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Abstract

This study aims to examine high school students' artificial intelligence literacy in visual arts subjects and their attitudes toward metaverse-based digital art. The research was conducted using a comparative-relational screening model, one of the screening models. The study sample consisted of 278 9th, 10th, 11th, and 12th grade students. The Visual Themed Artificial Intelligence Literacy Scale and the Metaverse-Based Digital Art Scale were used as data collection tools. According to the research findings, high school students' AI literacy levels in visual subjects were found to be moderate, while their metaverse-based digital art attitudes were found to be low. Analyses conducted by gender revealed that male students had significantly higher mean scores than female students in both AI literacy and metaverse-based digital art attitudes. Comparisons by grade level revealed that 12th grade students had significantly higher AI literacy levels in visual subjects and metaverse-based digital art attitudes than 9th grade students. Regression analysis revealed that AI literacy in visual subjects significantly and positively predicted metaverse-based digital art attitudes, with the model explaining 19.3% of the variance. Based on the research findings, the following recommendations are recommended: developing AI literacy at an early age, integrating the metaverse into visual arts, providing digital pedagogical training for teachers, and enhancing school environments with augmented reality support. Digital ethics should be emphasized in curricula, the STEAM approach should be supported, and intercultural communication should be encouraged through metaverse-based digital art exhibitions. Future research should examine the multidimensional nature of artificial intelligence literacy, and changes in metaverse attitudes should be assessed through longitudinal and experimental studies.

Introduction

In the age of digitalization, technological transformations in education are reshaping learning processes not only at the cognitive level but also in terms of the development of creative thinking. The integration of new technologies, particularly artificial intelligence (AI) and the metaverse, into learning environments is transforming how students access information and developing interdisciplinary thinking skills (Luckin et al., 2016). Visual arts education is one of the fields directly affected by this transformation. In this new era, where traditional art

approaches meet digital environments, students' artificial intelligence literacy and attitudes toward digital art have become important research topics. Artificial intelligence is not limited to technical fields but is also being used effectively in fields such as art, design, and creativity. AI systems that work with algorithms in art production processes offer students new avenues of expression in composition, color balance, and formal arrangements (Akın Demircan et al., 2025; McCormack et al., 2019). The literature emphasizes that AI literacy is directly related to students' skills such as critical thinking, problem-solving, and digital ethics (Özcan & Polat, 2023; Touretzky et al., 2019; Yurt, 2025). In this context, high school students' awareness of AI technologies and the extent to which they integrate these technologies into creative processes are among the factors determining the future of arts education.

Another concept that has gained prominence in education and the art world in recent years is metaverse technologies. The metaverse is defined as a digital universe integrating components such as virtual reality (VR), augmented reality (AR), and blockchain, and offers a space where individuals interact with their digital avatars (Dionisio et al., 2013). Artistic activities conducted in this digital universe transform not only aesthetic production but also participants' perception of and attitudes toward art in the digital environment. Younger generations, in particular, actively participate in digital exhibitions, virtual workshops, and NFT (non-fungible token)-supported art projects organized through the metaverse (Ante, 2021). In this context, determining high school students' artificial intelligence literacy and their attitudes toward digital art practices implemented in metaverse environments will yield important findings for contemporary art education policies. Students' technological literacy levels can directly impact their artistic production and perception processes. Furthermore, the impact of digital art on the construction of individual and cultural identities plays a decisive role in shaping young people's aesthetic sensitivities and creative potential (Saygın & Fındıklı, 2021). This research aims to examine high school students' artificial intelligence literacy and metaverse-based digital art attitudes within the context of visual arts.

Visual Arts Education and Digital Transformation

Digital transformation is radically redefining the conceptual, aesthetic, and sociocultural boundaries of the contemporary visual arts field (Ozturk & Ozturk, 2022, 2024). As accessibility to information and communication technologies increases, production tools are democratized, allowing artists to produce original content on individual or collective platforms (Çakır et al., 2019). This process is noted to offer significant contributions to social responsibility (Clarke and Underwood, 2011), and digital art movements are fueled by this dynamic.

Furthermore, thanks to the rapid development of global network infrastructures, spatial barriers between artists and audiences are disappearing, thus making interactive exhibition experiences more widespread. The acceleration of digital content production raises new legal issues regarding the originality, ownership, and copyright of works, raising the ethical dimensions of art education (Ruiz-Rosa et al., 2021). In this context, integrating social responsibility-focused volunteering into digital art combines students' aesthetic sensitivities with an awareness of social benefit, and interdisciplinary learning scenarios are being developed. High school students, in particular, who participate in online volunteering projects, strengthen their social entrepreneurship skills while using digital tools and engage in creative collaborations (Trajano et al., 2023).

The digitalization of visual arts represents a long-term transformation, considering the technological evolution that began with the invention of photography. With the transition from analog photography to digital sensors, the chemical nature of image recording gave way to digital coding. However, with the emergence of computer graphics, artists began to produce pixel-based compositions. With the widespread use of personal computers in the 1980s, digital illustration software became accessible, thereby reducing production costs (Ghazali et al., 2024). Although early digital artists were forced to settle for low-resolution works due to technical limitations, advancing hardware capabilities are improving visual quality. In this context, from a social responsibility perspective, digitalization provides artists with the opportunity to raise awareness of global issues and stimulate audience participation (Sönmezoğlu, 2022). As online exhibition platforms are developed, accessibility is increased through data compression algorithms, thus making art accessible to a wider audience. By creating virtual galleries, exhibitions are no longer dependent on space, and viewers can consume content independently of time and space. As the digitalization process accelerates, interactive media arts, such as the use of motion sensors in installations, are gaining popularity (Luckin et al., 2016). Furthermore, Web 2.0 technologies are transforming viewers from mere consumers to content producers, thus increasing the prevalence of collective production models (Erturgut & Soysekerci, 2012). Digital art movements spreading through social media are creating a viral effect and reshaping the masses' perception of visual culture. When artists transfer styles using AI-supported tools, they are reinterpreting historical art movements, thus strengthening postmodern eclecticism. However, representational problems arise when algorithmic biases fail to adequately reflect cultural diversity when training models. Therefore, a critical approach to the digitalization process is crucial for integrating ethical awareness into art education and shaping future art pedagogy (Forster and Grichnik, 2013; Kara, 2025).

At a conceptual level, digitalization is shifting visual art production from an "object" to a "process" focus. When artworks can be reduced to their components of code, pixels, and algorithms, traditional definitions of material culture are questioned. Furthermore, the fluid nature of digital ontology emphasizes that works do not have a fixed "final" state. In this context, the process-oriented understanding of art is reshaped by the real-time interactions of participants, thus blurring the boundaries of the work. When students manipulate algorithms in code-based productions, the composition is recreated, transforming the learning experience into an experiment-making model (Liszt-Rohlf et al., 2021). However, unequal access to digital infrastructure prevents pedagogical practices from benefiting all students equally. Therefore, educators must use low-cost open-source software in resource-constrained environments. When algorithmic art approaches are applied in community-based art projects, they draw attention to social problems and develop students' empathy (Francis, 2011). Furthermore, when digital museum collections are combined with interactive guides, semi-gamified learning experiences are offered, thus deepening the conceptual framework. When AI is incorporated into the artistic production process, the ability to explain algorithmic inferences is crucial for ethical transparency. However, unless copyright laws are frequently updated in the digital environment, the legal status of AI-generated content remains uncertain. Students reconsider the concept of ownership when they realize that AI outputs carry the status of "co-creation" (McCabe et al., 2007).

Digital Art Applications and Artificial Intelligence Literacy in Visual Arts Education

When digital art applications become widespread in educational environments, learning processes become

multisensory, interactive, and student-centered. When computer labs, tablets, and online design software are provided, students create original digital portfolios. In this context, digital art projects combined with service-learning models develop students' sense of social responsibility and strengthen their creative problem-solving skills (Cívico-Ariza et al., 2020). As curriculum updates, digital photography, 3D modeling, and animation modules are added to the curriculum, thus establishing interdisciplinary connections. Furthermore, the use of open-source software reduces licensing costs, but teachers' need for technical support increases. Students develop critical thinking skills when they receive peer feedback during digital art classes. Art teachers use rubrics to evaluate projects, thus basing learning outcomes on objective criteria (Baron, 2007). Virtual reality studios are established, allowing students to experience three-dimensional spaces. When these technologies are used in the classroom, aesthetic reflection processes are deepened, and students' art criticism skills are significantly enhanced (Crisan & Borza, 2012). Furthermore, by adding gamification elements, learning motivation is increased, thus increasing project completion rates. In practical workshops, students can receive real-time feedback using a digital drawing tablet, facilitating immediate correction of errors. Asynchronous learning opportunities are diversified when teachers upload the microlearning videos they create to online platforms (Mitra & Borza, 2010). However, when online security and personal data protection principles are neglected, student privacy is at risk. Therefore, school administrations are updating their cybersecurity protocols and raising student awareness.

Sustainable use of digital art tools in the school environment also impacts students' long-term career aspirations. Students share their portfolios on online platforms, creating professional networks at an early age (Holdsworth & Quinn, 2010). Furthermore, digital exhibition experiences support students' sense of self-efficacy, and strengthen their attitudes toward art careers. However, constantly changing software versions threaten the timeliness of pedagogical materials. Therefore, it is crucial for teachers to foster lifelong learning habits. When school libraries provide access to online databases, students' visual reference pool expands (Pevnaya & Drozdova, 2022). Students draw inspiration from digital collections to reinterpret cultural heritage and produce original works. When copyright conflicts occasionally arise, teachers reduce legal risks by introducing open licensing models. By adopting the Creative Commons license, students use openly shared works ethically. Furthermore, awareness of their digital footprint is fostered, enabling students to manage their online identities. When social media campaigns are conducted, non-school communities are involved in the project, thus increasing the widespread impact (Bacter & Marc, 2016).

AI-powered art production makes it possible to create original compositions using the visual representation capabilities of deep learning algorithms (Amaniampong & Oyelere, 2024; Franceschet et al., 2021; Lähdesmäki et al., 2025). Text-to-image models such as Midjourney and DALL-E encode user text prompts in vector space and then perform image synthesis. Therefore, linguistic concepts transform into multidimensional contexts in the visual space. In this context, artists create fictional universes by writing descriptive texts, construct alternative reality themes, and stimulate audience curiosity. Furthermore, AI provides iterative outputs, enabling rapid prototyping and shortening the trial-and-error cycles of the creative process (Dursun, 2021). The copyright of the datasets used during model training raises ethical debates. While generative networks demonstrate high performance in abstract styles, identity privacy issues arise when realistic portraits are produced. Furthermore, style transfer by changing the weights of neural networks allows for versatile visual language experimentation.

When high-resolution outputs are achieved, print quality is improved, thus expanding the possibility of physical exhibition (Quirion, 2021). As datasets are optimized, classification biases are identified and algorithmic fairness principles are tested. Lack of diversity in visual production is addressed, particularly when patterns based on gender or cultural stereotypes are identified. Artificial intelligence's ability for random variation, combined with the artist's intuitive interventions, offers a hybrid creative aesthetic. However, the "authenticity" status of algorithmic production is still a subject of theoretical debate. The art market is tokenizing AI-generated works in NFT format, making them available for secondary sale, and developing new revenue models (Ante, 2021). Thus, AI-based art production plays a leading role in the digital ecosystem from the perspective of both content creation and economic value generation.

The use of AI tools in educational processes supports students' creative thinking skills and fosters critical digital literacy (Kerrigan et al., 2009). When students observe different visual outcomes by modifying text prompts, learning occurs through trial-and-error strategies. Therefore, process-based feedback is provided immediately based on the variations suggested by the algorithm. Furthermore, during in-class projects, AI-generated preliminary visuals reduce production costs and increase prototyping speed (Dursun, 2021). Although teachers consider the "black box" nature of the algorithm a pedagogical risk, explainable AI tools reduce anxiety by visualizing the model's decision logic. Furthermore, by increasing the cultural heterogeneity of datasets, students gain access to multicultural motifs and support the diversity of visual representations. In this context, AI-supported art activities, when combined with social responsibility projects, strengthen awareness of ethical art production (Silva et al., 2023). However, while AI outputs are inherently synthetic, mechanisms for determining originality in student work become challenging. Without plagiarism checks, the boundaries between authentic production and algorithmic reproduction become blurred. Therefore, evaluation criteria are being redesigned, and process-oriented rubrics are being created. Furthermore, copyright awareness workshops are being conducted to provide legal information on dataset usage and work tokenization (Fortnow & Terry, 2021). When students discuss algorithm parameters in interactive panels, metacognitive thinking practices develop. However, the sense of "ease" associated with AI production risks eroding the perception of artistic labor (Davis & Thilagaraj, 2021).

Artificial intelligence literacy is the multifaceted set of knowledge and skills required for individuals to not only use AI technologies but also understand their operation, critically evaluate them, and effectively apply them in various contexts. In the field of education, AI literacy contributes to increasing teacher candidates' awareness of these technologies and enables their appropriate integration into pedagogical practices (Pfeiffer et al., 2023). The definition of AI literacy cannot be limited to technical competencies alone; individuals' development of ethical sensitivity, understanding the social implications of AI, and the ability to use these technologies consciously and responsibly are also integral components of this concept (Shiri, 2024).

For educators, AI literacy plays a central role in preparing students for the demands of the digital age and in the effective use of AI-enabled tools in teaching environments. In this context, ethical awareness, a key dimension of AI literacy, supports prospective teachers in using these technologies responsibly and sensitively in the classroom. Shiri (2024) emphasizes that ethical issues that may arise in the use of AI applications, particularly data security, algorithmic biases, and digital inequalities, must be addressed in educational processes. Prospective teachers who

understand these ethical issues and can evaluate AI within this framework can provide their students with safer and more informed learning environments. For example, a teacher who is aware of risks such as personal data breaches can take a more active role in raising students' awareness and taking the necessary precautions (Lu et al., 2024). Likewise, prospective teachers who can question the effects of AI technologies on social structure can make more responsible choices regarding the use of these technologies and contribute to their students' awareness of digital ethics (Park & Woo, 2022).

Metaverse-Based Art

The concept of the Metaverse, defined as a three-dimensional online environment where users are represented by avatars and interact with each other in virtual spaces, has emerged in recent years as a result of the growing interest of multinational technology companies in technologies such as Web 3.0, NFTs (Non-Fungible Tokens), blockchain, and cryptocurrency (Anagu et al., 2024; Talan & Kalinkara, 2022; Ritterbusch & Teichmann, 2023). Following the internet and mobile internet revolutions, the Metaverse is considered an evolving paradigm of the next-generation internet, where users can live virtually and experience an alternative life on an online platform. The metadata repository integrates various emerging technologies such as augmented and virtual reality (ARV), 5G, wearable sensors, and artificial intelligence, providing an immersive three-dimensional experience. A digital twin is defined as a virtual model of a physical product or service that produces a mirror image of the real world (Wang et al., 2023).

Extended Reality (XR) refers to the combination of the real and virtual worlds and human-machine interaction (Doolani et al., 2020). The concept also brings together next-generation internet technologies such as "Augmented Reality (AR)," "Virtual Reality (VR)," and "Mixed Reality (MR)." Augmented Reality (AR) is defined by Milgram and Kishino (1994) as a reality environment in which digital media products are used instead of real-world objects. Today, augmented reality technologies are offered to users through wearable technologies such as smartphones, tablets, glasses, or headsets. Augmented reality technology was first applied in the defense industry, industry, and medicine (Caudell & Mizell, 1992). Later, with the development of technology, its use has been made possible in many different fields such as entertainment, commerce, education, art, and tourism. Virtual Reality (VR) is a digitally created artificial environment and differs from augmented reality in this respect. Users report that they find themselves in a different world with VR technologies and experience similar sensations as they would in the physical environment through specialized sensor equipment (Slater and Sanchez-Vives, 2016). Mixed Reality (MR) systems are an interdisciplinary field that incorporates signal processing, computer graphics, mobile information technologies, wearable technologies, and data from information visualization displays and sensors. With mixed reality systems, users perceive both the physical environment around them and digital elements through hardware (Costanza et al., 2009).

In conjunction with the phenomenon of virtual society, the concept of the Metaverse, driven by digital technologies, is increasingly attracting attention. The Metaverse, created by technologies such as virtual reality and augmented reality, allows people to have interactive experiences similar to the real world and has the potential to have profound impacts on daily life practices (Dionisio et al., 2013). Defined as the next-generation internet,

where users can interact with each other and software applications in a three-dimensional virtual environment through avatars, interest in the Metaverse is growing daily. Contrary to popular belief, the Metaverse is not merely a playground; it is also a platform adaptable to art, education, business, and many other fields. It offers people the opportunity to transcend real-world limitations and engage in diverse experiences. Therefore, it has the potential to usher in a new era in fields such as art and education (McCormack et al., 2019).

The Metaverse enables art to become interactive and participatory. While viewers in traditional art are passive, in the Metaverse environment, they become active participants (Aydoğan et al., 2022). Viewers can contribute to artworks, manipulate them, and even create their own works. This interactive environment contributes to the democratization of art. The boundaries between artists and viewers are blurring, and each individual becomes a potential artist. This encourages art to be viewed as a collective process and helps build stronger bonds within communities. In this transformation process, NFTs are revolutionizing the art world. NFTs enable the tokenization of digital artworks using blockchain technology, verifying the ownership and originality of the works. This enables digital artworks to gain collectible value and be valued as commodities. NFTs offer new revenue models for artists (Düzünli and Perdahçı, 2024).

Students' Perception of Digital Art

Students' perceptions of digital art are shaped simultaneously with the cognitive and affective changes of adolescence. Particularly when social media use intensifies, exposure to visual culture increases, thereby transforming aesthetic perception patterns. In this context, digital art consumption plays a decisive role in students' identity construction processes (Liszt-Rohlf et al. 2021). When students use artificial intelligence-based production tools, they redefine the concept of creativity. However, when the "labor" dimension of the algorithmic production process becomes obscured, the artistic subject position becomes questionable. Therefore, art education programs increase students' conceptual awareness by incorporating critical digital literacy modules. When peer culture generates instant feedback on digital sharing platforms, students' sense of self-worth becomes dependent on social approval. Furthermore, students who participate in socially beneficial projects develop empathy-enriched aesthetic judgments (Ghazali et al., 2024). While students' motivation for success increases when they participate in digital art competitions, the competitive environment heightens performance anxiety. Although teacher guidance reduces anxiety, self-regulation strategies need to be taught. Students concretize their career possibilities when they interact with professional artists during virtual gallery visits. Furthermore, community-based digital art projects deepen students' civic awareness (Forster & Grichnik, 2013). Exposure to visual media saturation shortens attention spans, transforming instructional strategies. Consequently, microlearning, interactive narrative, and story-based approaches maintain student interest. Consequently, high school students' perceptions of digital art are constantly evolving through the interaction of technological, psychological, and social factors.

Peer influence plays a powerful catalyst role in the development of students' artistic identities related to digital art. When art associations and online communities are established, a culture of sharing is fostered and critical dialogue environments are expanded (Moore et al., 2014). When students integrate AI-based recommendation systems into their content creation processes, their production speed increases, but the perception of originality

becomes uncertain. Therefore, mentoring by teachers reduces ethical tensions. When students register their digital artworks in NFT format, they gain a sense of ownership, but market-driven valuation processes can conflict with artistic goals. In this context, the value-driven approach defined in the social entrepreneurship literature (London & Morfopoulos, 2009, London, 2018) is being applied to artistic production, suggesting social benefit-based models (Ciddi, 2019, 2025). Furthermore, energy-efficient blockchain solutions are being explored to reduce the carbon footprint of digital artworks. While technical hurdles increase costs, crowdfunding campaigns offset these costs (Liszt-Rohlf et al., 2021). Students develop financial literacy when they prepare financial statements with mentor support. As their sense of self-efficacy for an artistic career increases, students' tendency to take creative risks increases. When a social impact analysis is conducted, the digital art project's stakeholder networks are identified and a sustainability plan is developed (Holdsworth & Quinn, 2010). Consequently, students synthesize entrepreneurial and artistic expression skills through experiential learning. Ultimately, students' perceptions and attitudes toward digital art are enriched by interdisciplinary experiences, opportunities for social responsibility, and a heightened sense of ethical awareness.

An examination of the international literature reveals that holistic research addressing the metaverse and AI-focused art pedagogy at the high school level remains extremely limited (Phillips et al., 2015). In particular, there are no studies that jointly model perception and attitude variables within the framework of social entrepreneurship and social responsibility (García-Jurado et al., 2021). However, there are conflicting findings in the literature regarding how AI-generated artworks affect student perception, and there is a continuing lack of data on younger age groups (Dursun, 2021). Consequently, the existing literature often avoids multivariate structural models and fails to clarify the relationship (Kline, 2011). However, young people's digital asset creation and use of AI are increasing, and this motivation needs to be pedagogically guided (Fortnow & Terry, 2021). In particular, the affective impact of AI-enhanced art production has not yet been sufficiently investigated (Franceschet et al., 2021).

A review of studies conducted in the Turkish context reveals that research focusing on the metaverse and AI-focused art education is still in its infancy (Saygın & Fındıklı, 2021). Studies examining the pedagogical integration of AI-based art production tools in the literature are generally limited to the teacher's perspective and exclude student perception (Kaya, 2013). Furthermore, no research has been found examining high school students' AI literacy and metaverse-based digital art attitudes. Consequently, research in Turkey is quite limited in terms of AI literacy and the metaverse. In particular, the Turkish regulatory framework regarding copyright, ethics, and compensation mechanisms in AI-supported art production remains incomplete, causing teachers to experience legal uncertainty (Tanriverdi et al., 2019). Furthermore, existing studies mostly focus on university students, leaving the high school level secondary (Ghazali et al., 2024). Therefore, the gap in the literature indicates the need for empirical studies that will focus on the perception and attitude dimensions of metaverse and artificial intelligence-based art education at the high school level. The purpose of this study is to examine high school students' artificial intelligence literacy in visual arts subjects and their attitudes toward metaverse-based digital art. To this end, the research sought answers to the following questions:

- What are the levels of high school students' AI literacy in visual subjects and their attitudes toward metaverse-based digital art?

- Do high school students' AI literacy in visual subjects and their attitudes toward metaverse-based digital art differ by gender?
- Do high school students' AI literacy in visual subjects and their attitudes toward metaverse-based digital art differ by grade level?
- Does participating high school students' AI literacy in visual subjects significantly predict their attitudes toward metaverse-based digital art?

Method

This study, which aimed to examine high school students' perception levels of Metaverse-Based Digital Art and their artificial intelligence literacy in visual subjects according to demographic variables such as gender, grade, and school type, was conducted based on the comparative relational screening model, a general screening model. The comparative relational screening model is a research model designed to determine the relationship between two or more variables, the existence and/or degree of covariance, based on independent variables (Karasar, 2005).

Population and Sample

The population of this study consisted of secondary school students studying in the central districts of Ankara and Mersi provinces during the 2024-2025 academic year. The study group consisted of 278 students from 9th, 10th, 11th, and 12th grades enrolled in one private and one public secondary school within the borders of the same provinces. Although the study group was selected through random selection using a simple cluster sampling method, voluntary participation of the students was the premise.

Data Collection Tools

Personal Information Form

The questions were created to determine the demographic information of high school students. Personal variables related to gender, grade, school type, and school level were determined using a personal information form.

Visual Themed Artificial Intelligence Literacy Scale

It is a measurement tool developed to measure students' artificial intelligence literacy in visually themed subjects, based on the studies of Çelebi et al. (2023), Shiri (2024), and Wang et al. (2023). The "Artificial Intelligence Literacy in Visual Themes Scale" consists of 10 items. The scale was prepared on a 5-point Likert-type scale, ranging from most negative to most positive, and exploratory factor analysis revealed a one-dimensional structure. Cronbach's alpha reliability for the Artificial Intelligence Literacy in Visual Themes Scale was calculated as 0.88.

Metaverse-Based Digital Art Scale

In this study, a Likert-type scale developed by Karaman (2023) was used to measure high school students'

metaverse-based digital art attitudes. When developing this data collection tool, the literature was first reviewed and the opinions of academics teaching in this field were obtained. Following these interviews, a Likert-type form was created for the attitude items in the survey. The form was finalized after consulting two field experts experienced in scale development and determining that the form was understandable and answerable. The Likert-type survey items created for the study consisted of five-point response options. Cronbach's alpha coefficient was calculated as 0.81 based on the data obtained from these options.

The scale aims to measure participants' interest and perception of the metaverse, and their relationship with digital art. The items cover cognitive awareness of the metaverse (e.g., "I am knowledgeable about the metaverse"), interest and currency ("I find the metaverse interesting," "I follow the metaverse regularly"), conceptual perception ("I can perceive the relationship between the metaverse and art," "The metaverse topic seems very complex"), rational evaluation ("The idea of art in the metaverse makes sense"), comparative attitude ("I think the virtual metaverse is more interesting than the physical real world/environment"), and perception of contribution ("I think the metaverse contributes to digital art"). The scale items are structured on a 5-point Likert-type scale (1=Strongly Disagree, 5=Strongly Agree).

Data Analysis Techniques

Skewness and kurtosis values were used to test the normality of the scale scores used in the study. If the skewness and kurtosis values used in the normal distribution of scores obtained from a continuous variable fall within ±1, this can be interpreted as indicating that the scores do not exhibit a significant deviation from the normal distribution (Tabachnick & Fidell, 2007). Since the scale scores did not exhibit a significant deviation from normal, two-sample t-test and ANOVA tests were used in comparisons according to demographic variables. The Scheffe post hoc test was used to determine which groups the difference in the ANOVA test occurred between. Regression analysis was also conducted for the predictive research question. The significance level in the analyses was set at .05.

Findings

When Table 1 was examined, it was seen that the students' scores on the artificial intelligence literacy scale for visual subjects are minimum 1.83; maximum 4.83; mean 3.22; and standard deviation 0.59.

Table 1. Descriptive Statistics on Artificial Intelligence Literacy in Visual Subjects and Metaverse-Based Digital Art Attitude Scales

	N	Minimum	Maximum	Mean	Std. Deviation
Artificial Intelligence Literacy in Visual Subjects	278	1.83	4.83	3.22	0.59
Metaverse-based digital art attitudes	278	1.00	4.38	2.58	0.98

The high school students who participated in the study were found to have a moderate level of artificial

intelligence literacy in visual subjects. The students' scores on the metaverse-based digital art attitude scale were found to be minimum 1.00; maximum 4.38; mean 2.56; and standard deviation 0.98. According to these values, it was observed that the high school students' attitudes towards metaverse-based digital art are low.

When Table 2 was examined, it was found that the mean scores given to the AI literacy scale in visual subjects differ significantly according to the gender variable ($p<0.05$). According to the group means, male students were found to have higher levels of AI literacy in visual subjects compared to their female peers.

Table 2. Analysis of Artificial Intelligence Literacy Scale Scores in Visual Subjects According to the Gender Variable

	N	Mean	Std. Deviation	t	p
Female	144	3.14	0.58	-2.514	0.013
Male	134	3.31	0.60		

When Table 3 is examined, a significant difference was found in the mean scores given to the metaverse-based digital art attitude scale based on the students' gender variable ($p<0.05$). According to the group means, male students were found to have higher metaverse-based digital art attitudes compared to their female peers.

Table 3. Analysis of Metaverse-Based Digital Art Attitude Scale Scores According to the Gender Variable

	N	Mean	Std. Deviation	t	p
Female	144	2.45	0.93	-2.326	0.021
Male	134	2.72	1.01		

Table 4 reveals that the mean scores on the AI literacy scale for visual topics significantly differed by grade level ($p<0.05$). Further analysis using the Scheffe test revealed that 12th-grade students had higher AI literacy levels for visual topics compared to ninth-grade participants.

Table 4. Analysis of Artificial Intelligence Literacy Scale Scores in Visual Subjects by Grade Level

Grade Level	N	Mean	Std. Deviation	F	p
9	55	3.05	0.64	8.037	0.000
10	62	3.11	0.60		
11	99	3.20	0.54		
12	62	3.52	0.52		
Total	278	3.22	0.59		

When Table 5 was examined, a significant difference was found in the mean scores given to the metaverse-based digital art attitude scale according to students' grade level ($p<0.05$). Further analysis using the Scheffe test revealed

that eleventh- and twelfth-grade students had higher metaverse-based digital art attitudes than ninth-grade participants.

Table 5. Analysis of Metaverse-Based Digital Art Attitude Scale Scores by Grade Level

Grade Level	N	Mean	Std. Deviation	F	p
9	55	2.23	0.89	3.482	0.016
10	62	2.57	0.96		
11	99	2.64	1.00		
12	62	2.79	0.98		
Total	278	2.58	0.98		

As seen in Table 6, the regression model created between the variables of AI literacy in visual subjects and metaverse-based digital art attitude was found to be statistically significant ($F= 67.296$; $p<0.05$). The R2 value of the model was found to be 0.193. This finding indicated that AI literacy in visual subjects explained 19.3% of the variance in the dependent variable of metaverse-based digital art attitude. According to this finding, AI literacy in visual subjects made a significant positive contribution to the effect on metaverse-based digital art attitude.

Table 6. Results of Regression Analysis Between Artificial Intelligence Literacy in Visual Subjects and Metaverse-Based Digital Art Attitude Variables

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.217	0.293		0.742	0.459
Artificial Intelligence	0.733	0.089	0.443	8.203	0.000

Dependent Variable: Metaverse-Based Digital Art Attitude

$R= 0.443$; $R^2=0.193$; $F=67.296$; $p<0.05$

Discussion and Conclusion

This research examines high school students' AI literacy levels in the visual arts context and their attitudes toward metaverse-based digital art, exploring how these two variables shape demographic subgroups and predictive relationships. The research focuses on defining students' overall levels, explaining potential gender-based differences, discussing the impact of grade level on the variables, and finally, testing whether AI literacy significantly predicts metaverse attitudes. The findings indicate that AI literacy is generally moderate, while metaverse-based attitudes remain relatively low, suggesting that students exhibit a cautious yet curious approach to new technologies. A moderate level of literacy indicates that students conceptually understand AI but have room for improvement in their application skills. Low metaverse attitudes suggest that digital art has not yet been internalized within the context of the virtual universe. These findings align with relevant research in the digital transformation literature (Massi et al., 2020; Klinke, 2020). Scholars who argue that young digital natives internalize abstract concepts more quickly through experiential learning predict that attitude levels may increase

in the future (Blazhev, 2021). Furthermore, a moderate level of AI literacy suggests that students have limited but growing access to algorithm-based production tools. This finding supports the need for widespread adoption of AI-based pedagogical practices (Baran, 2023). Low metaverse attitudes are interpreted as being influenced by accessibility issues and ethical dilemmas regarding energy consumption of virtual reality equipment (Quirion, 2021). The study by Genç and Özdemir (2023) also supports these findings, finding that digital transformation creates multiple effects on artistic identity. While there is evidence in the literature that digital art experiences increase motivation in students (Black and Browning, 2011; Peppler, 2010), the current research shows that this increase has not yet fully materialized in the context of the metaverse. Therefore, unless students' conceptual readiness translates into practice, their attitudes do not reach the desired level. The results highlight the importance of integrating metaverse experiences into pedagogical frameworks in conjunction with the development of artificial intelligence literacy.

Differences According to Gender Variable

The research findings show that students' attitudes towards both artificial intelligence literacy and metaverse-based digital art exhibit significant differences in the context of the gender variable. The finding that male students scored relatively higher on both variables is similar to studies in the literature discussing gender-based access to and interest in digital technologies (Chung, 2007; González-Zamar and Abad-Segura, 2021). The high level of literacy observed in male students suggests that curiosity in algorithmic production processes may be related to social roles; this seems consistent with the trend frequently reported in the literature on digital game culture and maker movements (Sürek, 2021). In contrast, the findings that female students prioritize the dimensions of aesthetics and social responsibility when preferring artistic technological environments (Quinn, 2011) explain the low score on metaverse attitudes in the current study. Kanmaz and Pehlivan (2024) emphasize that gender-based differences in perception of creativity in digital graphic design processes affect pedagogical practices; Therefore, the findings point to the need for teachers to implement gender-sensitive designs. Akın and Çakmak (2023) state that digital transformation in virtual reality spaces can reinforce gender segregation when not supported by inclusiveness principles; the current results confirm this. The discrepancy between the finding in the literature that female students exhibit higher participation in social media-based digital art sharing (Nelson, 2018) and the results of our study is attributed to the perception of uncertainty regarding the abstract structure of the metaverse. The results reveal the importance of developing gender-sensitive digital art pedagogy strategies. While male students' perceptions of technological self-efficacy are high, female students' potential to develop aesthetic and ethically focused approaches creates pedagogical richness. Therefore, gender-based differences need to be reduced through balanced classroom task distribution and role models (Mazlum, 2022).

Differences According to the Grade Level Variable

Research findings demonstrate that as students' grade levels increase, both AI literacy and metaverse-based digital art attitudes increase. The primary determinant of this increase is the increased cognitive maturation and technology exposure of students in higher grades. Digital art pedagogy literature argues that it becomes easier to transform abstract concepts into concrete applications with age (Savazzi et al., 2014; Torshilova & Polosukhina,

2016). Furthermore, it has been reported that students in higher grades realize the need to create digital portfolios during university and career planning and turn to AI and metaverse tools (Taylor & Carpenter, 2007). Increasing digital autonomy with increasing grade levels strengthens AI literacy and increases motivation for artistic expression in the metaverse (Marner & Örtegren, 2014). However, the consistency between the findings in the literature that digital art attitudes are associated with higher affective responses in early adolescence (Pavlou, 2006) and the results of our study suggests that aesthetic sensitivity gains structural depth with age. Support is needed for lower-grade students who struggle to internalize abstract digital concepts without teacher guidance (Pan & Cheng, 2022). Erdem (2022) recommends constructivist approaches to reduce cognitive load in NFT and digital transformation-based art practices; the findings reinforce this suggestion. The results emphasize that increasing technological curiosity and self-confidence as grades progress necessitate the addition of age-specific differentiated tasks to the pedagogical framework. While motivation to produce artistic content in metaverse environments increases in upper-grade students, perceptual exploration activities become more prominent in lower-grade students. Therefore, planning learning experiences within the framework of the principle of graduated difficulty is recommended (Henson-Dacey, 2015).

Artificial Intelligence Literacy as a Predictor of Metaverse Attitude

Research findings indicate a positive and significant relationship between students' AI literacy levels and their metaverse-based digital art attitudes. Increased AI literacy fosters positive attitudes toward artistic interaction in the metaverse. This relationship aligns with models in the literature that argue that technological self-efficacy directly affects attitude and intention variables (León-Pérez et al., 2020). Erişti and Freedman (2024) reveal that teacher competencies play a critical role in digital culture integration, and that this increased competency is reflected in student attitudes. The current finding confirms this transmission mechanism at the level of student literacy. Furthermore, it has been stated that AI literacy increases security, ethics, and copyright awareness in metaverse environments, thus developing positive attitudes toward the virtual art marketplace in students (Kulakova, 2022). Our findings are consistent with studies emphasizing that AI support in digital art practices democratizes creativity (Mazzone & Elgammal, 2019). However, criticism that overreliance on AI tools exacerbates debates about authenticity (Yusa et al., 2022) highlights the need for balanced pedagogical use. The literature argues that the complex conceptual structure of metaverse environments requires a high level of technological literacy (Wang et al., 2023); this is supported by our research findings. The results indicate that AI literacy reduces students' perception of risk towards the metaverse and increases their motivation to explore. This is consistent with the main findings of technological acceptance models explaining the influence of perceived usefulness and perceived ease on attitude (Alshater et al., 2024). Therefore, AI literacy education can be considered a prerequisite for metaverse-based digital art pedagogy. Students' ability to critically evaluate algorithmic bias and ethical issues ensures the sustainability of positive attitudes (Flick, 2022). In conclusion, the finding that an increase in artificial intelligence literacy directly strengthens metaverse attitudes provides strong evidence for the need to develop integrated competency sets in digital arts education.

This study clarifies the causal hierarchy between AI literacy and metaverse attitudes in the digital art pedagogy literature. The findings show that AI literacy is a direct determinant of attitudinal tendencies, thus supporting

technology acceptance models (León-Pérez et al., 2020). This result reinforces theoretical expectations that AI-supported learning environments can transform students' aesthetic evaluations (Mazzone & Elgammal, 2019). Therefore, the study adds a new digital layer to the theory of cognitive autonomy in art education. The findings expand on the arguments of Genç and Özdemir (2023), who emphasize the multilayered impact of digital transformation on artistic identity. In this context, the research reveals the need to reinterpret digital culture theory in the context of art education. The shaping of metaverse attitudes in a way that is sensitive to AI literacy provides holistic evidence for interdisciplinary STEAM approaches (Erişti & Freedman, 2024). This study proposes a multi-level conceptual framework by examining students' interactions with digital visual culture across cognitive, affective, and social dimensions. The study also adapts social learning theory, which explains digital inequality and gender differences, to the field of art pedagogy. This adaptation reveals the transformation of the concept of cultural capital in the digital age. The results embody the pedagogical implications of ethical dilemmas frequently discussed in the literature at the student level (Flick, 2022). This study highlights the possibility of students simultaneously developing technological self-efficacy and artistic expression skills.

The practical implications of the findings offer important insights for curriculum designers. Integrating AI modules into visual arts courses at early stages accelerates students' development of positive attitudes toward metaverse environments. This supports Kanmaz and Pehlivan's (2024) emphasis on progressive competence in digital graphic design processes. School administrators establishing metaverse laboratories and AI-supported workshops reduces inequalities in access to technology. It is recommended that in-service courses on AI literacy be made mandatory in teacher education programs. This approach brings Akkaya's (2023) need for a metaverse-based pedagogical transformation in art education to a practical level.

Limitations

This study's sample consisted solely of high school students in an urban Anatolian city, limiting generalizability to different socioeconomic contexts. Cross-sectional data collection prevents the capture of changes over time. The self-report nature of the measurement tools increases the likelihood of social desirability bias influencing the results (González-Zamar & Abad-Segura, 2021). The rapidly evolving nature of the metaverse makes it difficult to achieve conceptual consistency when measuring students' perceptions (Hurst et al., 2023). The choice of a quantitative design in this study limits the ability to obtain in-depth qualitative insights. Differences in classroom implementation do not fully control for teacher influence. The inability to collect data in schools with limited access to technological equipment reduces the diversity of findings.

The limitation of the adaptation process of the AI literacy scale to the local culture to a pilot sample may increase measurement error. Because this study was conducted in the post-pandemic period, it does not fully reflect the effects of digital burnout. The conceptual model used in the study excludes individual psychological variables. Participants' digital activity habits outside of art are not considered as a control variable. The findings are interpreted considering cultural context differences. These limitations reduce the generalizability of the results and require design improvements in follow-up studies. Therefore, careful inferences should be made when interpreting the findings.

Recommendations

Based on research findings, it is recommended that algorithmic thinking and ethical AI modules be incorporated into curricula to develop AI literacy at early stages. Providing students with metaverse-based studio experiences in visual arts courses enriches pedagogical interaction. School administrators transforming physical workshops into augmented reality-supported hybrid spaces strengthens learning motivation. Incorporating certification programs focused on metaverse pedagogy into teachers' professional development plans builds sustainable capacity. Curriculum development committees should update course objectives with digital ethics and responsible media production. Supporting the STEAM transformation by adding an art dimension to STEM labs enhances interdisciplinary creativity. Providing international visibility through metaverse extensions of digital art exhibitions in schools improves students' intercultural communication skills. Gender-balanced role allocation in collaborative learning groups reinforces equitable participation. Integrating AI-supported automated feedback tools into student portfolios fosters self-regulation skills. Communicating metaverse security risks and ethical principles in family information sessions raises public awareness. Local arts institutions' partnerships with schools to share virtual exhibition infrastructure increase resource utilization efficiency. Involving civil society technology mentors in students' project-based learning processes accelerates the generation of innovative ideas. Standardizing digital art assessment criteria in national curricula increases measurement reliability. Finally, educational fiction designers can develop adaptive content using metaverse learning analytics data, enabling learning personalization.

Future research can be conducted based on multilevel models, separately addressing the cognitive, affective, and psychomotor sub-dimensions of AI literacy. Longitudinal studies can reveal the trajectory of metaverse attitude change over time. The impact of AI-supported intervention programs can be tested at a causal level using experimental methods. Detailed qualitative case studies can reveal in-depth subjective meanings of students' virtual studio experiences. Designs enhanced with neurasthenic measurements can investigate the impact of metaverse environments on emotion regulation. Furthermore, action research focusing on the impact of gender-sensitive design experiments will be important for understanding the nature of pedagogical transformation.

References

Akın, D., & Çakmak, S. (2023). Sanal gerçeklik: sanat mekânlarının dijital dönüşümü. *Akademik Sanat*, (20), 107–122.

Akın Demircan, Z., Çeliker Ercan, G., & Kaşarcı, İsmail. (2025). How Technological Readiness Shapes Pre-Service Teachers' Digital Material Design Competencies: A Structural Equation Modeling Approach. *International Journal of Current Educational Studies (IJCES), 4*(1), 77-94. https://doi.org/10.46328/ijces.172

Alshater, M. M., Nasrallah, N., Khoury, R., & Joshipura, M. (2024). Deciphering the world of NFTs: a scholarly review of trends, challenges, and opportunities. *Electronic Commerce Research*, 1–57. https://doi.org/10.1007/s10660-024-09881-y

Amaniampong, A., & Oyelere, S. (2024). Systematic literature review on pedagogies and visualization tools for machine learning in K-12 schools. *International Journal of Studies in Education and Science*

(IJSES), *5*(3), 195-222.

Anagu, E. J., Abiodun, O. J., Cletus, F., & Ephraim, B. (2024). Determinants Influencing the Adoption of Metaverse-Based Learning Platforms among University Students. *International Journal of Technology in Education and Science*, *8*(3), 411-429.

Ante, L. (2023). Non-fungible token (NFT) markets on the Ethereum blockchain: Temporal development, cointegration and interrelations. *Economics of Innovation and New Technology*, *32*(8), 1216-1234. https://doi.org/10.2139/ssrn.3904683

Aydoğan, D., Yengin, D., & Bayrak, T. (2022). Sanatın hibrit gerçeklik alanı: 'Metaverse'. *Yedi*, (28), 53–66.

Bacter, C., & Marc, C. (2016). Students' involvement in social volunteering. *Bulletin of the Transilvania University of Braşov. Series VII: Social Sciences Law*, 81–88.

Baran, H. (2023). *Yapay zekâ sanal gerçeklik ve dijital sanatın evrimi*. Duvar Yayınları, İzmir.

Baron, D. P. (2007). Corporate social responsibility and social entrepreneurship. *Journal of Economics & Management Strategy*, *16*(3), 683–717.

Black, J., & Browning, K. (2011). Creativity in digital art education teaching practices. *Art Education*, *64*(5), 19–34.

Blazhev, B. (2021). Visual Arts and Digital Technologies. *Cultural and Historical Heritage: Preservation, Presentation, Digitalization (KIN Journal)*, *7*(2), 191–207.

Caudell, T. P., Mizell, D. W. (1992). Augmented reality: An application of heads-up display technology to manual manufacturing processes. In System Sciences, 1992. Proceedings of the Twenty-Fifth Hawaii International Conference on (2, 659-669). IEEE.

Chung, S. K. (2007). Art education technology: Digital storytelling. *Art Education*, Vol. 60, pp. 17–22. Taylor & Francis.

Ciddi, M. L. (2019). Türkiye'de cumhuriyet öncesi ve sonrası resim eğitiminin gelişimi. *Bilim Eğitim Sanat ve Teknoloji Dergisi*, *3*(2), 62-68.

Ciddi, M. L. (2025). Analysis of attitudes of undergraduate art students toward painting workshop lessons. *International Journal on Social and Education Sciences*, *7*(2), 195-204.

Cívico-Ariza, A., Colomo-Magaña, E., González-García, E., & Sánchez-Rivas, E. (2020). Volunteering in the university context: Student perception and participation. *Education Sciences*, *10*(12), 380.

Clarke, J., & Underwood, S. (2011). Learning Based on 'Entrepreneurial Volunteering' Using Enterprise Education to Explore Social Responsibility. *Industry and Higher Education*, *25*(6), 461–467.

Costanza, E., Kunz, A., & Fjeld, M. (2009). Mixed reality: A survey. In Human machine interaction (47- 68). Springer, Berlin, Heidelberg.

Crisan, C. M., & Borza, A. (2012). Social entrepreneurship and corporate social responsibilities. *International Business Research*, *5*(2), 106.

Çakır, E., Öztürk, M. S., & Ünal, M. (2019). Interpainting as a creating method in digital illustration: Reinterpretations from movie scenes. *Bilim Eğitim Sanat ve Teknoloji Dergisi*, *3*(2), 78-88.

Çelebi, C., Yılmaz, F., Demir, U., & Karakuş, F. (2023). Artificial intelligence literacy: an adaptation study. *Instructional Technology and Lifelong Learning, 4*(2), 291- 306. https://doi.org/10.52911/itall.1401740

Davis, J., & Thilagaraj, A. (2021). Non-fungible token (NFT) – The game changer in the digital art world. *Anvesak*, *51*(15), 190–193.

Dionisio, J. D. N., Burns, W. G., & Gilbert, R. (2013). 3D virtual worlds and the metaverse: Current status and future possibilities. *ACM Computing Surveys (CSUR)*, *45*(3), 1–38. https://doi.org/10.1145/2480741.2480751

Doolani, S., Wessels, C., Kanal, V., Sevastopoulos, C., Jaiswal, A., Nambiappan, H., & Makedon, F. (2020). A review of extended reality (xr) technologies for manufacturing training. *Technologies, 8(*4), 77.

Dursun, N. (2021). NFT/crypto art and motion graphics relationship. *Journal of Social, Humanities and Administrative Sciences*, *7*(40), 1037–1055.

Düzenli, K., & Perdahçı, Z. N. (2023). Metaverse ve NFT'nin mimarlığa etkileri: Geleceğin yapıları nasıl şekillenecek? *Dokuz Eylül Üniversitesi Mimarlık Fakültesi Dergisi*, *4*(2), 165–182.

Ergen, İ. (2022). *Yapay Zekâ İle Gelişen Tasarım Grafik ve Oyun Tasarımı, Otonom Sanat, Metaverse ve NFT Olasılıklarını Keşfetmek*. Efe Akademi Yayınları.

Erişti, S. D. B. (2023). Dijital görsel kültüre dayalı yaratıcı pedagojik yaklaşımlar. *Ondokuz Mayıs Üniversitesi Güzel Sanatlar Fakültesi Uluslararası Sanat ve Tasarım Araştırmaları Dergisi*, *1*(1), 49–60.

Erturgut, R., & Soysekerci, S. (2012). Social entrepreneurship effect on educational activity: the research in Turkey universities. *Procedia-Social and Behavioral Sciences*, *46*, 3954–3958.

Flick, C. (2022). A critical professional ethical analysis of Non-Fungible Tokens (NFTs). *Journal of Responsible Technology*, *12*, 100054.

Forster, F., & Grichnik, D. (2013). Social entrepreneurial intention formation of corporate volunteers. *Journal of Social Entrepreneurship*, *4*(2), 153–181.

Fortnow, M., & Terry, Q. (2021). *The NFT handbook: How to create, sell and buy non-fungible tokens*. John Wiley & Sons.

Franceschet, M., Colavizza, G., Finucane, B., Ostachowski, M. L., Scalet, S., Perkins, J., & Hernández, S. (2021). Crypto art: A decentralized view. *Leonardo*, *54*(4), 402–405. https://doi.org/10.1162/leon_a_01981

Francis, J. E. (2011). The functions and norms that drive university student volunteering. *International Journal of Nonprofit and Voluntary Sector Marketing*, *16*(1), 1–12.

García-Jurado, A., Pérez-Barea, J. J., & Nova, R. J. (2021). A new approach to social entrepreneurship: A systematic review and meta-analysis. *Sustainability*, *13*(5), 2754.

Genç, Ö., & Özdemir, F. (2023). *Sanatta dijital dönüşüm ve kripto sanat*. (Yüksek Lisans Tezi) Nevşehir Hacı Bektaş Veli Üniversitesi.

Ghazali, E. M., Mutum, D. S., Nguyen, B., Hamzah, Z. L., & Mohtar, M. (2024). Social entrepreneurship and volunteering: Moderation effects of volunteer experience levels on social entrepreneurial intent model. *Entrepreneurship Research Journal*, *14*(1), 53–88.

González-Zamar, M.-D., & Abad-Segura, E. (2021). Digital design in artistic education: An overview of research in the university setting. *Education Sciences*, *11*(4), 144.

Henson-Dacey, J. B. (2015). *High School Visual Art Students' Perceptions of Creativity*. Walden University.

Holdsworth, C., & Quinn, J. (2010). Student volunteering in English higher education. *Studies in Higher Education*, *35*(1), 113–127.

Hurst, W., Spyrou, O., Tekinerdogan, B., & Krampe, C. (2023). Digital art and the metaverse: benefits and challenges. *Future Internet*, *15*(6), 188.

Kanmaz, Z. İ., & Pehlivan, S. (2024). Dijital dönüşüm çağında değişen paradigma ve grafik tasarım süreci. *Sanat*

ve Tasarım Dergisi, *1*(33), 233–252.

Kara, S. (2025). The effect of artificial intelligence applications in 6th grade visual arts course on student attitudes and course outcomes. *International Journal of Modern Education Studies, 9*(1).

Karaman, M. (2023). Sanal Evren (Metaverse) Ortamında Dijital Sanatın Konumlanması Üzerine Görsel Sanat Öğrencilerinin Görüşleri. *Elektronik Sosyal Bilimler Dergisi, 22*(88), 1811-1827.

Karasar, N.(2005). *Bilimsel araştırma yöntemi* (14. Baskı). Ankara: Nobel Yayın ve Dağıtım.

Kerrigan, F., O'Reilly, D., & Vom Lehn, D. (2009). Producing and consuming arts: A marketing perspective. *Consumption Markets & Culture*, *12*(3), 203–207. https://doi.org/10.1080/1025386090306322

Klinke, H. (2020). The digital transformation of art history. In *The Routledge companion to digital humanities and art history* (pp. 32–42). Routledge.

Kulakova, O. S. (2022). Digital art in the light of NFT: Market role and legal uncertainty. *Digital Lj*, *3*, 36-58.

Lähdesmäki, S., Väisänen, S., & Hyytinen, H. (2025). University Teachers' Perspectives on Using Artificial Intelligence in Teaching and Its Related Aspects. *International Journal on Social and Education Sciences*, *7*(3), 272-291.

León-Pérez, F., Bas, M.-C., & Escudero-Nahón, A. (2020). Self-perception about emerging digital skills in Higher Education students. *Comunicar: Media Education Research Journal*, *28*(62), 89–98.

Liszt-Rohlf, V., Fields, M., Gerholz, K.-H., Seco, V., & Haury, C. (2021). The benefits of volunteering, volunteers' competencies, and their integration into business education. *International Journal for Business Education*, *161*(1), 5-28.

London, M. (2018). Leadership and advocacy: Dual roles for corporate social responsibility and social entrepreneurship. In *Contemporary Issues in Leadership* (pp. 259–278). Routledge.

London, M., & Morfopoulos, R. G. (2009). *Social entrepreneurship: How to start successful corporate social responsibility and community-based initiatives for advocacy and change*. Routledge.

Lu, K., Zhu, J., Pang, F., & Shadiev, R. (2024). Understanding the relationship between colleges students' artificial intelligence literacy and higher order thinking skills using the 3P model: The mediating roles of behavioral engagement and peer interaction. *Educational Technology Research and Development,* https://doi.org/10.1007/s11423-024-10434-1

Luckin, R., Holmes, W., Griffiths, M. & Forcier, L. B. (2016). *Intelligence Unleashed. An argument for AI in Education.* London: Pearson.

Marner, A., & Örtegren, H. (2014). Education through digital art about art. *International Journal of Education Through Art*, *10*(1), 41–54.

Massi, M., Vecco, M., & Lin, Y. (2020). Digital Transformation in the Cultural and Creative Industries. *Digital Transformation in the Cultural and Creative Industries*, 1–9.

Mazlum, H. (2022). Çağdaş Sanat Eğitiminde Dijital Teknolojinin Rolü. *Uluslararası İnsan ve Sanat Araştırmaları Dergisi*, *9*(4), 345–358.

Mazzone, M., & Elgammal, A. (2019). *Art, creativity, and the potential of artificial intelligence* (Vol. 8). MDPI.

McCabe, T. L., White, K. M., & Obst, P. L. (2007). The importance of volunteering functions to university students. *Australian Journal on Volunteering*, *12*(2), 50–58.

McCormack, J., Gifford, T., & Hutchings, P. (2019, April). Autonomy, authenticity, authorship and intention in computer generated art. In *International conference on computational intelligence in music, sound, art*

and design (part of EvoStar) (pp. 35-50). Cham: Springer International Publishing.

Milgram, P., & Kishino, F. (1994). A taxonomy of mixed reality visual displays. *IEICE TRANSACTIONS on Information and Systems, 77*(12), 1321-1329.

Mitra, C., & Borza, A. (2010). The role of corporate social responsibility in social entrepreneurship. *Management & Marketing*, *5*(3), 123-158.

Moore, E., Warta, S., & Erichsen, K. (2014). College students' volunteering: Factors related to current volunteering, volunteer settings, and motives for volunteering. *College Student Journal*, *48*(3), 386–396.

Nelson, G. L. (2018). *Perceptions about Hands-On Art Making by Online Students*. Walden University.

Ozturk, M. U., & Ozturk, M. S. (2022). The Analysis of Fine Arts Students' Social Media Awareness Levels Related to Appearance. *International Journal of Education in Mathematics, Science and Technology*, *10*(3), 722-739.

Ozturk, M. S., & Ozturk, M. U. (2024). Investigation of the Relationship between Creative Personality Traits and Internet Usage of Fine Arts Faculty Students. *International Journal of Education in Mathematics, Science and Technology*, *12*(2), 513-531.

Özcan, A., & Polat, S. (2023). Artificial Intelligence and Chat Bots in Academic Research. *Journal of Research in Social Sciences and Language, 3*(2), 81–90.

Pan, R., & Cheng, J. (2022). Design and Application of the Digital-Oriented Interactive System for Teaching Preschool Art Education. *Mathematical Problems in Engineering*, *2022*(1), 1242038.

Park, J., & Woo, S.E. (2022). Who likes artificial intelligence? personality predictors of attitudes toward artificial intelligence. *The Journal of Psychology, 156*(1), 68-94.

Pavlou, V. (2006). Pre-adolescents' perceptions of competence, motivation and engagement in art activities. *International Journal of Art & Design Education*, *25*(2), 194–204.

Peppler, K. A. (2010). Media arts: Arts education for a digital age. *Teachers College Record*, *112*(8), 2118–2153.

Pevnaya, M. V., & Drozdova, A. A. (2022). *Cultural Volunteering of University Students: Assessment of Participation Experience and Potential for Development*.

Pfeiffer, A., Denk, N., Serada, A., & Dingli, A. (2022). Digital identities, NFTS and AI in the education sector: Showcasing a demonstrator. *INTED2022 Proceedings*, 6867–6876.

Quinn, R. D. (2011). E-learning in art education: Collaborative meaning making through digital art production. *Art Education*, *64*(4), 18–24.

Quirion, A. (2021). What is an NFT and why should archivers pay attention? *Archeota*, *7*(1), 10–12.

Ruiz-Rosa, I., García-Rodríguez, F. J., & Delgado-Rodríguez, N. (2021). Volunteering as an explanatory factor of social entrepreneurship: an analysis of an educational context. In *Next Generation Entrepreneurship*. IntechOpen.

Savazzi, F., Massaro, D., Di Dio, C., Gallese, V., Gilli, G., & Marchetti, A. (2014). Exploring responses to art in adolescence: a behavioral and eye-tracking study. *PloS One*, *9*(7), e102888.

Saygın, E. P., & Fındıklı, S. (2021). Canvas to key: The role of NFTs in the digital transformation of the art market. *Business & Management Studies: An International Journal*, 9(4), 1452–1466.

Shiri, A. (2024). Artificial intelligence literacy: A proposed faceted taxonomy. *Digital Library Perspectives, 40*(4), 681-699. https://doi.org/10.1108/DLP-04-2024-0067

Silva, R., Rodrigues, M., Franco, M., Oliveira, C., & Sousa, N. (2023). How do social responsibility and social

entrepreneurship generate value creation in pandemics? *Journal of Enterprising Communities: People and Places in the Global Economy*, *17*(2), 305–333.

Slater, M. & Sanchez-Vives, M. V. (2016). Enhancing our lives with immersive virtual reality. *Frontiers in Robotics and AI, 3*, 74-88.

Sonmezoglu, U. (2022). A Research on Individual Social Responsibility and Social Entrepreneurship Tendencies of University Students. *Journal of Educational Issues*, *8*(3), 69–83.

Sürek, A. (2021). *Dijital oyunların ortaöğretim görsel sanatlar dersine katkısına yönelik öğrenci görüşleri*. (Yüksek Lisans Tezi), Pamukkale Üniversitesi Eğitim Bilimleri Enstitüsü.

Tabachnick, B. G., & Fidell, L. S. (2007). *Experimental designs using ANOVA* (Vol. 724). Belmont, CA: Thomson/Brooks/Cole.

Talan, T., & Kalinkara, Y. (2022). Students' Opinions about the Educational Use of the Metaverse. *International Journal of Technology in Education and Science*, *6*(2), 333-346.

Tanriverdi, M., Uysal, M., & Üstündağ, T. M. (2019). What is blockchain technology? What it is not: A review of the literature. *Journal of Information Technologies*, *12*(3), 204–217.

Taylor, P. G., & Carpenter, B. S. (2007). Mediating art education: Digital kids, art, and technology. *Visual Arts Research*, 84–95.

Torshilova, E. M., & Polosukhina, I. A. (2016). The Influence of Modern Adolescents' Vision of Life on Their Perception of Art. *International Journal of Environmental and Science Education*, *11*(18), 10751–10759.

Touretzky, D. S., Gardner-McCune, C., Martin, F., & Seehorn, D. (2019). Envisioning AI for K-12: What should every child know about AI? *Proceedings of the AAAI Conference on Artificial Intelligence*, *33*(1), 9795–9799. https://doi.org/10.1609/aaai.v33i01.33019795

Trajano, S. da S., Sousa-Filho, J. M. de, Matos, S., & Lessa, B. de S. (2023). Do volunteers intend to become social entrepreneurs? The influence of pro-social behavior on social entrepreneurial intentions. *Nonprofit and Voluntary Sector Quarterly*, *52*(2), 443–473.

Wang, H., Ning, H., Lin, Y., Wang, W., Dhelim, S., Farha, F., … Daneshmand, M. (2023). A survey on the metaverse: The state-of-the-art, technologies, applications, and challenges. *IEEE Internet of Things Journal*, *10*(16), 14671–14688.

Yurt, E. (2025). The Self-Regulation for AI-Based Learning Scale: Psychometric Properties and Validation. *International Journal of Current Educational Studies (IJCES), 4*(1), 95-118. https://doi.org/10.46328/ijces.176

Yusa, I. M. M., Yu, Y., & Sovhyra, T. (2022). Reflections on the use of artificial intelligence in works of art. *Journal of Aesthetics, Design, and Art Management*, *2*(2), 152–167.

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