increased, the attitude toward AI was significantly positive. Therefore, a plan to increase interest toward AI is needed to positively change the attitude toward AI (Kim & Lee, 2018, 2020b; Kim et al., 2021; Shin & Kim, 2009). This result aligns with those in previous studies showing that the higher the level of programming, the more positive the attitude toward AI will be (Han, 2020; Lee et al., 2009).

Experience with a programming language had a significant effect on middle school students' attitudes toward AI, and students who did not have experience with programming languages had more negative attitudes toward AI than those who had experience with block- and text-based programming languages. Thus, experience with programming languages has a positive effect on attitude toward computer science, such as AI (Charters et al., 2014; Han, 2020; Kim and Lee, 2016b). However, the attitudes were different, depending on the type of programming language among GS and DS.

Among GS, students who had experience with block or block and text had a more positive attitude toward AI than students who did not experience programming. However, students who experienced text-based programming languages did not show a significant difference in their attitudes toward AI compared with students who did not have experience with programming. Therefore, middle school students who experienced only text-based programming languages such as Python or C did not change their attitudes toward AI. On the other hand, students who had experience with block and text languages had a more positive attitude toward AI than students with just experience with block. Therefore, learning a text-based programming language after learning a block-based programming language, such as Scratch, is effective in cultivating a positive attitude toward AI (Kim & Lee, 2020a; Maloney et al., 2010; Resnick et al., 2009). In addition, in the Korean curriculum, it is proposed to teach middle school students a class using a block-based programming language (Kim & Lee, 2016a, b; Lambić et al., 2021; Lee, 2018). The students who learned the text-based programming language learned this language without yet receiving this education, so it did not have a significant effect on their attitude toward AI. Hence, considering the ability and level of middle school students, appropriate education should be carried out for learners by utilizing a block-based programming language (Maloney et al., 2010; Resnick et al., 2009), and a curriculum for learning text-based programming language according to the learner's level should be used (Kim & Lee, 2017, 2019, 2020a; Lambić et al., 2021; Lee, 2018).

The study's findings revealed that, initially, DSs exhibited more favorable attitudes toward AI compared to GSs. However, post AI-education, the attitudes of DSs towards AI demonstrated a positive shift. These results underscore the significance of implementing AI education policies tailored for DSs. Although device accessibility is comparable in Korea, there remains a digital divide concerning practical use (NIA, 2022). This suggests that education stands as a pivotal means to bridge this utilization gap. Contrarily, for GSs, the benefits of AI education seem limited, echoing findings from earlier studies (Shin et al., 2018). Yet, it's noteworthy that both GSs and DSs displayed enhanced positive attitudes toward AI when exposed to programming languages and when their interest in AI was piqued. This indicates that AI education should be more application-oriented, drawing from real-life examples, rather than being solely theoretical. In fact, when students interacted with block and text-based programming languages or engaged with tangible AI projects, their attitudes toward AI significantly improved. The inference is clear: a structured AI curriculum transitioning from programming languages to hands-on projects is essential.

Furthermore, in light of the 2022 revised curriculum in South Korea which incorporates AI, it's crucial for both pre-service teachers and active educators to undergo relevant training or coursework. This is imperative not just for teaching AI-centric lessons but also for integrating AI tools in regular classes. For a successful integration of AI into classroom settings and for delivering effective education, it's vital for teachers, both current and upcoming, to foster a positive disposition toward AI. Hence, teacher training and pre-service teacher education should emphasize experiential learning with programming languages and methods to cultivate a keen interest in AI.

5 Conclusion

In the present study, the influence of socio-cultural factors on middle school students' attitudes toward AI was analyzed. The following conclusions were drawn: There was a difference in the attitudes of Korean middle school students toward AI based on socio-cultural factors. Students experiencing difficulties because of socio-cultural factors had a more positive attitude toward AI. On the other hand, gender showed different effects on attitudes toward AI based on socio-cultural factors. Among GS, there was a gender gap, but among DS, there was no gender difference.

Experiences related to AI appeared differently depending on the socio-cultural factors. There was no significant difference between direct and indirect experiences of AI among students experiencing difficulties because of socio-cultural factors. On the other hand, the experience of AI education showed that DS had a difference in attitude toward AI. Therefore, AI-related experiences were influenced by socio-cultural factors. DS were able to see the possibility of positively changing attitudes toward AI because of AI education experiences, though direct and indirect experiences of AI were not affected by the digital divide.

Interest toward AI was a major factor influencing middle school students' attitudes toward AI, regardless of socio-cultural factors. In particular, the higher the interest toward AI, the more positive the attitude toward AI was. In addition, the experience of the programming language was not affected by socio-cultural factors. Students who had experience with block- and text-based programming languages had a more positive attitude toward AI than students who did not have experience with programming languages. Hence, interest toward AI and programming language experience were factors causing the differences in middle school students' attitudes toward AI, regardless of socio-cultural factors.

Previous studies have shown that students experiencing difficulties because of socio-cultural factors have lower academic achievement, self-efficacy, and attitudes than GS. However, in the present study, attitudes toward AI were of DS higher than those of GS. In the current study, only middle school students' attitudes toward AI were analyzed according to socio-cultural factors, and no analyses were performed to measure the influence of each factor, such as correlation, path analysis, or structural equation. Therefore, future work is needed to analyze the influence of socio-cultural factors on attitudes toward AI by using personal characteristics and related factors.

In educational research, the overall development of learners is aimed at learner growth. Accordingly, not only the cognitive domain, but also the affective domain develops together. There are many factors in the affective domain in education, but the most representative factor is attitude toward the subject or content. In the present study, the influence of socio-cultural factors on attitudes toward AI was analyzed, which can be found as an effect of socio-cultural factors resulting from AI education.

In the present study, interest toward AI and experience with a programming language were found to be factors that influenced attitudes toward AI, regardless of socio-cultural factors. In educational research, interest toward a specific object or object is said to be a factor that affects the effectiveness or achievement of education. Therefore, to improve the effectiveness of education, research should be conducted on ways to increase interest toward subjects or contents. The current study showed that the higher the interest toward AI, the better the attitude toward AI. Therefore, like the results shown in previous educational studies, it was confirmed that interest toward AI affects the educational effect of AI and that there is no difference based on socio-cultural factors. Therefore, to increase the educational effect of AI, future studies are needed on ways to increase interest toward AI.

In a study of attitudes toward robots, differences in attitudes were found because of regionality according to regions or countries. According to the results of a comparison by country, the United States had a more positive attitude toward robots than Asian countries such as Korea and Japan, perceiving robots as colleagues or servants, depending on the country. Therefore, there will be differences in perceptions among countries in attitudes toward AI.

In a study investigating the perception of AI among elementary school students in Korea, each student perceived AI in a certain way, such as an enemy, colleague, or servant. This perception is greatly influenced by mass media, and perception can act as a major factor in forming attitudes. Therefore, like the research investigating perceptions and attitudes toward robots, attitudes toward AI will also differ by country or region. Therefore, it is necessary to conduct an international study that compares attitudes toward AI, here targeting middle school students.

Appendix 1

Table 9 Negative Attitude toward Artificial intelligence Scale

	Factor	Items	Cronbach α
NAAIS	Social influence of AI	If artificial intelligence behaves like humans, it seems that bad things will happen to humans.	.772
		I think the future society will be dominated by artificial intelligence.	
		If artificial intelligence has emotions, I would be anxious.	
		I am worried that artificial intelligence could have a bad influence on children.	
	Communication with AI	I can maintain a conversation with AI. *	.778
		I can communicate fluently with artificial intelligence. *	
		I can understand what artificial intelligence is saying. *	
		I can predict what AI will do. *	
	Situations of interaction with AI	I am very nervous about dealing with artificial intelligence.	.751
		I am nervous about manipulating and using artificial intelligence with other people.	
		I have anxiety to even think of artificial intelligence judging what it is.	
		I would be anxious to work in a job that works with artificial intelligence.	
	Emotions in interaction with AI	If AI has emotions, I can be friends with AI. *	.698
		I am comfortable living with artificial intelligence that has emotions. *	
		I am comfortable talking to artificial intelligence. *	
	Characteristics of AI	I know how fast artificial intelligence can do things. *	.623
		I understand how useful artificial intelligence can be. *	

*Reversed items

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Data availability The datasets generated during and/or analysed during the current study are not publicly available due to the student's personal information is included, and the IRB has decided not to disclose personal information to the outside but are available from the corresponding author on reasonable request.

Declarations

Financial interests The authors have no relevant financial or non-financial interests to disclose.

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