PERSPECTIVES OF SCIENCE AND EDUCATION
PSEJOURNAL.WORDPRESS.COM
SCIENTIFIC ARTICLE |

The Impact of Adolescents' Attitudes Toward Artificial Intelligence Technology on Digital Literacy: The Mediating Role of Digital Self-Efficacy and the Moderated Mediation Effect of Household Income

Y. J. KIM

ABSTRACT

Introduction. The problem and the aim of the study. Enhancing digital literacy among adolescents is increasingly recognized as a key competency for future societal participation. This study is necessary to examine how attitudes toward artificial intelligence, along with psychological and socioeconomic factors – specifically digital self-efficacy and household income – jointly influence digital literacy, thereby providing empirical evidence to inform equitable and effective digital education policies. *This study aimed* to examine the mediating role of digital self-efficacy in the relationship between adolescents' attitudes toward artificial intelligence (AI) technology and their digital literacy, and to investigate whether this mediating effect is moderated by household income.

Research methods. Data were drawn from the 2023 Digital Divide Survey conducted by the National Information Society Agency (NIA) of Korea. A total of 329 adolescents aged 13 to 19 were selected based on the criteria of being enrolled in middle or high school, having access to mobile devices and the internet at home, and having prior experience with AI technologies. Data were analyzed using SPSS 24.0 and PROCESS Macro 4.3.

Results. The results showed that, first, a more positive attitude toward AI technology was significantly associated with higher levels of digital literacy (Coeffect = .506, $p < .001$). Second, digital self-efficacy significantly mediated the relationship between AI attitudes and digital literacy (Effect = .118, 95% CI [.044, .201]). Third, this mediating effect was significantly moderated by household income, such that the indirect effect was stronger among adolescents from higher-income households (Index = .025, 95% CI [.002, .057]).

Conclusion. This study highlights the need for an integrated approach to enhancing adolescents' digital literacy by considering psychological and socioeconomic factors alongside technical skills. It also underscores the importance of customized AI education and calls for future research using multi-group and qualitative methods to deepen contextual understanding.

KEYWORDS

attitudes toward AI technology, digital self-efficacy, digital literacy, household income, moderated mediation effect

For Citation: Kim, Y. J. (2025). The Impact of Adolescents' Attitudes Toward Artificial Intelligence Technology on Digital Literacy: The Mediating Role of Digital Self-Efficacy and the Moderated Mediation Effect of Household Income. *Perspektivy nauki i obrazovania = Perspectives of Science and Education*, (5), 726–737. https://doi.org/10.32744/pse.2025.5.47

Received: 23 April 2025 | Approved: 26 June 2025 | Published: 31 October 2025

INTRODUCTION

In recent years, international organizations such as UNESCO, the Council of Europe, and the Union of International Associations (UIA) have emphasized the critical importance of digital literacy and the ethical integration of artificial intelligence (AI) in education. UNESCO's "AI and Education: Guidance for Policymakers" [1] advocates for the responsible and inclusive use of AI technologies to enhance learning opportunities while ensuring equity and human-centered development. Similarly, the Council of Europe [2] has promoted digital citizenship education that prepares young people to navigate and critically engage with digital environments. These global initiatives reflect a growing consensus that digital skills—especially among adolescents—are foundational for active participation in contemporary knowledge societies.

Against this backdrop, the rapid advancement of artificial intelligence (AI) technology, driven by the Fourth Industrial Revolution, has accelerated digital transformation and introduced significant changes and challenges across all sectors of society. In particular, the release of ChatGPT by OpenAI in 2022 has drawn global attention as an innovative technology with applications in education, healthcare, finance, and law, thereby expanding its influence worldwide. Following the COVID-19 pandemic, AI technology has become deeply embedded in everyday life, especially with the widespread adoption of online learning, remote work, the metaverse, YouTube, Netflix, and e-commerce platforms [3].

AI is generally defined as the science of designing machines to simulate a wide range of human capabilities [1]. Technologies such as natural language processing (NLP), machine learning (ML), and generative AI have been increasingly applied to personalized learning recommendations, automated feedback systems, and intelligent tutoring systems, thereby expanding the potential of educational environments [3]. In response to these developments, many countries are strengthening education on the use and ethics of AI technologies. South Korea, for example, has integrated AI-related content into primary and secondary school curricula since 2021, aiming to cultivate digital talent for the future society [4].

However, the rapid pace of technological change has also led to a polarization in attitudes toward technology adoption. Even among digital natives, including adolescents, attitudes toward AI technology vary significantly [3]. Such attitudes—whether positive or negative—extend beyond mere preferences for or against technology; they are closely linked to an individual's level of digital literacy and, more broadly, to their capacity to engage meaningfully in future society. Digital literacy is not limited to technical proficiency but is defined as the ability to critically search for and evaluate information, as well as to act with digital ethics and social responsibility [5]. International frameworks such as the European Union's Dig Comp model and the OECD's digital competence framework also identify digital literacy as a core competency for the future [6; 7].

Another critical factor deserving attention is adolescents' attitudes toward AI technology. According to Davis's [8] Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) [9], the adoption of emerging technologies such as AI is determined by an individual's attitude, perceived usefulness, and perceived ease of use. Adolescents' attitudes toward AI are closely associated with their ability to engage with the technology—whether through active utilization or critical reflection—and these attitudes significantly influence the development of digital literacy.

From an educational perspective, adolescents' attitudes toward AI have become an important subject of inquiry. However, in South Korea, existing studies have primarily focused on perceptions and attitudes toward AI, rather than on their implications for digital literacy. For example, prior research has examined university students' perceptions of AI education [10], as well as their views on the implementation and instructional use of AI technologies [11]. In contrast, international studies have actively explored the broader impacts of AI on adolescents, including its influence on mental health [12], healthcare [13], and education [3]. These findings suggest that AI will increasingly exert a direct influence on various aspects of adolescents' lives soon.

Attitudes toward AI technology are recognized as a strong predictor of actual technology adoption [14]. Moreover, AI education is considered both a facilitator and a core component of digital literacy [15]. Recent studies have emphasized the transformative potential of digital literacy education incorporating AI tools [16] and have reported that the integration of AI into higher education is

accelerating innovation in digital literacy development [17]. Therefore, it is reasonable to expect that adolescents with more positive attitudes toward AI will exhibit higher levels of digital literacy.

Although adolescents are the generation most familiar with digital environments and are expected to lead future societies, they remain vulnerable in terms of critical engagement, ethical sensitivity, and the ability to discern reliable information [18]. Therefore, identifying the multifaceted factors that contribute to the development of digital literacy among adolescents holds both academic and policy-level significance.

Previous studies have identified various determinants of digital literacy, including home environment, school education, and socioeconomic background [19]. More recently, however, psychological factors—particularly digital self-efficacy—have gained increasing scholarly attention. According to Bandura [20], self-efficacy refers to an individual's belief in their ability to successfully perform a specific task, which has a direct impact on behavioral motivation and execution. In digital contexts, adolescents' belief in their ability to effectively use digital technologies may serve as a critical mediating mechanism in fostering digital literacy.

Empirical studies have shown that individuals with higher levels of digital self-efficacy tend to exhibit more proactive and effective behaviors in information seeking, problem-solving, and online communication [21]. Among adolescents, ICT self-efficacy is regarded as a key motivational construct closely associated with ICT adoption, usage, and digital literacy levels [22].

Moreover, AI education has been found to have a positive impact on adolescents' self-efficacy. For instance, a study conducted with university students majoring in computer science reported that the use of generative AI enhanced their academic self-efficacy [23]. Similarly, research involving primary and secondary school students found that AI education significantly improved their AI-specific self-efficacy [24]. Additional studies have demonstrated that AI-based education positively affects Chinese high school students' digital skills and self-efficacy [25], and that ICT self-efficacy contributes to digital reading competence [26], as well as indirectly influencing CIL (computer and information literacy) achievement [22].

Taken together, these findings suggest a sequential pathway in which adolescents' attitudes toward AI technology positively influence digital self-efficacy, which in turn positively affects digital literacy. The present study aims to empirically verify the mediating role of digital self-efficacy within this process.

Furthermore, these cognitive and psychological factors may be influenced by socioeconomic variables, among which household income has been identified as a critical moderator in the relationship between attitudes toward AI technology, digital self-efficacy, and digital literacy [27]. First, income disparity contributes to unequal access to and competence in using digital technologies, thereby serving as a structural cause of the digital divide [28]. Second, this divide exacerbates educational inequality by limiting learning opportunities for lower-income adolescents [29]. Third, empirical studies have shown that adolescents from higher-income households tend to demonstrate more favorable attitudes toward technology adoption and utilization [30]. Based on this context, the present study aims to examine whether household income moderates the mediating effect of digital self-efficacy in the relationship between attitudes toward AI technology and digital literacy. This analysis will provide insights into the conditional processes through which socioeconomic status shapes adolescents' engagement with digital technologies.

In this context, the present study aims to address the following three academic gaps. First, it seeks to empirically investigate the relationship between adolescents' attitudes toward AI technology and their digital literacy, thereby contributing to the literature on the psychological determinants of technology acceptance and digital competence. Second, the study examines the mediating role of digital self-efficacy to elucidate the psychological pathways through which AI attitudes influence digital literacy. Third, it explores whether household income exerts a moderated mediation effect, thereby providing an integrated understanding of the indirect structural mechanisms through which socioeconomic status influences adolescents' digital capabilities.

To this end, this study aims to analyze the mediating effect of digital self-efficacy and the moderated mediating effect of household income in the relationship between adolescents' attitudes toward AI technology and their digital literacy. By offering empirical evidence on the psychological and socioeconomic mechanisms underpinning digital literacy, this study contributes to improving both the effectiveness and equity of digital education and supports the development of an inclusive digital society.

MATERIALS AND METHODS

Data Collection Procedures and Characteristics of the Study Sample

The model posits that adolescents who hold more positive attitudes toward AI are likely to develop stronger digital self-efficacy, which in turn enhances their digital literacy. Furthermore, the strength of this indirect relationship is hypothesized to vary according to household income, reflecting the influence of socioeconomic background on adolescents' access to and engagement with digital technologies.

The participants of this study were adolescents aged between 13 and 19 years, currently enrolled in middle and high schools in Korea. The data used in this study were sourced from the 2023 Digital Information Gap Survey conducted by the National Information Society Agency (NIA) (2024) [31]. The survey data for the general population were collected from a sample of 7,000 individuals aged 7 and above, with a stratified proportional random sampling method applied across different regions of the country. The data collection was carried out through structured face-to-face interviews using questionnaires between October and December 2023, and the results and data were publicly released in April 2024. The survey was coordinated by the Ministry of Science and ICT and conducted by the National Information Society Agency, with the data collection managed by the Korea Gallup Survey Research Institute.

For the purpose of this study, the sample was restricted to adolescents aged 13 to 19 who were enrolled in middle or high school, had access to mobile devices, had internet access at home, and had experience with AI technologies. A total of 329 responses were used for data analysis.

The sample consisted of 174 male students (52.9%) and 155 female students (47.1%), with the male participants outnumbering the female participants. The age range of the sample was from 14 to 19 years, with an average age of 16.57 years. Of the 329 participants, 327 (99.4%) reported no disabilities, and 291 (88.4%) resided in urban areas, with significantly fewer participants from rural areas.

Measurement Tools

In this study, Attitudes Toward AI Technology and digital self-efficacy were measured using a 4-point Likert scale, while Digital literacy was measured using a 5-point Likert scale. Higher scores indicate a stronger tendency toward the respective attitudes or abilities.

The independent variable, Attitudes Toward AI Technology, was assessed with 8 items, such as: "AI technology will make my life more convenient," "AI technology will create more economic opportunities," and "AI technology will provide better information services." The reliability of this scale was Cronbach's alpha = .698.

The dependent variable, Digital Literacy, was measured with 12 items, such as: "I can install, uninstall, and upgrade programs on a PC, as well as copy, delete, move, and modify files and folders," "I can host or participate in meetings using online remote conferencing apps," and "I can use online collaboration tools to work with others on tasks or projects." The reliability of this scale was Cronbach's alpha = .871.

The mediating variable, Digital Self-Efficacy, was assessed using 4 items, including: "I am confident in learning how to use digital devices," "I am confident in using digital devices," "I can quickly learn how to use new digital devices," and "I want to use digital devices more." The reliability of this scale was Cronbach's alpha = .749.

The moderating variable, Household Income, was measured using an 11-point interval scale, with categories ranging from "less than 1 million KRW" to "more than 10 million KRW." Higher scores indicate higher household income.

Data Analysis Methods

Data were analyzed using SPSS Win version 24.0. Reliability analysis, descriptive statistics, frequency analysis, and correlation analysis were conducted. To examine the mediating effect of digital self-efficacy and the moderated mediating effect of Household Income, the SPSS PROCESS

Macro version 4.3 was used. Specifically, model 4 was applied to test the mediating effect of digital self-efficacy, and model 7 was used to test the moderated mediating effect of household income. A bootstrap method with 5,000 resamples was specified, and a 95% confidence interval was set. Before conducting the analyses, the reliability of the variables was confirmed by calculating Cronbach's alpha through reliability analysis.

RESULTS

General Trends of Key Variables and Correlations Between Variables

A descriptive statistical analysis was conducted to determine the general levels of attitudes toward AI technology, digital self-efficacy, digital literacy, and household income among adolescents (Table 1). First, the independent variable, attitudes toward AI technology, had a mean score of 3.215 out of 4 points. The mediating variable, digital self-efficacy, had a mean score of 3.363 out of 4 points, and the dependent variable, digital literacy, had a mean score of 3.917 out of 5 points, indicating a relatively high level. On the other hand, the moderating variable, household income, had a mean score of 5.830 out of 11 points, which was below the median value of 6 points.

Before conducting further analyses, skewness and kurtosis were examined to assess the normality of the variables. The results showed skewness values ranging from -0.131 to 0.330, and kurtosis values ranging from -0.004 to 1.645. As neither the skewness exceeded an absolute value of 3 nor the kurtosis exceeded an absolute value of 8, it was confirmed that the variables followed a normal distribution [32].

Table 1

Descriptive Statistics of Adolescents' Attitudes Toward AI Technology, Digital Self-Efficacy, Digital Literacy and Household Income <N=329>

		Mean		Skewness		Kurtosis	
		Statistics	S.D.	Statistics	S.E.	Statistics	S.E.
Independent	Attitudes Toward AI Technology	3.215	.334	-.131	.134	.408	.268
Mediating	Digital Self-Efficacy	3.363	.432	-.300	.134	-.004	.268
Moderating	Household Income	5.830	1.506	.330	.134	1.645	.268
Dependent	Digital Literacy	3.917	.574	-.183	.134	-.057	.268

Before testing the research model, multicollinearity among the variables was examined through the correlation between them (Table 2). Focusing on the dependent variable, digital literacy, it was found that as attitudes toward AI technology increased, digital literacy also increased ($r = .295$, $p < .001$), and as digital self-efficacy increased, digital literacy also increased ($r = .269$, $p < .001$). However, the correlation between household income and digital literacy was not statistically significant ($r = .068$, $p > .05$). Lastly, examining the correlation coefficients, ranging from .068 to .369, it can be concluded that there is no risk of multicollinearity among the variables.

Mediating Effect of Digital Self-Efficacy

To examine the mediating effect of digital self-efficacy in the relationship between attitudes toward AI technology and digital literacy, the SPSS PROCESS Model 4, as proposed by Hayes [38], was used for analysis (Table 3, 4) (Figure 1).

It was found that attitudes toward AI technology had a significant positive effect on digital literacy (Coeffect = .506, $p < .001$) (Table 3). This indicates that more positive attitudes toward AI technology among adolescents are associated with higher levels of Digital Literacy.

Table 2

Correlations among Key of Variables <N=329>

	Attitudes Toward AI Technology	Digital Self-Efficacy	Household Income	Digital Literacy
Attitudes Toward AI Technology	1			
Digital Self-Efficacy	.369***	1		
Household Income	.077	-.081	1	
Digital Literacy	.295***	.269***	.068	1
**p<.01, ***p<.001				

Next, the mediating effect of digital self-efficacy was examined in the relationship between attitudes toward AI technology and digital Literacy. Attitudes toward AI technology had a positive effect on digital self-efficacy (Coeffect = .476, $p < .001$), and digital self-efficacy had a positive effect on digital literacy (Coeffect = .247, $p < .01$). The results suggest that more positive attitudes toward AI technology led to higher digital self-efficacy, which in turn enhances digital literacy (Table 4) (Figure 1).

Finally, to verify the significance of the mediating effect of digital self-efficacy in the relationship between attitudes toward AI technology and digital literacy, a bootstrapping analysis with 5,000 iterations was conducted, with a 95.0% confidence interval set. The direct effect of attitudes toward AI technology on digital literacy was .506, which decreased to .389 when digital self-efficacy was added. The mediating effect index of .118 (.044 ~ .201) was statistically significant. Therefore, it can be concluded that the mediating effect of digital self-efficacy is statistically significant (Table 4) (Figure 1).

Table 3

The Effect of Attitudes Toward AI Technology on Digital Literacy in the Elderly <N=329>

Direct Effects Model (Dependent: Digital Literacy)							
Variables		Coeffect	SE	t	p	LLCI	ULCI
Constant		2.290	.294	7.801	.000	1.712	2.867
Independent	Attitudes Toward AI Technology	.506	.091	5.576	.000	.328	.685
R^2 =.064, F=20.297, p=.000							

Table 4

The Mediating Effect of Digital Self-Efficacy <N=329>

Dependent: Digital Self-Efficacy							
Variables		Coeffect	SE	t	p	LLCI	ULCI
Constant		1.832	.215	8.532	.000	1.410	2.255
Independent	Attitudes Toward AI Technology	.476	.066	7.168	.000	.346	.607
R^2 =.136, F=51.386, p=.000							
Dependent: Digital Literacy							
Variables		Coeffect	SE	t	p	LLCI	ULCI
Constant		1.836	.320	5.745	.000	1.208	2.465
Independent	Attitudes Toward AI Technology	.389	.096	4.038	.000	.199	.578
Mediating	Digital Self-Efficacy	.247	.074	3.324	.001	.101	.394

R^2 =.117, F=21.547, p=.000				
Verification of the Mediating Effect of Digital Self-Efficacy				
	Effect	BootSE	BootLLCI	BootULCI
Total Effect	.506	.091	.328	.685
Direct Effect	.389	.096	.199	.578
Indirect Effect	.118	.040	.044	.201

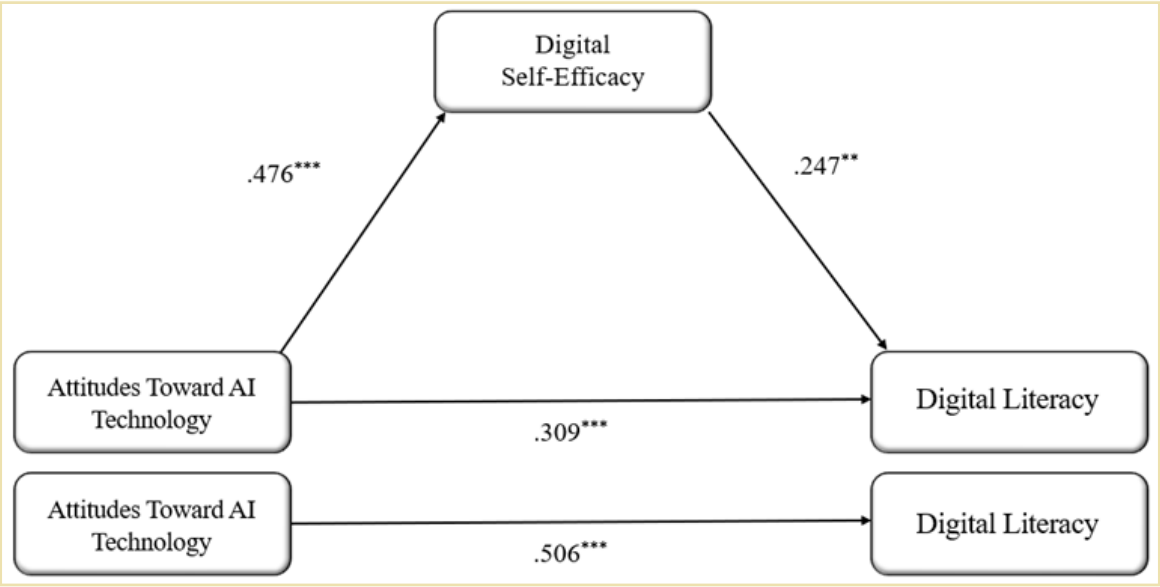

Figure 1 The Mediating Effect of Digital Self-Efficacy

Moderated Mediation Effect of Household Income

To examine the moderated mediation effect of household income, Model 7 of the SPSS PROCESS Macro was applied. Additionally, to minimize multicollinearity, both the independent and moderator variables were mean-centered for analysis (Table 5, 6) (Figure 2)

The analysis of the moderated mediation effect in the path from attitudes toward AI technology to digital self-efficacy to digital literacy revealed that the interaction between attitudes toward AI technology and household income had a significant effect on digital self-efficacy (Coeffect = .099, $p < .05$), and digital self-efficacy had a positive effect on digital literacy (Coeffect = .247, $p < .001$). This indicates that the impact of attitudes toward AI technology on digital literacy through digital self-efficacy varies according to household income (Table 5) (Figure 2).

Table 5

The Moderating of Household Income <N=329>

Dependent: Digital Self-Efficacy							
Variables		Coeffect	SE	t	p	LLCI*	ULCI**
Constant		3.359	.022	152.767	.000	3.316	3.403
Independent	Attitudes Toward AI Technology	.474	.066	7.162	.000	.344	.604
Moderating	Household Income	-.025	.015	-1.715	.089	-.055	.004
Interaction	Attitudes Toward AI Technology × Household Income	.099	.045	2.223	.027	.011	.187
R^2 =.161 F=20.725, p=.000							

Increase R^2 with Interaction			
Interaction	R^2	F	p
Attitudes Toward AI Technology × Household Income	.013	4.942	.027

Dependent: Digital Literacy						
Constant	3.085	.252	12.235	.000	2.589	3.581
Attitudes Toward AI Technology	.389	.096	4.038	.000	.199	.578
Digital Self-Efficacy	.247	.074	3.324	.001	.101	.394
R^2 =.117, F=21.547, p=.000						
*LLCI=boot Lower bound within 95% confidence interval of indirect effect **ULCI=boot Upper bound within 95% confidence interval of indirect effect						

To examine the size and direction of the moderated mediation effect, which refers to the change in the mediation effect depending on the level of the moderator, the conditional indirect effects of household income in the path from attitudes toward AI technology to digital self-efficacy to digital literacy were analyzed. The conditional indirect effects for all three levels of household income showed that the values of the Boot LLCI (lower limit) and Boot ULCI (upper limit) did not contain '0' within the 95% confidence interval, indicating that the effects were statistically significant. Additionally, the size of the conditional indirect effect increased as household income increased. In other words, as household income increases, the influence of attitudes toward AI technology on digital literacy through digital self-efficacy becomes stronger. Moreover, the index of the moderated mediation effect was .025 (BootSE = .014), and the 95% confidence interval for the lower limit (Boot LLCI = -.002) and upper limit (Boot ULCI = -.057) did not contain '0', confirming that the moderated mediation effect of Household Income is significant (Table 6).

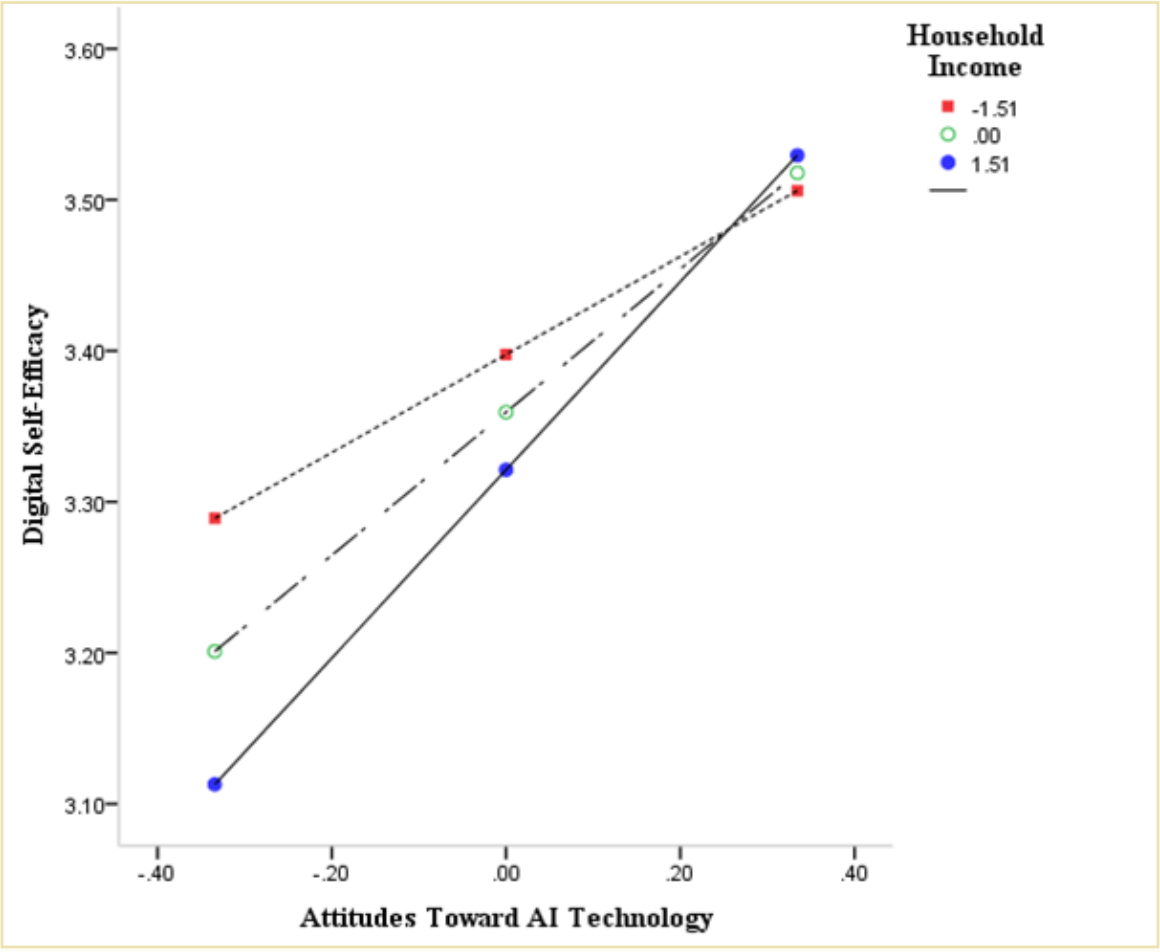

Figure 2 The Moderating of Household Income

Table 6

Conditional Indirect Effects of Household Income <N=329>

Attitudes Toward AI Technology → Digital Self-Efficacy →Digital Literacy (Conditional Indirect Effects by Household Income)				
Household Income	Effect	BootSE	BootLLCI	BootULCI
-1.506	.080	.036	.021	.162
.000	.117	.040	.044	.203
1.506	.154	.053	.056	.267
Verification of the Moderated Mediating Effect Index				
	Index	BootSE	BootLLCI	BootULCI
Household Income	.025	.014	.002	.057

DISCUSSION

Based on the main findings of this study, the theoretical and practical implications are derived through comparison with prior research, and suggestions for educational applications are provided as follows:

First, it was found that the more positive the adolescents' attitudes toward AI technology, the higher their level of digital literacy. This result is consistent with previous studies that argued for a positive relationship between attitudes toward AI technology and digital literacy [14; 16]. This suggests that a positive attitude toward AI does not merely lead to technology acceptance but also contributes to the enhancement of adolescents' digital competence and critical thinking skills. In fact, major countries, including South Korea, are actively promoting policies to integrate AI education into the formal curriculum for adolescents. For example, South Korea began pilot AI courses in 2021, and in 2023, it initiated the "Customized Education Environment for Transitioning to AI-Based Digital Textbooks" [4]. Similarly, the United States' "AI for K–12" [33] and the European Union's Digital Education Action Plan [34] emphasize AI literacy as a core digital competence.

Building on this educational trend, future AI education should not be limited to a single subject but should be integrated across various disciplines such as social studies, ethics, and information technology. This approach would help students understand the social implications of AI and contribute to the development of digital citizenship. Designing project-based AI lessons where adolescents can actively participate would not only increase their interest in AI but also foster the formation of positive attitudes toward the technology. Furthermore, it is essential to strengthen training for teachers on AI teaching methods and simultaneously enhance their educational capabilities to understand the connections between AI and digital literacy. This would ensure that educators are well-equipped to facilitate meaningful and effective learning experiences for students in the evolving digital landscape.

Secondly, the mediating effect of digital self-efficacy in the relationship between adolescents' attitudes toward artificial intelligence (AI) technology and digital literacy was found to be significant. This supports previous research [22; 26] which suggests that psychological factors, such as self-efficacy, influence digital learning outcomes in technology-based learning environments. These findings indicate that educational strategies aimed at promoting digital self-efficacy are essential for enhancing learning motivation in digital environments. Specifically, providing opportunities for success through the use of AI and digital tools or using real-life problem-solving learning approaches can help boost students' confidence. Additionally, incorporating peer learning or mentoring programs, where students can observe and imitate the success stories of their peers, can indirectly enhance their self-efficacy.

Thirdly, household income was found to have a moderating effect in the relationship between attitudes toward artificial intelligence technology, digital self-efficacy, and digital literacy. Specifically, as the household income level increased, the influence of attitudes toward AI technology on digital self-efficacy and digital literacy became stronger. These results highlight that the digital divide, which has been identified as a key factor in exacerbating educational inequality post-pandemic, goes beyond mere access to devices, influencing the development of psychological and cognitive

capacities. This finding aligns with previous research [27; 30], which emphasized the importance of income level in the digital information gap.

Considering this, policy efforts to address digital inequality for low-income households are crucial. For instance, utilizing community resources such as public libraries, youth centers, and local schools to offer free or low-cost AI and digital literacy education programs could be effective. Additionally, institutional support measures, such as the provision of internet access, digital devices, and the deployment of digital mentors, should be implemented as part of educational welfare initiatives to bridge the digital divide.

CONCLUSION

This study aimed to clarify the mediating role of digital self-efficacy in the relationship between adolescents' attitudes toward artificial intelligence (AI) technology and digital literacy, and to examine how this process varies according to household income levels. For this analysis, data from the "2023 Digital Information Gap Survey" by the Korea Intelligence Information Society Agency (2024) [31] was utilized. The sample consisted of 329 adolescents aged 13 to 19, limited to those who were middle or high school students, owned mobile devices, had internet access at home, and had experience with AI. SPSS Win 24.0 version and SPSS PROCESS MACRO 4.3 were used for the analysis.

The main findings of this study are as follows:

Adolescents with more positive attitudes toward AI technology exhibited higher levels of digital literacy.

A mediating effect of digital self-efficacy was found in the relationship between AI technology attitudes and digital literacy.

This mediating effect was moderated by household income, with higher income levels amplifying the relationship between AI technology attitudes, digital self-efficacy, and digital literacy.

These results have significant academic implications as they structurally identify the relationship between attitudes toward AI technology, digital self-efficacy, and digital literacy, while also confirming the moderating effect of socioeconomic factors such as household income. Notably, this study suggests that improving digital literacy requires an integrated approach that considers not only technical aspects but also psychological and social factors. Practically, AI education for adolescents should go beyond mere technical instruction and focus on customized designs that reflect psychological motivations and social backgrounds to enhance effectiveness. Future research should include more refined model testing through multi-group analysis that incorporates various socio-cultural factors. Additionally, qualitative approaches should be integrated to deepen the understanding of adolescents' experiences.

ACKNOWLEDGEMENTS

This paper was supported by the 2025 Hanseo University Research Support Project.

REFERENCES

1. UNESCO, AI and Education: Guidance for Policy-makers. UNESCO, 2021. Available at: https://unesdoc.unesco.org/ark:/48223/pf0000376709 (accessed 10 April 2025).
2. Council of Europe, Digital citizenship education handbook, Council of Europe, 2019. Available at: https://rm.coe.int/digital-citizenship-education-handbook/168093586f (accessed 10 April 2025).
3. Lai T., Xie C., Ruan M., Wang Z., Lu H., Fu S., Influence of Artificial Intelligence in education on adolescents' social adaptability: The mediatory role of social support. *Plos One,* 2023, vol. 18, no. 3, e0283170. DOI: 10.1371/journal.pone.0283170.
4. Ministry of Education, Announcement of the main points of the 2022 revised curriculum general guidelines

draft. Ministry of Education, Republic of Korea, 2021, 24 November. Available at: https://www.moe.go.kr/boardCnts/viewRenew.do?boardID=294&boardSeq=89671&lev=0&m=020402&opType=N&page=1&s=moe&searchType=null&statusYN=W (accessed 10 April 2025).
5. Eshet Y., Digital literacy: A conceptual framework for survival skills in the digital era. *Journal of Educational Multimedia and Hypermedia*, 2004, vol. 13, no. 1, pp. 93–106. Available at: https://www.learntechlib.org/primary/p/4793 (accessed 5 April 2025).
6. Ferrari A., DIGCOMP: A framework for developing and understanding digital competence in Europe. *European Commission Joint Research Centre*, 2013. DOI: 10.2788/52966
7. OECD, 21st-century readers: Developing literacy skills in a digital world. OECD Publishing, 2021. DOI: 10.1787/a83d84cb-en.
8. Davis F. D., Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 1989, vol. 13, no. 3, pp. 319–340. DOI: 10.2307/249008
9. Venkatesh V., Morris M. G., Davis G. B., Davis F. D., User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 2003, vol. 27, no. 3, pp. 425–478. DOI: 10.2307/30036540
10. Moon K. H., Yang J. Y., Park S. H., A Study on the direction of AI liberal arts education based on the AI perceptions of freshmen in university. *Korean Journal of General Education*, 2021, vol. 15, no. 5, pp. 11–23. DOI: 10.46392/kjge.2021.15.5.11
11. Kyun S., Yi J., Kwon S., Students' perception of universities' introduction of Artificial Intelligence and of the Artificial Intelligence professors. *Journal of Educational Research*, 2018, vol. 16, no. 3, pp. 77–101. DOI: 10.31352/JER.16.3.77
12. Welch V., Wy T. J., Ligezka A., Hassett L. C., Croarkin P. E., Athreya A. P., Romanowicz M., Use of mobile and wearable Artificial Intelligence in child and adolescent pychiatry: Scoping review. *Journal of Medical Internet Research*, 2022, vol. 24, no. 3, e33560. DOI: 10.2196/33560
13. Rowe J. P., Lester J. C., Artificial Intelligence for personalized preventive adolescent healthcare. *Journal of Adolescent Health*, 2020, vol. 67, no. 2, pp. S52–S58. DOI: 10.1016/j.jadohealth.2020.02.021
14. Marangunić N., Granić A., Technology acceptance model: A literature review from 1986 to 2013. *Universal Access in the Information Society*, 2015, vol. 14, no. 1, pp. 81–95. DOI: 10.1007/s10209-014-0348-1
15. Bender S. M., Awareness of Artificial Intelligence as an essential digital literacy: ChatGPT and Gen-AI in the classroom. *Changing English*, 2024, vol. 31, no. 2, pp. 161–174. DOI: 10.1080/1358684X.2024.2309995
16. Kazanidis I., Pellas N., Harnessing generative Artificial Intelligence for digital literacy innovation: A comparative study between early childhood education and computer science undergraduates. *AI*, 2024, vol. 5, no. 3, pp. 1427–1445. DOI: 10.3390/ai5030068
17. Rospigliosi P. A., Artificial Intelligence in teaching and learning: What questions should we ask of ChatGPT? *Interactive Learning Environments*, 2023, vol. 31, no. 1, pp. 1–3. DOI: 10.1080/10494820.2023.2180191
18. Livingstone S., Helsper E. J., Gradations in digital inclusion: children, young people and the digital divide. *New Media & Society*, 2007, vol. 9, no. 4, pp. 671–696. DOI: 10.1177/1461444480708033518
19. Hargittai E., Digital na(t)ives? Variation in internet skills and uses among members of the "Net Generation". *Sociological Inquiry*, 2010, vol. 80, no. 1, pp. 92–113. DOI: 10.1111/j.1475-682X.2009.00317.x
20. Bandura A., Self-efficacy: The exercise of control. New York: W. H. Freeman, 1997.
21. Eastin M. S., LaRose R., Internet self-efficacy and the psychology of the digital divide. *Journal of Computer-Mediated Communication*, 2000, vol. 6, no. 1, JCMC611. DOI: 10.1111/j.1083-6101.2000.tb00110.x
22. Rohatgi A., Scherer R., Hatlevik O. E., The role of ICT self-efficacy for students' ICT use and their achievement in a computer and information literacy test. *Computers & Education*, 2016, vol. 102, pp. 103–116. DOI: 10.1016/j.compedu.2016.08.001
23. Yoo K., Ahn S., The effect of generative AI-based education on college students' academic self-efficacy, metacognition, and problem-solving skills. *Journal of Korean Association of Computer Education*, 2024, vol. 27, no. 4, pp. 13–20. DOI: 10.32431/kace.2024.27.4.002
24. Lee S., Han J., Analysis of relationships among SW interests, AI interests, level of programming skills, AI self-efficacy, and persistence of AI learning. *Journal of Korean Association of Computer Education*, 2020, vol. 23, no. 6, pp. 51–58. DOI: 10.32431/kace.2020.23.6.005
25. Wang H., Experience of AI-based digital intervention in professional education in rural China: Digital competencies and academic self-efficacy. *European Journal of Education*, 2025, vol. 60, no. 1, e70031. DOI: 10.1111/ejed.70031
26. Yu R., Hu J., A multilevel mediation study on the effects of ICT self-efficacy on adolescents' digital reading performance. *International Conference on Computer Science and Education* (pp. 615-622), Singapore: Springer Nature Singapore, 2022.
27. Liu B., Zhou J., Digital literacy, farmers' income increase and rural internal income gap. *Sustainability*, 2023, vol. 15, no. 14, 11422. DOI: 10.3390/su151411422
28. Li G., Digital inequality and household income distribution: Evidence from rural China. *Applied Research in*

Quality of Life, 2023, vol. 18, no. 6, pp. 3061-3087. DOI: 10.1007/s11482-023-10220-w
29. Francis D. V., Weller C. E., Economic inequality, the digital divide, and remote learning during COVID-19. *The Review of Black Political Economy*, 2021, vol. 49, no. 1, pp. 41–60. DOI: 10.1177/00346446211017797
30. Camerini A. L., Schulz P. J., Jeannet A. M., The social inequalities of internet access, its use, and the impact on children's academic performance: Evidence from a longitudinal study in Switzerland. *New Media & Society*, 2018, vol. 20, no. 7, pp. 2489–2508. DOI: 10.1177/1461444817725918
31. National Information Society Agency, 2023 digital divide survey report. National Information Society Agency, 2024. Available at: https://www.nia.or.kr/site/nia_kor/ex/bbs/View.do?bcIdx=26517&cbIdx=81623 (accessed 10 April 2025).
32. Kline T. J., Psychological testing: A practical approach to design and evaluation, Sage Publications, 2005.
33. Touretzky D., Gardner-McCune C., Martin F., Seehorn D., Envisioning AI for K-12: What should every child know about AI?. *Proceedings of the AAAI Conference on Artificial Intelligence*, 2019, vol. 33, no. 01, pp. 9795–9799. DOI: 10.1609/aaai.v33i01.33019795
34. European Commission, Digital education action plan 2021–2027: Resetting education and training for the digital age, 2020. Available at: https://education.ec.europa.eu/focus-topics/digital-education/ action-plan (accessed 10 February 2025).

Author

Yun-Jeong Kim
Corresponding Author
(Republic of Korea)
Department of Social Welfare
Hanseo University
E-mail: twoyun21@hanmail.net
ORCID ID: 0000-0001-7707-8330

Author contribution

Yun-Jeong Kim: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Writing – Original Draft, Writing – Review & Editing

The author declared no conflicts of interest