International Journal on Advanced Science Engineering Information Technology

Vol.13 (2023) No. 5
ISSN: 2088-5334

Change in Attitude toward Artificial Intelligence through Experiential Learning in Artificial Intelligence Education

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***Abstract*—Given the rapid advancements in artificial intelligence (AI), the education sector has been actively striving to instill AI-related competencies in students. In a notable development in 2022, South Korea took a pioneering step by overhauling its curriculum with a primary focus on enhancing students' AI skills. However, despite these efforts, a persistent challenge remains: many students continue to harbor unfavorable perceptions and attitudes toward AI. The existing educational methods have proven insufficient in addressing this issue. Consequently, this study embarked on a quest to identify effective strategies for cultivating a more positive outlook on AI among middle school students. To tackle this challenge head-on, an experiential learning-based AI education program was meticulously designed and implemented for middle school students in Korea. The study rigorously evaluated the program's impact on students' attitudes toward AI. The results unveiled a significant improvement in students' perceptions of AI following the intervention, providing solid empirical evidence of the efficacy of the experiential learning-based AI education program in reshaping middle school students' attitudes toward AI. This research underscores the paramount importance of practical, hands-on experiences in education as a potent means to bridge the gap between knowledge and perception. It offers invaluable insights that can guide the development of AI education curricula worldwide, emphasizing the indispensable role of experiential learning approaches in nurturing positive attitudes and beliefs about AI among students.**

***Keywords*—Attitude; experiential learning; artificial intelligence; middle school students; attitude artificial intelligence.**

Manuscript received 18 Dec. 2022; revised 29 Apr. 2023; accepted 11 Sep. 2023. Date of publication 31 Oct. 2023.

I. INTRODUCTION

The advancement of technology has brought about significant transformations in society, profoundly influencing our daily lives. In the contemporary world, the impact of technology on society continues to grow, with artificial intelligence (AI) emerging as a transformative force [1]. AI, a technology that simulates human intelligence using computers, enables problem-solving through recognition, reasoning, learning, and interaction. Fueled by the development of diverse algorithms, particularly in deep learning, AI has garnered considerable attention as a catalyst for change in modern society [2], [3]. Its influence extends well beyond computer science, permeating various domains, such as industry, economy, and society, thereby reshaping the fabric of human existence [4].

With the rising influence of AI, there has been a corresponding increase in the significance of cultivating talent for the advancement of AI technology. Numerous countries are incorporating AI education into their school curricula, while organizations and companies are actively promoting the revitalization of AI education. In line with this global trend, the Korean government has introduced various policies to foster AI expertise and recently unveiled a revised curriculum to strengthen AI education [5]–[7]. However, despite the burgeoning interest in AI education, Korean schools encounter challenges in its effective implementation [8]–[10].

Despite being exposed to AI through media and experiencing AI interactions with AI assistants and various devices, learners' attitudes toward AI have been found to be predominantly negative [9]–[14]. Elementary school students tend to hold positive perceptions and attitudes toward AI, while middle and high school students exhibit negative perceptions and attitudes [11], [13]. Moreover, direct and indirect experiences with AI can positively impact learners' attitudes [10], [11], [15], whereas AI education alone can neither significantly alter negative attitudes toward AI nor induce attitude change [9], [10]. Despite the increasing importance of AI education, Korean students continue to harbor negative perceptions and attitudes toward AI, with

limited evidence supporting the effectiveness of AI education in promoting attitude change.

In line with Korea's 2022 revised curriculum, which emphasizes digital AI literacy and reinforces AI education across elementary, middle, and high schools [5], the implementation of AI education in Korea is scheduled for 2025. However, the current educational landscape presents limitations in achieving the desired outcomes through AI education. In light of this challenge, the present study addresses how attitudes toward AI can be transformed through AI education. To accomplish this, an educational program incorporating experiential learning was developed and subsequently applied to middle school students in Korea to analyze any changes in attitudes toward AI.

II. Materials and Method

A. Materials

In a study investigating the attitudes of Korean middle school students toward robots, students with prior exposure to AI education were found to exhibit more negative attitudes toward AI. This negative perception was attributed to the unfavorable image and perception of AI developed through their AI education. Previous research has consistently demonstrated that negative attitudes toward AI arise from perceiving AI as an adversary (negative) rather than a colleague (positive) or a tool (neutral) [9], [10], [13], [15]. This implies that learners perceive AI as merely a computer program or a piece of source code as it lacks a tangible entity, thereby fostering their fears and concerns regarding AI [16]. The opaque nature of AI, referred to as a "black box," wherein the inner workings of the algorithm or program remain concealed, has contributed to learners' misconceptions about AI through education or experiences, thereby contributing to their negative attitudes toward AI [17], [18].

Shin et al. [9] noted that, in Korea, AI education primarily focuses on explaining principles and concepts, which can result in negative perceptions and attitudes toward AI. To address this issue, they suggested helping students comprehend AI concepts and principles through concrete examples and by showcasing their practical applications. Furthermore, they proposed facilitating students' understanding of the versatility and scalability of AI by using these examples. Therefore, to effectively alter the attitudes of middle school students toward AI, it is imperative to develop an educational program that provides them with opportunities to engage with real-life AI cases and applications, fostering these students' comprehension of AI concepts and principles while highlighting their applicability and scalability [9], [10], [13].

This study integrated experiential learning into AI education to cultivate positive attitudes toward AI. Experiential learning entails a process of synthesizing, structuring, and reflecting upon concrete experiences within an unstructured learning environment. One of the most prominent experiential learning models is Kolb's cyclical experiential learning model [19], which has been extensively applied in the field. According to Kolb's experiential learning theory, learners engage in a new learning situation and acquire knowledge through active participation (concrete experience). Subsequently, learners review and contemplate their learning experiences from multiple perspectives (reflective observation). Next, generalizations are formulated based on the outcomes of reflective observations (abstract conceptualization). Finally, learners validate the generalized concepts by actively applying them to learning situations using subjective judgment (active experimentation) [20]–[22].

Jun [21] devised an AI education program centered on experiential learning, catering to learners pursuing liberal arts education at the university level. The author formulated an AI education model rooted in experiential learning, encompassing four stages: AI experience, AI observation, AI conceptualization, and AI application. The AI experience stage entails engaging in hands-on activities and discussions concerning AI and delving into ethical considerations related to AI. Subsequently, the AI observation stage involves reflective contemplation while observing the various facets of AI technology and contemplating ethical alternatives. Next, the AI conceptualization stage centers on comprehending AI technologies and principles, drawing upon diverse AI-related issues and case studies. Finally, the AI application stage involves designing one's own AI project, allowing for practical application and implementation.

In this study, Jun's [21] experiential learning-based AI education program was adapted to suit the requirements of middle school students' AI education. Drawing from the Korean AI content system and the revised curriculum of 2022, we formulated the following learning contents: understanding AI (grasping AI concepts and characteristics and AI-based problem-solving), AI and data (recognizing the significance of data, data collection and analysis), and AI application (learning through AI, AI-based problem-solving, and project development) [5], [19], [23], [24]. Consequently, the educational model encompasses experience, observation, conceptualization, and experimentation phases. During the experience phase, learners explore and engage with real-life instances of AI implementation. In the observation phase, learners contemplate the applicability and scalability of AI by reflecting on their experiences. The conceptualization phase aims to foster an understanding of AI concepts and principles based on previous observations. Finally, in the experimentation phase, students are encouraged to create AI programs that cater to real-life needs.

B. Methods

1) Participants: 50 first-year junior high school students were selected for this study. The subjects were chosen from two schools to differentiate between the control and experimental groups. The experimental and control groups comprised 25 students each. Both schools were located in South Korea and classified as middle schools. The gender distribution of the subjects was approximately equal, with similar proportions of males and females in each group. The students had undergone 17 hours of software (SW) education, which included designing algorithms, creating programs, and engaging in physical computing per the 2015 revised curriculum in South Korea. A significant number of students had prior direct or indirect exposure to AI, as evidenced by attitudinal research on AI. Additionally, approximately 60% of the students had received AI education. Consequently, although the students possessed considerable exposure to and

familiarity with AI, they lacked experience in comprehending its concepts or developing practical applications.

2) Treatment: The study was conducted during the first semester of the 2022 academic year, specifically from March to July. A total of 15 h were dedicated to the AI training program, which was developed based on the principles of experiential learning. The training program encompassed four key stages: experience, observation, conceptualization, and experimentation.

During the experience phase, the participants delved into the world of self-driving cars and engaged in activities that allowed them to gain first-hand experience. In the observation stage, the focus shifted to exploring how AI technology employed in self-driving cars could be applied to various contexts and expanded upon. The conceptualization phase involved an in-depth explanation of AI concepts related to the technology used in self-driving cars, enabling object recognition and obstacle avoidance. Additionally, students honed their skills in adopting this technology by designing and creating programs in a block-based programming environment.

In the final stage, experimentation, the students collaborated on a team project to develop a practical AI product. In particular, they worked on creating a robotic vacuum cleaner using microbits and husky lenses. The project's objective was to design a robot vacuum cleaner capable of navigating obstacles within a classroom setting and effectively cleaning targeted areas where trash was located [25], [26].

In South Korea, middle school students follow a mandatory national curriculum, ensuring uniform education across schools. For this study, the research was conducted in 2022, during which education was provided under the 2015 revised curriculum for middle schools. In the middle school information course this curriculum covers various topics, such as digital ethics, computer structure, data and information, abstraction, algorithms, programming, and physical computing. Therefore, the participants in this study were enrolled in the middle school information course and received instruction on digital ethics, data and information, and abstraction throughout the treatment period [5].

However, the revised curriculum did not include any AI-related education apart from the treatment provided in this study [27]. Hence, before the intervention, the students did not receive any formal education on AI within the framework of the information curriculum.

3) Test tool: The instrument used in this study was the attitudes toward artificial intelligence in middle school students questionnaire [15], [28], [29]. This questionnaire was specifically designed to assess attitudes toward AI, drawing upon previous research on attitudes toward computers and robots. It comprises 17 questions and employs a 5-point Likert scale for responses. The questionnaire encompasses various dimensions, including the social influence of AI (4 items), communication with AI (4 items), situations involving interaction with AI (4 items), emotions experienced during interaction with AI (3 items), and characteristics of AI (2 items). The internal consistency of the questionnaire, as measured with Cronbach's α, ranged from .623 to .772, indicating acceptable reliability. The reverse items were appropriately reversed in the questionnaire. Therefore, higher scores on the questionnaire indicated a more positive attitude toward AI among the participating students [15].

4) Analysis: This study aimed to assess the effectiveness of an experimental learning-based AI training program by implementing it in the experimental group. To achieve this goal, pre-test and post-tests were conducted on the experimental and control groups before and after the intervention. To examine the comparability of the two groups, the pre-test scores of both groups were analyzed using an independent sample t-test. Similarly, the post-test scores were analyzed using the same approach for both groups. Additionally, the difference between the pre-and post-test scores was analyzed using a paired sample t-test to evaluate changes within each group. Based on the findings of these analyses, the impact of the experiential Haxon-based AI education program on Korean middle school students was examined.

III. Results and Discussion

To assess the initial disparity between the experimental and control groups prior to the intervention, a pre-test was conducted to compare middle school students' attitudes toward AI. The findings revealed no statistically significant difference between the experimental group (M = 3.01, SD = .39) and control group (M = 3.04, SD = .41), t = -.33, p = .74. This indicates that there was no significant disparity in the attitudes of the two groups before the implementation of the intervention. Furthermore, no significant differences were observed between the two groups in the specific factors examined (See Table 1).

TABLE I
ATTITUDES TOWARD AI IN EXPERIMENTAL AND CONTROL GROUPS IN PRE-TEST

Domain	Group	*M*	*SD*	*t*	*p*
Social influence of AI	Exp.	3.36	.62	.05	.96
	Con.	3.35	.88		
Communication with AI	Exp.	2.78	.69	-1.59	.12
	Con.	3.08	.64		
Situations of interaction with AI	Exp.	2.70	.67	1.32	.19
	Con	2.46	.62		
Emotions in interaction with AI	Exp.	2.89	.92	-.10	.92
	Con.	2.92	.94		
Characteristics of AI	Exp	3.54	.88	-.73	.47
	Con.	3.72	.87		
Total	Exp.	3.01	.39	-.33	.74
	Con.	3.04	.41		

Upon examining the alteration in attitudes toward AI within the control group, it was observed that the attitudes became more negative in the post-test (M = 3.02, SD = .51) compared to the pre-test (M = 3.04, SD = .41). However, no statistically significant difference was found between the pre-test and post-test (t = .16, p = .88). Consequently, no changes in attitudes toward AI were evident among Korean middle school students following the regular curriculum. In terms of specific factors, the social influence of AI (t = .42, p = .68), situations of interaction with AI (t = .87, p = .39), and

characteristics of AI (t = -.56, p = .58) displayed a negative shift in attitude from the pre-test to the post-test, whereas communication with AI (t = -.63, p = .54) and emotions in interaction with AI (t = .05, p = .96) demonstrated a positive shift in attitude within the same period (See Table 2). However, no statistically significant differences were detected in any of the factors, indicating that the control group did not exhibit significant changes between the pre-test and post-test. Thus, it can be deduced that the 2015 revised curriculum, implemented in the first grade of middle school in Korea, does not substantially alter attitudes toward AI among middle school students.

TABLE II
CHANGES IN ATTITUDES TOWARD AI IN THE EXPERIMENTAL GROUP THROUGH TREATMENT

Domain	Group	*M*	*SD*	*t*	*p*
Social influence of AI	Exp.	3.35	.88	.42	.68
	Con.	3.23	1.01		
Communication with AI	Exp.	3.08	.64	-.63	.54
	Con.	3.21	.80		
Situations of interaction with AI	Exp.	2.46	.62	.87	.39
	Con	2.30	.73		
Emotions in interaction with AI	Exp.	2.92	.94	.05	.96
	Con.	2.91	.83		
Characteristics of AI	Exp	3.72	.87	-.56	.58
	Con.	3.86	.84		
Total	Exp.	3.04	.41	.16	.88
	Con.	3.02	.51		

Subsequently, we analyzed the alterations in attitudes toward AI among middle school students who received experiential learning-based AI education. The post-test (M = 3.64, SD = .44) results exhibited a positive shift in attitudes toward AI compared to the pre-test (M = 3.01, SD = .39), and this disparity proved to be statistically significant (t = -4.54, p < .01). This confirms the efficacy of the experiential learning-based AI education program in fostering a favorable transformation in the attitudes of middle school students toward AI. Furthermore, all factors underwent an increase in values from the pre-test to the post-test. However, the difference between the two tests was not significant for emotions in interaction with AI (t = -1.92, p = .07). Consequently, this study provides concrete evidence that the experiential learning-based AI education program effectively promotes a positive shift in middle school students' attitudes toward AI. Moreover, it highlights the significant impact of the social influences of AI (t = -2.70, p = .01), communication with AI (t = -5.19, p = .01), situations of interaction with AI (t = -2.48, p = .02), and characteristics of AI (t = -2.56, p = .02) on attitude change (See Table 3).

To ascertain the modifications in the experimental group, we analyzed the disparity in attitudes toward AI between the experimental (M = 3.64, SD = .44) and control groups (M = 3.02, SD = .51) following the treatment. The post-test revealed that the experimental group exhibited significantly more positive attitudes toward AI compared to the control group (t = 4.59, p < .01). While no difference in attitudes toward AI was observed between the two groups in the pre-test, a significant difference emerged in the post-test, favoring the experimental group. This study highlights that attitudes toward AI, developed through experiential learning, significantly improve middle school students' attitudes toward AI.

TABLE III
CHANGES IN ATTITUDES TOWARD AI IN THE EXPERIMENTAL GROUP THROUGH TREATMENT

Domain	Group	*M*	*SD*	*t*	*p*
Social influence of AI	Exp.	3.36	.62	-2.70	.01*
	Con.	3.89	.60		
Communication with AI	Exp.	2.78	.69	-5.19	.00*
	Con.	3.78	.77		
Situations of interaction with AI	Exp.	2.70	.67	-2.48	.02*
	Con	3.24	.89		
Emotions in interaction with AI	Exp.	2.89	.92	-1.92	.07
	Con.	3.36	.85		
Characteristics of AI	Exp	3.54	.88	-2.56	.02*
	Con.	4.12	.56		
Total	Exp.	3.01	.39	-4.54	.00*
	Con.	3.64	.44		

*$p < .05$

Additionally, the experimental group demonstrated more positive attitudes across all detailed factors. However, although the disparity in attitudes between the experimental and control groups was significant in terms of the social influence of AI (t = 2.82, p = .01), communication with AI (t = 2.57, p = .01), and situations of interaction with AI (t = 4.08, p = .01), no significant difference was observed in emotions in interaction with AI (t = 1.91, p = .06) and characteristics of AI (t = 1.29, p = .20). Therefore, it was revealed that the experimental group exerted a significant effect on select factors rather than encompassing all factors (See Table 4).

TABLE IV
ATTITUDES TOWARD AI IN THE EXPERIMENTAL AND CONTROL GROUPS IN POST-TEST

Domain	Group	*M*	*SD*	*t*	*P*
Social influence of AI	Exp.	3.89	.60	2.82	.01*
	Con.	3.23	1.01		
Communication with AI	Exp.	3.78	.77	2.57	.01*
	Con.	3.21	.80		
Situations of interaction with AI	Exp.	3.24	.89	4.08	.00*
	Con	2.30	.73		
Emotions in interaction with AI	Exp.	3.36	.85	1.91	.06
	Con.	2.91	.83		
Characteristics of AI	Exp	4.12	.56	1.29	.20
	Con.	3.86	.84		
Total	Exp.	3.64	.44	4.59	.00*
	Con.	3.02	.51		

*$p < .05$

Shin et al. [9] emphasized incorporating concrete examples of AI applications and their utilization in AI-related education rather than solely focusing on abstract principles and mechanisms of AI or limiting AI education to a few forms.

Building on this premise, Jun [21] explored the potential of experiential learning in AI education. In line with these prior studies, in the present study, we developed an AI education program using experiential learning for middle school students and implemented it in the targeted demographic. The findings revealed that middle school students who underwent experiential learning-based AI education exhibited improved attitudes toward AI, albeit with varying levels of significance across different factors [10], [21], [30].

Experiential learning did not significantly impact the factors of emotions in interaction with AI and the characteristics of AI. Cho et al. [14] argued that AI education in Korea primarily focuses on understanding the principles and operations of AI, making it challenging for learners to engage fully with AI education. Given the societal shift toward coexistence with AI, it is imperative to shift the educational focus from AI technology-centered instruction to social and emotional education to reshape learners' attitudes toward AI. This necessitates transforming negative perceptions and attitudes toward AI through experiential encounters and fostering a sense of familiarity with it through activities that involve creating AI outputs [9], [13], [14],[31]–[33]. Consistent with this perspective, the present study employed experiential learning in AI education and found that the social influence of AI, communication with AI, and situations of interaction with AI positively shaped the behaviors of middle school students. Park and Shin [11] discovered that a significant proportion of Korean middle school students perceive AI as a daunting technology, indicating the importance of instilling positive perceptions and values regarding AI through education [9], [10], [13], [30]. In this study, we established that experiential learning serves as an effective instructional approach to cultivating positive perceptions of AI among middle school students.

However, no significant effects were observed for emotions in interaction with AI and the characteristics of AI. Kim [13] discovered a connection between attitudes toward AI and the metaphorical framing used to describe AI. In particular, when AI is perceived metaphorically as a "tool" or an "operation," it elicits minimal emotions or sentiments. In our study, we did not observe a significant change in emotions in interaction with AI, which can be attributed to the perception of AI as a tool in the context of problem-solving. Attitudes encompass multidimensional constructs, including emotions and cognition, and are shaped by human emotions and thoughts [10], [33], [34]. Therefore, in AI education utilizing experiential learning, it is crucial to educate students about AI's potential, possibilities, and functions, rather than solely perceiving it as a tool [13].

Although AI education is actively being conducted, there are aspects of AI that remain challenging to comprehend due to its "black-box" nature, where learners cannot directly observe the inner workings of AI [17], [18]. Middle school students, in particular, may struggle to understand the intricacies of AI in situations where abstract concepts or principles are difficult to grasp [9], [10], [13]. Given this context, it is reasonable to expect that AI education using experiential learning might not significantly impact middle school students' understanding of the characteristics of AI. Previous studies have demonstrated that AI, being an intangible algorithm, can form negative perceptions and attitudes when learners perceive it solely as a source code or a computer program [9], [16]. Student participation in AI education has been associated with an increase in perceiving AI as a source code or a program, leading to a rise in negative attitudes toward AI [9], [10], [13], [16]. In contrast to prior research, our study discovered that education can positively influence middle school students' attitudes toward AI. However, students' attitudes toward AI can be influenced by the metaphors they encounter, their perceptions, and their emotions, which highlights the need for further investigation in this domain [9], [11], [13], [16], [35], [36].

IV. Conclusion

This study aimed to examine approaches to fostering positive attitudes toward AI among middle school students. To achieve this, we designed an AI education program incorporating experiential learning and implemented it with middle school students. By undertaking this study, we sought to address the challenges faced in AI education in Korea and proposed innovative directions for AI education specifically tailored to middle school students.

The study results revealed that middle school students who participated in experiential learning-based AI education exhibited more positive attitudes toward AI. In contrast, students who received no AI-related training showed no change in their attitudes. This finding aligns with prior research indicating that AI education, primarily focusing on principles and operational aspects, can negatively impact learners' attitudes toward AI. In contrast, our study aimed to address the limitations of conventional AI education by designing an instructional program that emphasizes AI's practical application and scalability through real-world examples. Experiential learning was employed as the primary pedagogical approach. Implementing this educational program positively changed middle school students' attitudes toward AI. Consequently, our findings highlight the efficacy of experiential learning to overcome the challenges identified in previous studies on AI education for middle school students.

However, experiential learning did not yield significant effects on all aspects of attitudes toward AI. While the social influence of AI, communication with AI, and situations of interaction with AI exhibited positive changes through the AI education program, emotions in interaction with AI and the characteristics of AI did not show significant improvements. This outcome can be attributed to the influence of emotions, metaphors, and perceptions, which impact attitudes. In particular, as AI is intangible, learners' perceptions of AI may vary. Moreover, perceptions of AI can be shaped through education and direct or indirect experiences with AI and exposure to traditional or media sources. Consequently, future studies should thoroughly examine the influence of these perceptions, emotions, and metaphor types on attitudes toward AI. Furthermore, exploring the appropriate integration of experiential learning in AI education for middle school students is crucial, considering their emotions and perceptions.

In this study, we provided 15 h of AI education to middle school students. Despite organizing the content and projects according to the students' level, the learners encountered difficulties understanding AI's characteristics. Therefore,

future research should investigate the educational content and the time required for learners to comprehend AI concepts and principles and effectively engage in AI projects. As this aspect is closely related to program implementation, it should be examined with the programming learning process.

This study was confined to middle school students. However, considering that AI education will be incorporated into the 2022 revised curriculum in Korea, encompassing elementary and high schools as well, it is imperative to investigate AI education using experiential learning for students at different educational levels. Additionally, it is crucial to analyze the effectiveness of such education across various school settings. Consequently, theories on AI education methods and teaching approaches should be formulated based on specific school and learner levels. The allocated time for AI education in Korean elementary school education is merely 17 h. As previous studies have indicated, such limited duration often results in an instructional focus on AI principles, potentially leading to negative attitudes among learners. To mitigate this concern, it is necessary to examine elementary school students' attitudes toward AI subsequent to AI education and to explore strategies for cultivating positive attitudes.

Prior research has indicated the existence of multiple factors influencing attitudes, necessitating a comprehensive analysis of these factors. Hence, conducting an in-depth investigation of the various factors influencing attitudes is imperative and analyzing their impact on attitude formation through structural equation modeling is imperative. Moreover, it is essential to explore the factors influencing attitudes toward AI using diverse research methods, such as illustrations, interviews, and descriptive surveys. By doing so, we can examine the variations in attitudes toward AI based on these factors.

ACKNOWLEDGMENT

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2022R1G1A1004701).

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