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Abstract

This research aimed to investigate the relationship between the digital literacy levels of university students enrolled in art education and their attitudes towards Artificial Intelligence (AI) technologies. The study utilized a relational survey model and was conducted with a total of 229 students studying in fine arts, music, visual arts education, and conservatory departments across Turkey. Data were gathered using the "Digital Literacy Scale" (Hamutoğlu et al., 2017) and the "General Attitude towards Artificial Intelligence Scale" (Schepman & Rodway, 2020). The findings indicate that students demonstrate high levels of digital literacy, high levels of positive AI attitudes, and moderate levels of negative attitudes toward AI. A statistically significant difference in digital literacy was found based on gender, favoring male students, but no difference was observed in AI attitudes. Regarding class level, senior students exhibited higher digital literacy levels, while negative AI attitudes increased in the final years. Furthermore, a positive and significant correlation was established between digital literacy and positive AI attitudes. The results suggest that art education students are effectively using technology in their creative processes but maintain a cautious approach regarding the artistic originality and ethical dimensions related to AI. In line with the findings, it is recommended that art education programs develop courses that integrate digital literacy and AI awareness.

Introduction

The 21st century is defined by the pervasive integration of digital technologies into all facets of life and, consequently, education. This profound digital transformation has fundamentally altered the core competencies expected of individuals, positioning "digital literacy" at the very center of the educational agenda (Eshet-Alkalai, 2004). Digital literacy encompasses more than merely using technological tools; it signifies a comprehensive set of skills for critically evaluating, creating, and effectively communicating information within digital environments. These competencies are becoming increasingly vital for Fine Arts education, a field traditionally built upon manual skill, aesthetic sensibility, and creativity. While digital tools open up new forms of expression, new media, and new audiences for artists, mastering these tools has become a necessity for art students (Ciddi,

2025; Çakır et al., 2019; Öztürk et al., 2023; Peppler, 2010; Tekin, 2025). In recent years, Artificial Intelligence (AI) technologies have made a revolutionary leap within the digital ecosystem. These technologies—which mimic and extend human capacity in areas such as visual production, music composition, text generation, and even critical thinking—are generating both great excitement and deep apprehension, particularly within creative disciplines. The integration of AI into the artistic creation process has rekindled fundamental questions in the philosophy of art, such as "the artist's role," "originality," and "the nature of creativity" (McCormack et al., 2019a).

Students of Fine Arts are situated at the epicenter of this dual transformation. They are expected, on one hand, to master analog processes like painting, sculpture, or traditional printmaking (Bazari et al., 2024; Cuevas & Bertsch, 2024; Unal, 2024; Susuz & Ozturk, 2023; Waemusa & Jongwattanapaiboon, 2023), while simultaneously acquiring the literacy skills demanded by the digital world and developing an attitude toward AI, which represents a new technological paradigm. These students' attitudes toward AI—whether they view it as a threat, a collaborator, or merely a tool—will be critical in shaping their future artistic practices and career trajectories (Cetinic & She, 2022).

In this context, the purpose of this study is to examine the relationship between the digital literacy levels and attitudes toward AI technologies among students pursuing Fine Arts education. The research aims to answer the following questions:

1. What are the digital literacy levels of students in art education?
2. What are the attitudes toward AI technologies of students in art education?
3. Is there a significant relationship between art education students' digital literacy levels and their attitudes toward AI?
4. Do art education students' digital literacy and AI attitudes differ based on demographic variables such as gender and class level?

The answers to these questions will provide valuable data to educators and policymakers on how to update Art education curricula to cultivate a new generation of artists equipped with the skills and understanding required by the digital age and the AI revolution, enabling them to be adaptable and critically minded.

Literature Review

Digital Literacy and Art Education

Digital literacy has evolved from being simply understood as "being able to use a computer" to being conceptualized as a complex set of skills. Digital competence and digital literacy are not vastly different concepts. Digital competence encompasses the knowledge and skills employed in processes such as accessing information, creating content, sharing, managing, communicating, collaborating, and problem-solving using technology (Reisoğlu & Çebi, 2022). Digital literacy skills, on the other hand, include abilities like adapting to different situations, collaboration, and communication. Knowing how to use digital tools to support these areas also falls under digital literacy. Digital literacy enables young people to evaluate new and emerging advantages while allowing them to overcome the challenges posed by technology (Hague & Payton, 2010).

Eshet-Alkalai (2004) categorized this concept into five components: photo-visual literacy, reproduction literacy, branching literacy, socio-emotional literacy, and real-time literacy. This framework is highly relevant, especially for art education students who work with musical, visual, and project-based assignments. Peppler (2010) emphasized that art education in the digital age must equip students not only with traditional art forms but also with the ability to design with digital tools, produce media, and understand these productions. According to Peppler, digital media art offers new possibilities for creative expression while simultaneously transforming the nature of art education.

The place of digital literacy in art education generally, and in music education specifically, has become a paramount topic in recent years. Scott (2013) suggests that by including information and communication technologies in the music education curriculum, students will gain both the skills to effectively integrate technology into educational contexts and an understanding of technology's function, availability, and creative applications. Omur and Sonsel (2021), in assessing the opinions of pre-service music teachers regarding piano lessons delivered via distance learning, underlined that the digital literacy levels of both teachers and students play a vital role and, therefore, the level of digital literacy in music education needs to be strengthened.

Artificial Intelligence and Creative Industries

Artificial Intelligence, particularly advancements in "generative AI," has begun integrating into creative processes in an unprecedented way. Technologies such as GANs (Generative Adversarial Networks) and large language and visual models like DALL-E, Midjourney, and Stable Diffusion can produce original visuals from text descriptions, imitate historical art styles, and offer new sources of inspiration to artists (Cetinic & She, 2022). This has led to the emergence of a new genre in the art world called "AI art." However, this rapid development has brought forth a series of debates. McCormack et al. (2019b) question whether works created by AI can be truly creative, given that the "intention" and "action" behind the work differ from those of a human artist. Furthermore, ethical and legal issues such as copyright, originality, and the ownership of existing artworks used to train AI models remain unclear (Boden, 2016).

On the other hand, the combination of music education and AI can be considered a groundbreaking innovation in contemporary music education. Firstly, the application of AI in music education has served as an auxiliary role for teachers in their lessons. Secondly, AI has the capacity to present lesson content to students in a more dynamic and engaging manner, thereby improving students' focus and information assimilation skills. Internet and AI, as tools that enhance artistic communication, have played a constructive role in the dissemination and facilitation of art education in general, and music education in particular (Li & Wang, 2024; Yang, 2020). While the use of AI in music education offers many advantages, it also brings disadvantages. Advantages include providing opportunities tailored to students' individual differences, offering instant feedback, and access to creativity-enhancing tools. Disadvantages can be evaluated as a shift away from traditional learning methods due to excessive technology use and the risk of losing the artistic and emotional dimensions. Therefore, establishing a balance between the advantages and disadvantages is important for the effective use of AI in music education (Dulkadir & Belge, 2025).

One of the most widely recognized models examining individuals' attitudes toward technology is Davis's (1989) Technology Acceptance Model (TAM). This model attempts to explain the intention and behavior of using a technology through factors like perceived usefulness and perceived ease of use. Studies conducted in the context of AI show that factors like job loss anxiety, social impact, trust, and enjoyment, in addition to perceptions of usefulness and ease, shape attitudes toward AI (Schepman & Rodway, 2020). For creative individuals such as Fine Arts students, whether AI poses a threat to their originality and creative identity ("perceived threat") may play a decisive role in their attitudes.

Related Research and Current Gap

Teachers and pre-service teachers play a significant role in ensuring the effective integration of AI into art education (Felix, 2020; Kara, 2025; Liang, 2024; Zhai, 2024). Effective technology integration in education largely depends on teachers' willingness to adopt technology (Guo et al., 2025). Therefore, determining teachers' technological competence and their attitudes and interest toward such applications during the AI integration process can play a crucial role in identifying the opportunities and limitations that may affect AI usage in art education settings (Ceran, 2022; Kılınçer, 2025; Velander et al., 2023).

The literature contains an increasing number of studies on AI attitudes in groups such as pre-service teachers (e.g., Gök et al., 2023; Setyadi et al., 2025; Sung, 2022), engineering (Dai, 2025; Yelamarthi et al., 2024), or medical students (Alam et al., 2023; Kimmerle et al., 2023). Similarly, many studies exist examining the digital literacy levels of general student populations. However, studies that address these two critical variables—digital literacy and attitudes toward AI—specifically within the unique context of Fine Arts students are extremely limited. This student group occupies a distinctive position where creativity is central, and technology can be perceived as both a tool and a potential competitor. Consequently, this research has the potential to fill a significant gap at the intersection of art education, digital literacy, and the psychology of AI. The current study is expected to contribute to the development of strategies for how Fine Arts education can adapt to this new digital-AI era.

Method

This research aimed to analyze and examine the relationship between attitudes toward Artificial Intelligence (AI) and digital literacy among students in art education. Accordingly, the research is an example of a relational survey model. The study also investigated the relationship between art education students' AI attitudes and digital literacy levels based on certain demographic variables (Hancock et al., 2010).

Research Group

The target population for the study consisted of students pursuing fine arts education in Turkey. The study's sample comprised 229 participating students selected using a convenience sampling method. Convenience sampling is a type of non-probability sampling where individuals most readily available for the study are included, optimizing for the study's purpose, time, and economic constraints (Golzar et al., 2022). The distribution of participating

students by department is as follows: 98 students (42.79%) were in Music Education, 91 (39.73%) in Visual Arts Education, 29 (12.66%) in Fine Arts Faculty programs, and 11 (4.08%) in Conservatories. Regarding gender, 155 participants (67.69%) were female, and 94 (41.04%) were male.

Data Collection Instruments

Data for the study were collected in 2025 via Google Forms. Prior to the study, students were informed about the research. The scale link obtained from Google Forms was then distributed to students through social networks. The data collection process, which required voluntary participation, lasted approximately 10 days.

Digital Literacy Scale

The "Digital Literacy Scale," adapted into Turkish by Hamutoğlu, Güngören, Uyanık & Erdoğan (2017) from the original scale developed by Ng (2012), was used as a data collection tool, along with demographic questions. The scale consists of 17 items and has four sub-dimensions (attitude, technical, cognitive, social). A 5-point Likert-type scale was used, rated from 1 (Strongly Disagree) to 5 (Strongly Agree). The minimum score attainable is 17, and the maximum is 85. The original adaptation study reported a Cronbach's Alpha reliability coefficient of .93 (Hamutoğlu et al., 2017). For the current research, the scale's Cronbach's Alpha reliability coefficient was determined to be .94.

General Attitude towards Artificial Intelligence Scale

Developed by Schepman and Rodway (2020) and adapted into Turkish by Kaya and colleagues (2022), this scale is composed of 20 items and has two sub-dimensions: negative attitude toward AI and positive attitude toward AI. Items related to negative attitudes toward AI are reverse-coded. It is rated on a 5-point Likert scale. The adaptation study reported Cronbach's Alpha values between .82 and .88, with reliability values of 0.77 for positive attitude and 0.83 for negative attitude.

Data Analysis

In the analysis of the data, the mean scores obtained from the scales were utilized. The mean scores for digital literacy and AI attitudes of art education students were interpreted as low for scores between 1.00−2.59, medium for scores between 2.60−3.39, and high for scores between 3.40−5.00. First, the data distribution was examined; since the skewness and kurtosis values fell between -1 and +1, it was concluded that the data exhibited a normal distribution. Therefore, parametric tests were used in the study. Minimum, maximum, arithmetic mean, and standard deviation values were employed to determine students' digital literacy and AI attitude levels. The Independent Samples t-test was used to determine whether students' digital literacy and AI attitude levels differed significantly based on gender and branch (department) variables. One-Way ANOVA was used to examine the change in students' digital literacy and AI attitude levels according to the class year variable. The Scheffé test was used for post-hoc analysis to identify the specific groups between which differences existed.

Results

Findings

Based on the analysis, the average and standard deviation scores from Table 1, which detail the digital literacy levels of art education students, show that participants obtained a mean score of 4.16 on the Digital Literacy Scale. This finding definitively establishes that the digital literacy levels of the art education students within this study sample are considered high.

Table 1. Descriptive Analysis Results of Digital Literacy Scores of Students Receiving Art Education

	N	Minimum	Maximum	Mean	Std. Deviation
Digital Literacy	229	1.00	5.00	4.16	0.63

Table 2 presents the mean and standard deviation values for the scores obtained by art education students on the Artificial Intelligence Attitude Scale. The analysis revealed that participating students achieved an average score of 3.75 on the Positive Attitude towards AI subscale, and an average score of 3.10 on the Negative Attitude towards AI subscale. Based on these values, art education students demonstrated a high level of positive attitude toward AI, while their negative attitude toward AI was found to be at a medium level.

Table 2. Descriptive Analysis Results of the Artificial Intelligence Attitude Scale Scores of Art Education Students

	N	Minimum	Maximum	Mean	Std. Deviation
Positive Attitudes Towards Artificial Intelligence	229	1.33	5.00	3.75	0.79
Negative Attitudes Towards Artificial Intelligence	229	1.00	5.00	3.10	0.93

Table 3 displays the results of the t-test comparing the Digital Literacy of art education students based on the gender variable. The analysis indicated that the participants' digital literacy levels differed significantly based on gender ($p<.05$), with this difference favoring male students. Specifically, male art education students were found to possess a higher level of digital literacy compared to their female peers.

Table 3. Analysis Results of Digital Literacy Scores by Gender Variable with Independent Samples t-Test

	Gender	N	Mean	Std. Deviation	t	p
Digital Literacy	Female	135	4.08	0.55	-2.333	0.021
	Male	94	4.27	0.73		

Table 4 displays the results of the t-test comparing the Artificial Intelligence (AI) attitudes of art education students based on the gender variable. The analysis results indicate that the participating art education students' positive and negative attitudes toward AI did not differ significantly based on gender ($p>.05$). Although male participants showed a slightly higher positive attitude, the AI attitudes of both genders exhibited a similar

distribution overall.

Table 4. Artificial Intelligence Attitude Scores According to Gender Variable, Independent Samples t-Test Analysis Results

Gender		N	Mean	Std. Deviation	t	P
AI Positive Attitude	Female	135	3.73	0.75	-0.427	0.669
	Male	94	3.77	0.84		
AI Negative Attitude	Female	135	3.13	0.89	0.548	0.584
	Male	94	3.06	0.98		

Table 5 presents the results of the F-test (ANOVA) examining differences in the Digital Literacy of art education students across class levels. The analysis indicated that students' digital literacy levels differed significantly based on the class level variable ($p<.05$). Further analysis conducted using the Scheffé test revealed that fourth-year (senior) and third-year students in art education programs possess significantly higher digital literacy levels compared to first-year students.

Table 5. Digital Literacy Scores by Class Variable F-Test Analysis Results

	Grade Level	N	Mean	Std. Deviation	F	p
Digital Literacy	1	60	3.90	0.60	5.392	0.001
	2	57	4.13	0.68		
	3	66	4.28	0.63		
	4	46	4.34	0.54		
	Total	229	4.16	0.63		

Table 6 presents the results of the F-test (ANOVA) examining differences in the Artificial Intelligence (AI) attitudes of art education students across class levels.

Table 6. F-Test Analysis Results of Artificial Intelligence Attitude Scores According to Class Variable

	Grade Level	N	Mean	Std. Deviation	F	p
AI Positive Attitude	1	60	3.74	0.65	1.583	0.194
	2	57	3.57	0.78		
	3	66	3.80	0.94		
	4	46	3.89	0.70		
	Total	229	3.75	0.79		
AI Negative Attitude	1	60	3.11	0.80	2.713	0.046
	2	57	3.00	0.95		
	3	66	3.35	1.06		
	4	46	2.88	0.80		
	Total	229	3.10	0.93		

The analysis indicated that the students' positive attitudes toward AI did not differ significantly based on the class level variable (p>.05). However, a statistically significant difference was found in students' negative attitudes toward AI according to class level. Post-hoc analysis revealed that participants studying in the final year (senior class) exhibited significantly higher negative attitudes toward AI.

Table 7 displays the results of the Pearson Correlation Test calculated between art education students' digital literacy and their attitudes toward Artificial Intelligence (AI). The analysis revealed a positive and statistically significant correlation coefficient of .224 (p<.05) between positive attitudes toward AI and digital literacy. This finding suggests that art education students with higher levels of digital literacy also exhibit higher levels of positive attitudes toward AI. On the other hand, the correlation coefficient calculated between negative attitudes toward AI and digital literacy was −.053, which was negative but not statistically significant.

Table 7. Correlation Analysis Results between Digital Literacy and Artificial Intelligence Attitudes of Art Education Students

		AI Positive Attitude	AI Negative Attitude	Digital Literacy
AI Positive Attitude	Pearson Correlation	1	-0.537**	.224**
	Sig. (2-tailed)		0.582	0.001
	N	228	227	228
AI Negative Attitude	Pearson Correlation	-0.537**	1	-0.053
	Sig. (2-tailed)	0.582		0.426
	N	227	227	227
Digital Literacy	Pearson Correlation	.224**	-0.053	1
	Sig. (2-tailed)	0.001	0.426	
	N	228	227	229

**. Correlation is significant at the 0.01 level (2-tailed).

Discussion and Conclusion

The research findings indicate that university students studying art education (music and visual arts) possess high levels of digital literacy. This result aligns with the literature showing the increasing integration of digital technologies into art education processes. Contemporary art education is no longer confined to traditional techniques but is expanding through tools such as digital drawing, audio editing, virtual installations, digital portfolios, and online sharing platforms (Çebi & Reisoğlu, 2019; İlhan & Yalman, 2022). This context enhances art students' opportunities to actively use technology and develop their digital skills.

The high digital literacy levels in art education students also imply a strengthening in components such as creative production, critical thinking, and digital ethics awareness in the digital environment (Ng, 2012). Specifically, music and visual arts students frequently utilize digital audio software, graphic design programs, and online art communities in their learning processes (Kaya & Kaya, 2023). The pedagogical use of these tools advances not

only students' technical skills but also their cognitive and cultural digital awareness (Redecker, 2017). Furthermore, the shift to online education following the COVID-19 pandemic likely played a significant role in boosting students' digital literacy. These experiences highlight that digital skills have become a pedagogical necessity, not merely a technical option (Bozkurt, 2021).

Despite the high general digital literacy, there is a need for deeper examination of the critical and ethical application of these skills within the art education context. Some studies suggest that while art students can use digital tools productively, their awareness regarding information validation, digital copyright, and the ethical dimensions of AI-supported production may be limited (Ilomäki et al., 2016; Çetin & Kocadağ, 2024). Therefore, while high digital literacy provides a crucial advantage for the transformation of art education in the age of AI, these skills must be developed within a sustainable and ethical framework.

Another finding is the observed differences in digital literacy based on gender and class level. Male participants exhibited a higher digital literacy level than their female peers, a finding consistent with many previous studies (Kara, 2021a; Ng, 2012; Siddiq & Scherer, 2019; Tondeur et al., 2018). The historical perception of digital environments as "technology-centric" has allowed males to gain earlier access and experience with technology (Cooper, 2006). This may lead male students to feel more competent in technical areas of art, such as software, audio editing, and graphic design (Aesaert & van Braak, 2014). However, recent literature notes an increase in female participation and high potential in digital creativity (Ilomäki et al., 2016). The gender difference observed here may stem from varying purposes of digital tool usage, with females often using them for communication and presentation, and males for production and experimental application (Baturay & Toker, 2020). It is recommended that instructional environments be created to actively support female students' participation in digital production and technical design processes to close this gap (Redecker, 2017).

A further significant finding is the class-level difference in digital literacy, where third- and fourth-year students showed higher digital literacy than first-year students. This can be explained by the cumulative experience gained throughout the curriculum, a pattern supported by the literature (Hatlevik & Christophersen, 2013; İlhan & Yalman, 2022). Project-based learning, online portfolio creation, and digital art production processes in university directly advance students' skills. Furthermore, senior students' tendency to view digital technology not merely as a tool but as a form of artistic expression supports their digital literacy development (Kaya & Kaya, 2023). This outcome underscores that digital literacy is a cultural and creative competence that evolves over time, not just a static cognitive ability.

The study determined that art education students have high positive attitudes toward AI but moderate negative attitudes. This indicates that students generally perceive AI technologies as innovative tools that support production processes and facilitate learning. This is consistent with literature highlighting increasing positive AI attitudes in higher education, where students find AI useful for learning, creativity, and productivity (Zawacki-Richter et al., 2019; Long & Magerko, 2020). In the arts, AI-supported applications like visual generation and digital composition are often seen as a "creative partner" (McCormack et al., 2019a). Conversely, the persistence of moderate negative AI attitudes can be linked to concerns about artistic originality, ethical responsibility, and

employment. Some art students worry that AI could diminish the human role in creative production or devalue artistic labor (Elgammal et al., 2021; Manovich, 2023). This finding suggests that despite prevailing positive views, AI is not fully internalized in the artistic domain, and students maintain emotional and ethical caution.

The lack of gender difference in AI attitudes supports studies suggesting that gender is becoming a less determining factor in technology perceptions (Çebi & Reisoğlu, 2019; Kara, 2021b). When considered alongside high digital literacy levels, this implies that cognitive awareness of AI is becoming gender-independent among university students. However, a significant difference was observed in negative AI attitudes based on class level, with final-year students showing higher negative AI attitudes. This can be attributed to increased awareness that comes with greater experience. Senior students, having observed AI's impact on artistic production more closely, may develop more conscious concerns regarding professional competition, originality, and ethical issues (Zhou et al., 2023; Kim, 2024). Additionally, pre-graduation anxiety about professional identity and future career paths, combined with AI's potential to transform employment fields, may contribute to elevated negative attitudes (Luckin et al., 2022). Overall, art education students exhibit a generally innovative and open attitude toward AI, but ethical and professional concerns become more pronounced with increasing professional awareness.

The research established a positive and significant correlation between art education students' digital literacy and their positive AI attitudes. This finding suggests that individuals with higher digital competence view AI technologies from a more functional, productive, and creative perspective. Literature corroborates this, emphasizing that digital literacy strengthens cognitive awareness, self-efficacy, and innovative attitudes toward AI (Long & Magerko, 2020; Ng, 2012; Tang et al., 2023). Students with high digital literacy are better able to grasp the logic, ethical boundaries, and potential of digital tools, making them more open and positive toward the opportunities AI offers in education and art production (Ilomäki et al., 2016).

In art education, digital literacy is not just a technical skill but encompasses creative thinking, aesthetic problem-solving, and the ability to use technology as an artistic medium (Kaya & Kaya, 2023). Consequently, it is natural for digitally skilled students to perceive AI as a new tool for art. High digital literacy enables students to evaluate AI as an opportunity that enhances productivity rather than a threat to the artistic process (McCormack et al., 2019b). Furthermore, sub-dimensions of digital literacy, such as critical thinking and ethical awareness, are key variables supporting positive AI attitudes (Redecker, 2017). This indicates that promoting digital competence will support students' positive attitudes toward AI technologies, not just through technical skill acquisition but through the pedagogical internalization of AI's artistic potential.

Recommendations

Based on the results of this research, the following recommendations are presented:

- Integration of Digital Literacy and AI-Focused Courses: Art education curricula should incorporate courses such as "Digital Art Applications," "Creative Production with AI," or "New Media Technologies in Art" to develop students' technical and ethical awareness.
- Pedagogical Use of AI-Supported Art Applications: Workshops and project-based activities should be

organized to enable students to consciously use AI tools (e.g., visual generation, audio synthesis, virtual exhibition design) in their creative production processes.

- Support for Female Students' Active Participation in Digital Production: To mitigate gender differences, mentorship or peer-supported learning models should be implemented to enhance female students' technical and creative skills in digital art applications.
- Ethics and Professional Awareness Seminars for Senior Students: Seminars and discussion sessions focusing on the ethical, legal, and aesthetic dimensions of AI in the art field should be organized to address the heightened negative AI attitudes observed in final-year students.
- Continuous Measurement and Development of Digital Literacy Skills: Educational faculties should conduct periodic assessments for digital literacy and AI awareness to monitor student development and provide individualized support.

In future research, comparing the digital literacy and AI attitudes of students in different art disciplines, such as music, painting, sculpture, and graphic design, could help identify differences across disciplines. Interviews or focus groups could be used to uncover the cognitive, emotional, and ethical reasons behind students' positive or negative attitudes toward AI. Longitudinal studies could be conducted to track changes in students' digital literacy and AI attitudes from the beginning to the end of their university education. This could provide a clearer explanation of the reasons for grade-level differences. The effects of using AI-based instructional materials or virtual assistants in art education on students' creativity, attitudes, and learning motivation could be tested through experimental research. It is recommended that art students' perceptions of originality, aesthetic value, and artistic identity in AI-generated artworks be examined through cross-cultural comparative studies. Quantitative analyses such as structural equation modeling (SEM) could be used to investigate the indirect effects of digital literacy on creative thinking, critical awareness, and AI attitudes.

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