

Artificial Intelligence in Pedagogical Processes: A Transformative Perspective on Teaching Art History

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ABSTRACT

This paper explores the transformative potential of artificial intelligence (AI) in art history education. Specifically, this study seeks to understand how AI can be effectively integrated into art history pedagogy to enhance student learning outcomes and foster creativity. The study highlights AI's diverse applications, including personalized learning experiences, automated assessments, and the cultivation of students' creative skills. A thorough literature review provides practical recommendations for effectively utilizing AI tools in research, education, and art, along with insightful examples for future studies. One key finding is AI's capacity to initiate a new educational era by tailoring content to individual student paces and interests, thus enhancing learning effectiveness. AI can also ease teachers' assessment burdens, allowing them to concentrate on more engaging and student-focused activities while improving students' analytical and interpretive skills regarding artworks. Nonetheless, the implementation of AI raises ethical concerns, particularly regarding potential biases in algorithms that could lead to unfair student assessments. Therefore, adhering to ethical principles is essential in the deployment of AI in education. A case study included in the paper showcases practical AI applications within art history education, illustrating how theoretical potential can manifest in real-world scenarios. For example, AI tools allow students to explore virtual museums, analyze artworks from different perspectives, and create their own digital art. In conclusion, the study concludes that AI has the potential to revolutionize art history education by enabling more active and effective learning for students while fostering a more creative and student-centered approach for teachers. However, it is crucial to exercise caution regarding the ethical use of AI and to manage associated risks as its role in art history education continues to expand.

Pedagojik Süreçlerde Yapay Zekâ: Sanat Tarihi Öğretiminde Dönüştürücü Bir Bakış

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Bu makale, yapay zekânın (YZ) sanat tarihi eğitiminde sunduğu dönüştürücü potansiyeli inceliyor. Çalışma, YZ'nin sanat tarihi pedagojisine nasıl etkili bir şekilde entegre edilerek öğrenci öğrenim sonuçlarını iyileştirip yaratıcılığı teşvik edebileceğini anlamayı amaçlıyor. Makalede, YZ'nin kişiselleştirilmiş öğrenme deneyimleri, otomatik değerlendirmeler ve öğrencilerin yaratıcı becerilerinin geliştirilmesi gibi çeşitli uygulamaları ele alınıyor. Kapsamlı bir literatür taraması, araştırma, eğitim ve sanat alanlarında YZ araçlarının etkili bir şekilde kullanılmasına yönelik pratik öneriler sunarken, gelecek çalışmalar için ilham verici örnekler de



Sanat Tarihi,
Yapay Zekâ.

sağlıyor. Araştırmanın önemli bir bulgusu, YZ'nin bireysel öğrenci hızına ve ilgi alanlarına göre içerik uyarlama kapasitesi sayesinde öğrenme etkinliğini artırarak yeni bir eğitim dönemini başlatma potansiyeline sahip olmasıdır. YZ, öğretmenlerin değerlendirme yükünü azaltabilir, böylece onların daha fazla öğrenci odaklı ve ilgi çekici etkinliklere yoğunlaşmalarına olanak tanır. Ayrıca, öğrencilerin sanat eserlerini analiz etme ve yorumlama konusundaki becerilerini geliştirmelerine katkıda bulunur. Ancak, YZ'nin uygulanması, algoritmaların olası önyargıları nedeniyle adil olmayan öğrenci değerlendirmelerine yol açma riski taşıyan etik endişeleri de beraberinde getirir. Bu nedenle, eğitimde YZ'nin kullanımında etik ilkelere bağlı kalmak büyük önem taşır. Makaleye dâhil edilen bir örnek olay incelemesi, sanat tarihi eğitiminde YZ'nin pratik uygulamalarını gözler önüne sererek teorik potansiyelin gerçek dünyada nasıl somutlaştığını gösteriyor. Örneğin, YZ araçlarının, öğrencilere sanal müzeleri keşfetme, sanat eserlerini farklı açılardan analiz etme ve kendi dijital sanat eserlerini yaratma fırsatı sunması gibi. Sonuç olarak, bu çalışma, YZ'nin öğrencilere daha aktif ve etkili bir öğrenme ortamı sağlarken, öğretmenler için daha yaratıcı ve öğrenci odaklı bir yaklaşım teşvik ederek sanat tarihi eğitimini devrim niteliğinde değiştirme potansiyeline sahip olduğunu ortaya koymaktadır. Ancak, YZ'nin etik kullanımı ve onun sanat tarihi eğitimindeki rolü genişledikçe, beraberinde getirdiği risklerin dikkatli bir şekilde yönetilmesi önemlidir.

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INTRODUCTION

Artificial Intelligence (AI) has emerged as a transformative force in both education and art, revolutionizing the learning process and artistic creation. The integration of AI technology has diversified and enhanced the educational experience, allowing students to access personalized learning materials and receive tailored support. Similarly, in the realm of art, AI has enabled artists to explore new avenues of creativity and produce works of art in ways previously unimagined. The impact of AI on education and art has sparked widespread interest and raised crucial questions about its potential implications.

Previous research, as demonstrated by Siemens and Baker (2012) as well as Peşman and Özdemir (2019), has highlighted the significant role of AI in personalizing learning, automating assessment, and enhancing educational efficiency. However, there remains an essential question to be addressed: How can AI truly transform the field of art history education and what are the potential implications for student learning experiences? This question is paramount as it directly impacts the future of educational practices and artistic creation.

The importance of addressing this question lies in the potential to uncover how AI can revolutionize art history education and subsequently influence student learning experiences. By exploring this, the study aims to contribute to the broader theoretical framework by shedding light on the transformative potential of AI in pedagogical processes.

To clearly state the research problem, this study focuses on understanding how AI technologies can be effectively integrated into art history education to enhance learning outcomes and foster creativity among students. The specific goals of this study include comprehensively examining the multifaceted applications and impacts of AI in art history education, addressing ethical issues in art production, and providing practical insights into the effective use of AI tools. By achieving these goals, the study aims to enrich the existing literature on AI in education and art, offering valuable implications for future research and educational practices.

This study is crucial in emphasizing the potential effects and application areas of its results, as it seeks to illuminate the transformative potential of AI in art history education and its broader implications for educational practices and artistic creation. Furthermore, the study will define important concepts and terms used in the context of AI in art history education, providing clarity and understanding crucial for the study's framework and practical application.

METHODOLOGY

This study employs a mixed-methods approach, combining a literature review and a case study. It incorporates both a literature review and a case study, allowing for a comprehensive exploration of the topic. The literature review provides a theoretical foundation and context, while the case study offers practical insights and real-world applications of the concepts discussed.

The literature review systematically examined scholarly articles published between 1972 and 2024 that explored the intersection of AI and art history education. A total of 28 articles were included in the review, selected based on several criteria. First, they were chosen for their direct relevance to the intersection of artificial intelligence, art, and education, particularly concerning AI-generated art, formal analysis, and the impact of AI on art history. Second, the sources comprise peer-reviewed journal articles, conference papers, and books from reputable publishers, ensuring a high level of scholarly rigor and credibility. Additionally, recent publications from 2020 onwards were prioritized to reflect the latest developments and discussions in the fields of AI and art education. The bibliography also encompasses a variety of perspectives, including theoretical analyses, case studies, educational applications, and

ethical considerations related to AI in art. Furthermore, articles that discuss methodologies for integrating AI in educational settings or evaluate its impact on learning outcomes were particularly valued. Finally, the inclusion of works that bridge various fields, such as computer science, sociology, art history, and education, highlights the interdisciplinary nature of contemporary discussions surrounding AI in art.

This bibliography aims to provide a comprehensive overview of current literature at the intersection of artificial intelligence, art, and education, including seven primary references that meet the criteria of relevance, academic rigor, and currency. Notable works include Albar Mansoa's examination of AI-generated art's impact on art education (2023), and Carpino and Hutson's exploration of AI in enhancing formal analysis skills (2024), alongside Hutson's evaluation of AI tools in digital art history learning (2024). Complementing these are contributions that assess the broader implications of AI in education, such as Peşman and Özdemir's study on AI-supported educational systems (2019) and Radford et al.'s research on natural language supervision in visual models (2021). Additionally, Zullich et al. present a case of AI integration in historical art analysis (2023).

Beyond the primary sources, twelve foundational references are included to enrich the discussion. These works range from Alpers' theoretical background on the relationship between visual art and literature (1972) to Cohen's historical context of AI in creative fields (2016) and Baker and Yacef's insights into data-driven educational approaches (2010). Other significant contributions, such as Fallis' examination of deepfakes' impact on authenticity (2021) and Franceschelli and Musolesi's exploration of copyright in AI-generated works (2022), address critical ethical and legal considerations. Together, these references represent a multifaceted understanding of how AI shapes artistic practice and educational methodologies, ensuring a rich context for discussing the evolving role of AI in art and education.

The second method, an example of a case study, involved a detailed analysis of a specific implementation of AI in an art history course. The data collection methods used in the case study included a variety of approaches to gather both quantitative and qualitative insights. Surveys and questionnaires were administered to students and instructors to collect quantitative feedback on their experiences with AI tools in the classroom. In-depth interviews were also conducted to obtain qualitative insights, exploring the impact of AI on learning practices and creativity from a personal perspective. Additionally, classroom observations were carried out to assess the practical application and effectiveness of AI tools in real-time learning situations, allowing for direct observation of student engagement. Performance data analysis involved examining students' performance metrics before and after the introduction of AI tools to measure any changes in learning outcomes. Content analysis was employed to evaluate assignments or projects created with the assistance of AI, aiming to understand its influence on students' creative processes. Finally, focus groups were organized to foster discussions among students about their experiences and perceptions regarding AI in the art history course, thereby capturing a collective understanding of AI's impact on their learning journey. Together, these methods provided a comprehensive understanding of how AI tools were integrated into art history education and their effects on students' learning and creativity. By sharing these data collection methods of the case study in my work, I contribute to a comprehensive understanding of the transformative potential of AI in art history education. This approach not only aligns with the principles of rigorous research, but also creates a clear framework for analysing the multifaceted effects of AI tools on students' learning and engagement. Sharing this information enhances the validity of the study as it demonstrates a systematic way of collecting and analysing data and ultimately supports the exploration of how AI can effectively revolutionise pedagogical practices in art history.

FINDINGS

A New Era in Education: The Role of Artificial Intelligence

Artificial intelligence is one of the important technological developments that have led to radical changes in education systems today. The use of artificial intelligence has started a new era in education with the potential to personalize learning processes, diversify teaching methods and make education management more efficient (Siemens & Baker, 2012). Artificial intelligence algorithms can analyze students' learning styles, strengths and weaknesses and offer special learning materials and activities for each student (Siemens & Baker, 2012). In this way, students have the opportunity to learn at their own pace and in line with their interests. In addition, artificial intelligence-based automatic assessment systems reduce teachers' workload while providing fast and accurate feedback to students (Peşman & Özdemir, 2019). Intelligent teacher systems, i.e. technology models designed using artificial intelligence and computer science, also provide one-on-one support to students and improve learning processes. (Brusilovsky, 2001). Thanks to its ability to analyze large data sets, artificial intelligence provides information about the general status of educational systems, student performance, and teaching activities, allowing educational decisions to be made more data-based (Russell & Norvig, 2016).

The use of artificial intelligence in education offers many benefits such as increasing student success, ensuring educational equality, improving the role of teachers, and increasing the efficiency of education systems (Baker & Yacef, 2010). On the other hand, with the widespread use of artificial intelligence in education, some difficulties may be encountered such as data privacy, algorithmic (data-based) biases, technical infrastructure deficiencies, and teachers' resistance to using artificial intelligence.

In the future, it is expected that artificial intelligence will adapt more to education. Artificial intelligence, which is developing more and more every day, will be able to undertake more complex and creative tasks in the learning process with these developments. For example, it can analyse students' emotional states and provide them with psychological support or produce original projects to develop students' creativity. Artificial intelligence has a significant potential for transformation in education; however, more research needs to be done on technical, pedagogical and ethical issues in order for artificial intelligence to be used effectively in education.¹ In addition, artificial intelligence should be seen as a tool in education and should aim to facilitate the teacher's job rather than replace it. The same concerns exist about the use of artificial intelligence in art history education, which is the main theme of this study; however, before this issue, it is necessary to examine the relevance of the subject to art production, which directly concerns art history, and to mention when artificial intelligence started to be used in this field, how it developed and what its ethical dimensions are.

Transformation from Data to Art: An Overview of the History and Ethical Dimension of Art Production with Artificial Intelligence

The initial efforts to leverage the capabilities of AI to generate coherent content based on human instructions can be traced back to the 1950s when scientists at the MIT (Massachusetts Institute of Technology) laboratory developed a program called ELIZA (Dehouche, N. & Dehouche, K., 2023; Wiezenbaum, 1976). ELIZA represents one of the early instances of software (text-to-text) designed to

¹In recent years, research and academic studies on the role and potential of artificial intelligence in education have intensified in Turkey. A detailed literature review can be conducted on this subject through channels such as TUBITAK ULAKBIM, Dergipark, Google Scholar, Scopus, Web of Science, YÖK thesis centre, ResearchGate, TUBITAK BİLGEM, and the Association of Computer and Educational Technologies (BETEM).

create original textual responses intended for human interpretation. This software offered basic replies to input text through pattern matching (the process of matching a particular pattern or repetition with another similar structure) and natural language processing methods.

AARON, an artistic AI program created by artist Harold Cohen in the 1970s, stands as one of the pioneering examples of art generated using artificial intelligence (Cohen, 2016). AARON had the capability to produce intricate shapes and drawings, adhered to a set of rules and constraints during the creation process, and developed the ability to learn from its own outputs over time (Aaron, 2023). The advancement of AI technology in the 1980s and 1990s facilitated the creation of more sophisticated art outputs through artificial intelligence. For instance, Karl Sims produced 3D (three-dimensional) images and animations using evolutionary algorithms (inspired by natural evolutionary processes, used in artificial intelligence for learning, decision making, and problem-solving) showcasing the progress in this field (Hutson & Robertson, 2023; Sims, 1992). The recent emergence of "deep learning" (a technology that allows computers to learn on their own based on data) has led to the generation of more lifelike outputs, sparking interest in the art world and among audiences. In 2015, a team of researchers at Google successfully trained a neural network on a dataset comprising over 10,000 images using deep learning techniques to generate original art pieces from input images. This led to the creation of the DeepDream program, which produces surreal and visually striking outputs from input images, simulating the communication processes of nerve cells in the human brain and information processing (Mordvintsev et al., 2015). Consequently, the text-to-text outputs achieved with ELIZA have evolved into image-to-image outputs. Another significant development was the sale of the AI-generated portrait titled "Portrait of Edmond Belamy" (Figure 1), created by the Paris-based Obvious art collective, which fetched over \$432,000 at an auction held by Christie's in 2018 (Cohn, 2018). The sale of the AI-generated portrait represents a significant milestone in the development of AI art, demonstrating its commercial viability, artistic potential, and public acceptance. This event highlights the progress made in AI technology and the increasing sophistication and value of AI-generated art.

Figure 1

Portrait of Edmond Belamy



Credits: Artificial Intelligence Software, 2018, canvas, 70x 70 cm. Source: https://commons.wikimedia.org/wiki/File:Edmond_de_Belamy.png (This image is in the public domain because it is a work of computer algorithms or artificial intelligence and does not contain sufficient human authorship to support a copyright claim.)

The year 2020 marked a significant advancement in text-to-text software. This development is linked to GPT-3/Generative Pre-trained Transformer, introduced by the specialized research company OpenAI. GPT-3 has made significant strides in the development of text-to-text models, ushering in the era of Large Language Models and enabling the generation of high-quality, human-like text for various

applications such as translation, text summarization, and creative writing (Dehouche, N. & Dehouche, K., 2023).

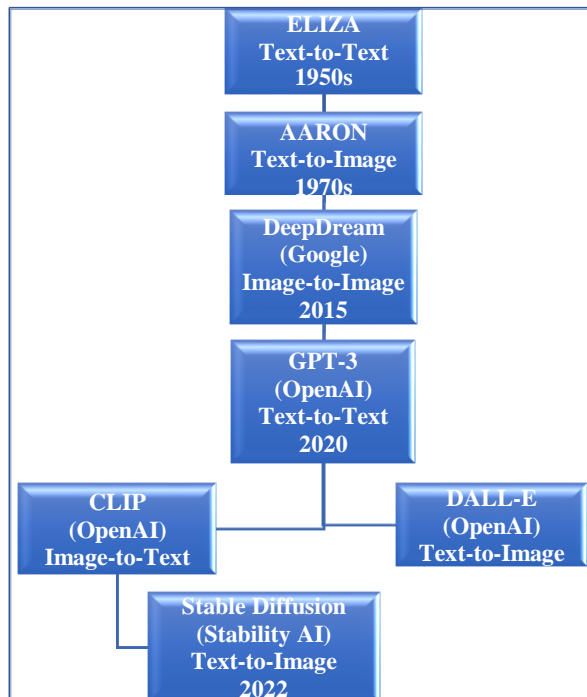
The GPT-3 discovery facilitated the development of another groundbreaking model, CLIP/Contrastive Language-Image Pretraining, designed by OpenAI to connect text to images. This resulted in a general-purpose image-text model trained on 400 million text-image pairs obtained from the internet, allowing for image classification without any labels. CLIP could generate coherent text describing any input image (Radford et al., 2021).

OpenAI further advanced their work by introducing DALL-E, capable of generating realistic image outputs (Ramesh et al., 2022). While DALL-E remained a closed-source and proprietary software, the code for CLIP was released as open-source. Leveraging this opportunity, Stability AI, a company focused on artificial intelligence research, created Stable Diffusion, an open-source text-to-image model with performance comparable to DALL-E, available under a license permitting both commercial and non-commercial use (Rombach et al., 2022).

A schematic overview of AI-generated art's history (Figure 2) clearly demonstrates the rapid advancements since the early days of ELIZA. However, the advent of CLIP and subsequent text-to-image systems has introduced ethical and societal concerns. These stem from the potential perpetuation of implicit biases related to gender, ethnicity, attractiveness, sincerity, wealth, and intelligence inherent in pre-trained deep learning models. A study analysing 10,000 portraits using CLIP confirmed these worries (Dehouche, 2021, p.167936). It revealed strong correlations between labels and social stereotypes, such as associating femininity with attractiveness, masculinity with wealth, and whiteness with desirability. This highlights the risk of misusing seemingly benign labels for harmful purposes. The study also critiques current algorithmic fairness definitions and advocates for bias mitigation throughout the system's development, not just during data collection and training.

Figure 2

The Development of Artificial Intelligence in Art Production



Another concern relates to the unauthorized use of copyrighted works. One study sought answers to the following questions: Can copyrighted works be used as a training set for generative models? How can we legally store copies of works to carry out the training process? To whom will the copyright of the generated data belong? In seeking answers to these questions, the laws in force in the United States and the European Union and potential future sanctions were considered. At the end of the study, practical guidelines for artists and developers working on deep-learning-generated art and policy recommendations for policymakers were formulated (Franceschelli & Musolesi, 2022, p. e17-1).

A further concern with text-to-image systems is their potential for misuse, such as generating deepfakes or disseminating disinformation. Fallis (2021, p. 623) investigates deepfakes, which are fabricated videos or audio recordings produced using AI. Unlike traditional photographic methods, deepfakes employ novel machine learning techniques to depict individuals saying or doing things they never have. The study warns of an impending "infocalypse" in news media and the blogosphere, where deepfakes make it virtually impossible to discern fact from fiction. The research delves into the reasons why deepfakes pose a significant threat to the integrity of information.

Despite all the ethical concerns, the revolutionary impact of artificial intelligence on art production is undeniable. This impact has also provided a completely new perspective on art history. With the use of AI in the production, analysis, and even creation of new works of art, art history education has begun to adapt to this transformation. The main reason for including AI-supported analysis tools and algorithms in education, in addition to traditional art history methods, is to enable students to examine works of art more deeply and evaluate them from different perspectives. The advantages and potential that AI offers to art education will not only help us better understand the past of art but also enable the training of generations who can make more accurate predictions about the future.

The Potential of Artificial Intelligence in Art History Education

Studies on the use and potential of artificial intelligence, one of the significant inventions of our time, continue at full speed today. The possibilities that AI offers in the field of art provide unique opportunities to develop formal analysis methods.² For example, through the use of AI, students can deeply examine and practically explore the plastic elements, composition, or technical characteristics of a work of art and visually recreate them. Therefore, AI makes a promising contribution to the concept of digital art history by expanding the scope of teaching methods in art history analysis (Zullich et al., 2023).

To leverage this contribution, traditional methods in art history education need to be aligned with "prompt engineering" for generative visual models/tools of artificial intelligence such as Dall-E 3, Midjourney³ and Stable Diffusion. Prompt engineering guides AI to generate visual outputs for a specific topic; in other words, it creates descriptive prompts. These descriptive prompts are used as inputs for generative visual models to create visual representations (Hutson & Robertson, 2023). This process is similar to formal analysis in art history; both require a keen eye for detail and the ability to translate visual elements into precise and descriptive language. By adapting their formal analysis skills to prompt engineering, students can effectively use generative AI tools like Dall-E 3, Midjourney, or Stable Diffusion and create prompts that allow them to reproduce works of art history in the most realistic form. In other words, they can combine the "close looking and describing" skill, which is one

²The tools used to evaluate the innovations that AI has created in the field of art are presented in detail in Appendix A at the end of the article.

³Midjourney is a publicly available pilot developed by an independent research lab. It is built by an AI community, not a company.

of the traditional methods of art history education, with the digital capabilities offered by AI (Jindong et al., 2023). On the other hand, although strategies for teaching close looking and formal analysis in art history have a long-standing tradition, comprehensive research on AI generative tools and prompt engineering is incomplete. This has led to some challenges in applying traditional art history methods to an AI-centred environment. For example, students have difficulty in determining the prompt or prompt sentences they will use to create the desired image with the help of AI. Additionally, relying on AI systems that provide "text-to-image" output may limit the richness of expression and lead to homogenization of artistic outputs. On the other hand, the benefits of using AI technologies in art history education cannot be denied, as students can use these technologies to better understand, and even appreciate, different artistic styles, movements, and methods. By entering the prompt sentences they determine into the system and selecting a style, students can create art that reflects various historical periods and artistic approaches. By interacting with works of art through AI, students can embark on an interactive journey by analysing the style and technique of these works through AI technologies. This new path not only encourages an active learning process but also ignites creativity and imagination. Ultimately, the vast possibilities of artistic expression are explored through a modern and digital lens (Hutson, 2024, p. 6-7).

Integration of Artificial Intelligence and Its Effects on Learning Processes with a Sample Case Study

The potential of artificial intelligence in art history education has recently become a subject of research in academic studies, and it is emphasized that this technology has the potential to personalize learning experiences, support students' creativity, and reduce teachers' workloads. However, the question of how this potential can be realized in practice is a significant issue that concerns those working in the field, and examining quality applications can guide us in finding the answer to this question. Case studies allow us to observe more closely how AI is affecting art history teaching and provide a foundation for future studies in this field.⁴ The example given below outlines a typical roadmap for case studies that have not yet been encountered in Turkey-centred studies but are planned to be conducted. In this context, an interesting and detailed application of AI in art history education was carried out at a four-year private art school located near St. Louis, Missouri. In this case study conducted by Professor James Hutson, a faculty member at Lindenwood University, the participants were undergraduate and graduate students enrolled in an online art history course covering the period from Ancient Mesopotamia to the fall of Rome.

The sample of the study consisted of 24 undergraduate and graduate students, 8 of whom were from the fields of art history and visual culture, who were enrolled in the Faculty of Arts and Humanities. The aim of the study was to evaluate the most effective pedagogical practices for using AI art generators in art history education by focusing on student perceptions, performance, and feedback supported by instructor observations (Hutson, 2024, p.7).

To accomplish this, students are assigned a task. The task requires students to innovatively combine art history knowledge with artificial intelligence technology. Accordingly, students will choose a work of art covered in class and try to recreate it using an AI art generator. This assignment will not only help students better understand the artwork they have chosen, but will also develop their digital art creation and prompt engineering⁵ skills. Details about the study are presented in Table 1.

⁴Some case studies showing how artificial intelligence can be evaluated in art history education, its effects and application areas are shared in a tabular form in Appendix B. Additionally, an international case study, which investigated how AI-generated digital art images would affect the future of Fine Arts students, referenced as (Albar Mansoa, 2023).

⁵Prompt engineering is the art of describing to an AI exactly what you want it to do.

Table 1

Art History Homework with Artificial Intelligence

Components	Definition
Purpose 1	Demonstrating understanding of a work of art through detailed formal analysis.
Purpose 2	Applying prompt engineering skills to recreate a work of art using AI technology.
Purpose 3	Exploring the intersection of art history and AI in both creating and studying art.
Step 1. Artwork selection	As part of the course, students choose a piece of art from any era that has left a lasting impression on them.
Step 2. Digital art creators	Before creating their artwork, students are expected to know what the AI model they choose can and cannot do. Options include: Midjourney (Web-based): https://www.midjourney.com/home Stable Diffusion (Web-based): https://stability.ai/stable-diffusion/ Craiyon (Web-based): https://www.craiyon.com DALL-E 2 (Subscription-based): https://openai.com/dall-e-2 ChatGPT-4 with DALL-E 3 (Subscription-based): https://openai.com/blog/chatgpt
Step 3. Formal analysis	Students are required to provide a thorough visual analysis of their chosen artwork. They should pay close attention to the artwork's formal elements, including materials, composition, subject, lighting, line, shape, and structure. The title, location, or style of the artwork should be omitted, and only visual descriptions should be included.
Step 4. Creating the AI artwork	By using formal analysis to guide the AI, prompts will be created to recreate the artwork. Multiple attempts may be necessary to achieve the most accurate guidance
Step 5. Reflective essay	Students are asked to write a 750-1000 word essay discussing the process of translating art historical analysis into AI <i>prompts</i> . The essay asks for insights into the student's work of art, the challenges of the re-creation process, and their views on the role of AI in art creation and history.
Submission requirements:	Students are required to submit their best AI-generated image and article, along with accompanying screenshots or explanations of the prompts used.

Grading Rubric				
Criteria	Excellent (90%–100%)	Good (70%–89%)	Satisfactory (50%–69%)	Needs improvement (<50%)
Formal analysis	In-depth and insightful analysis.	Comprehensive analysis with minor gaps.	Basic analysis with some missing elements.	Superficial or significantly incomplete.
Prompt engineering	Highly effective prompts; artwork closely resembles the original.	Effective prompts; artwork resembles the original with minor differences.	Adequate prompts; artwork somewhat resembles the original.	Ineffective prompts; artwork does not resemble the original.
Reflective essay	Insightful reflection, and excellent understanding of AI's role in art	Good reflection, a clear understanding of AI's role.	Basic reflection, some understanding of AI's role	Limited or unclear reflection, lacks understanding of AI's role.
Creativity and iteration process	Demonstrates high creativity and thoughtful iteration.	Good creativity and adequate iteration.	Some creativity, but limited iteration.	Lacks creativity and effective iteration.
Overall presentation	Excellent organization and clarity.	Good organization and clarity	Adequate organization and clarity.	Poor organization and lack of clarity

Source: Hutson, J. (2024). Integrating art and AI: Evaluating the educational impact of AI tools in digital art history learning. *Forum for Art Studies*. 1(1), p.8. <https://doi.org/10.59400/fas.v1i1.393>

Both qualitative and quantitative data collection methods were employed in this study. An online survey was administered to students at the beginning and end of the Fall 2024 semester. This survey collected demographic data, as well as data on students' expectations and experiences with AI-generated art. Open-ended questions were also included to allow students to express their views on the pedagogical impact of AI in art history.⁶ To ensure the confidentiality and anonymity of the survey data, "Qualtrics"⁷ was used. Additionally, statistics were calculated from the survey responses to enable comparative analysis (Hutson, 2024, pp. 7, 9-11).

Participants in the study were asked an open-ended question about the challenges they encountered when using AI generators. Responses revealed that students had varying experiences. For instance, one participant mentioned that they were unable to regenerate a specific and complex artwork. This suggests that AI has limitations when dealing with such works. Another student reported facing few difficulties but acknowledged that AI, while still developing, cannot fully replicate the emotions or

⁶Examples of questions that could be included in a survey about the use of AI in art history education are shared in Appendix C.

⁷Qualtrics is software used for experience management and data collection.

unique qualities of an original artwork, even though it can produce similar outputs. This response highlights the gap between the emotional depth and unique characteristics of an original artwork and AI-generated images. A major challenge faced by another student was the difficulty in crafting effective prompts to achieve the desired outcome. This emphasizes the importance of precise language in prompt engineering to guide the AI towards the desired results. When constructing prompts, it is crucial to provide detailed descriptions of formal elements such as colour, light, texture, perspective, composition, as well as objects and emotional atmosphere present in the artwork.

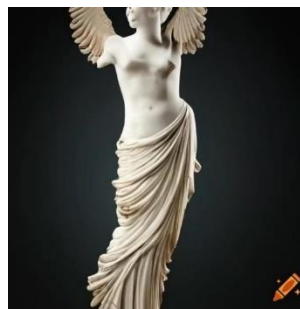
A student who had difficulty crafting effective prompts selected the *Nike of Samothrace* as their subject (Figures 3-4). The prompt described the statue as “A marble woman with no head or arms, stepping forward with her right leg, wearing a clinging dress, and wings spread for flight.” However, using *Craiyon*, the student found that AI image generators often produced figures with anatomical inaccuracies, resulting in incorrect limbs and awkward poses. This highlights the limitations of AI tools in capturing the intricate details of human anatomy and poses, which are crucial aspects of art historical analysis (Hutson, 2024, p. 13).

Figures 3 and 4

Winged Nike of Samothrace (left) and student image replicating it (right)



Title: *Nikes of Samothrace*, ca. 190 BC (?), Parian marble, h: 3.28 m., Louvre Museum, Paris. Source: https://commons.wikimedia.org/wiki/File:Nike_of_Samothrace_Louvre_Ma2369.jpg (The copyright holder of the photo has released it into the public domain, and this permission is valid worldwide).



Source: Hutson, J. (2024). Integrating art and AI: Evaluating the educational impact of AI tools in digital art history learning. *Forum for Art Studies*, 1(1), p.13. <https://doi.org/10.59400/fas.v1i1.393>

Some students encountered difficulties when they did not follow the assignment's third step, which asked them to avoid including specific details about the artwork's era, culture, and style (Hutson, 2024, p. 13). For instance, one student chose a Hellenistic-era Greek sculpture of a *dying Gaul* as their subject (Figure 5). Their prompt was: "An ancient Roman statue of a dying Celtic warrior lying on the ground, pushing himself up with one arm." The AI-generated image was not a close match to the original, suggesting that overly specific prompts can limit the AI's ability to interpret and generate accurate representations (Figure 6).

Figures 5 and 6

Dying Gaul (left) and student images replicating it (right)



Title: *Dying Gaul (Roman Copy)*, 230-220 BC, marble, 73 x 185 cm., Capitoline Museums, Source:

[https://commons.wikimedia.org/wiki/File:0_Galata_Morente_-_Musei_Capitolini_\(1\).jpg](https://commons.wikimedia.org/wiki/File:0_Galata_Morente_-_Musei_Capitolini_(1).jpg) (The copyright holder of the photograph has released it into the public domain, granting permission to copy, distribute and forward the work).



Source: Hutson, J. (2024). Integrating art and AI: Evaluating the educational impact of AI tools in digital art history learning. *Forum for Art Studies*. 1(1), p.14.

<https://doi.org/10.59400/fas.v1i1.393>

However, some students were successful in creating images using AI tools (Hutson, 2024, p. 14). For example, a student who chose the *Laocoön and His Sons* sculpture from the Hellenistic period of Greek art as his/her assignment subject, used *Stable Diffusion* to generate an output that resembled the original. He/she created the following prompt:

A muscular, middle-aged man with short, wavy hair, wearing a chiton, is being attacked around the waist by a two-headed serpent. The man has two young sons with short, tousled hair who are trying to cling to him and are also being attacked.” The student's use of detailed descriptors demonstrates the potential of AI to capture the essence of an artwork when provided with appropriate guidance. (Figures 7-8)

Figure 7 and 8

Laocoön and his sons (left) and student image replicating it (right).



Title: *Athanadoros, Polydoros and Agesander of Rhodes, Laocoön and his sons (Roman Copy)*, 42-19 BC, marble, h: 242 cm., Vatican Museums, Source:

https://commons.wikimedia.org/wiki/File:Laocoön_and_his_sons_group.jpg (The copyright



Source: Hutson, J. (2024). Integrating art and AI: Evaluating the educational impact of AI tools in digital art history learning. *Forum for Art Studies*. 1(1), p.15.

<https://doi.org/10.59400/fas.v1i1.393>

holder of the photo has released it into the public domain, granting permission to copy, distribute and forward the work.)

One of the most successful examples among the students who participated in the case study was the student who chose *the Parthenon*, a Classical-era temple of Ancient Greek architecture, as his/her subject. The student's success was attributed to his/her successful use of iterative prompting strategies (Figures 9-10). To achieve this success, the student iterated on his/her prompt seven times. The successful prompts were as follows:

1. A grand peripteral, Doric order temple made of white marble. 8 columns on the front and 12 columns on the sides. It is missing the roof and tiles, and the marble is weathered from age.
2. A grand peripteral, Doric-order temple made of white marble that has now faded with age. The temple has 8 columns on the front and 12 columns on the sides. The roof of the temple is missing and the pediments are severely damaged.
3. A massive peripteral temple made of yellowed marble with 8 Doric order columns on the front and 12 Doric order columns on the sides. The roof of the temple is missing and the pediments are severely damaged.
4. A massive peripteral temple made of yellowed marble with 8 Doric order columns on the front and 12 Doric order columns on the sides. The roof and interior of the temple is destroyed and the pediments are severely damaged.
5. A massive peripteral temple made of yellowed marble with 8 Doric order columns on the front and 12 Doric order columns on the sides. The roof of the temple is destroyed and the pediments are severely damaged. The interior of the temple was destroyed, leaving the interior empty and open.
6. A long peripteral temple made of weathered, yellowed marble with 8 plain Doric order columns on the front and 12 plain Doric order columns on the sides. The temple's roof is missing and the pediments are severely damaged and broken. The interior of the temple is gone, leaving the inside empty and open.
7. A long peripteral temple made of weathered, yellowed marble with 8 plain Doric order columns on the front and 12 plain Doric order columns on the sides. The temple's roof is missing and the pediments are severely damaged and broken. The interior of the temple is gone, leaving the inside empty and open. It sits on rocks in front of a blue, cloudy sky. (Hutson, 2024, pp. 15-16)

Figures 9 and 10

The Parthenon Temple (left) and student image replicating it (right).



Title: Iktinos and Kallikrates, Parthenon Temple, 5th century BC, marble, Acropolis of Athens,

Source:

https://upload.wikimedia.org/wikipedia/commons/c/ce/2006_01_21_Ath%C3%A8nes_Parth%C3%99

*Source: Hutson, J. (2024). Integrating art and AI: Evaluating the educational impact of AI tools in digital art history learning. *Forum for Art Studies*.*

1(1), p.16.

A9non.JPG (The copyright holder of the photo grants permission to copy, distribute and forward the work).

<https://doi.org/10.59400/fas.v1i1.393>

The examples above highlight both the challenges and opportunities of using AI in art history education. Success in this field depends on a deep understanding of the artworks being described and the careful and conscious use of prompts. While most students responded positively to the survey regarding the integration of AI tools into art history education, some expressed neutral or negative views. This indicates the presence of certain doubts and uncertainties. For example, one student stated that they did not have enough information yet but could not see how AI could have an impact beyond causing confusion and misrepresentation of artworks. In other words, they expressed concern about AI's potential to distort our understanding of art history. On the other hand, a contrasting view highlighted AI's potential to assist in image recognition, restoration, cataloguing, authenticity verification, personalized content recommendations, contextual analysis, and immersive experiences within art historical studies. This response emphasizes the multifaceted benefits of AI in enhancing accessibility and understanding of artistic heritage. Another positive view suggested that the increasing popularity of AI could enable the recreation of lost artworks, thereby fostering new perspectives on both ancient and modern art (Hutson, 2024, p. 11).

Positive feedback such as "I enjoyed this assignment very much and would like to do another AI assignment in my other classes," "it was insanely easy," and "innovative, challenging, and fun" indicates excitement and appreciation for the innovative use of AI in art history education. However, some students expressed doubts about the effectiveness and impact of this method, stating that "it did not significantly help me learn or understand art history." This doubt and concern highlight the complexity and sensitivity of integrating emerging technologies like AI into traditional academic disciplines such as art history (Hutson, 2024, p. 11).

A critical finding from the survey responses is that the integration of AI into art history requires careful consideration. Therefore, the effectiveness of AI in improving learning outcomes in art history lies not only in technological innovations but also in how it is integrated into the curriculum and aligned with pedagogical goals. In the fifth step of the case study, where students were asked to write essays about their challenges during the recreation process, their insights into the artwork, and their views on the role of AI in art creation and history, one student expressed this sentiment:

"I think AI in general is a really interesting and useful resource, but it depends on how people use it and why. When people use AI as a tool for inspiration, fostering creativity, or enhancing personal artistic endeavours, it can serve as a helpful resource to help those who are struggling. The way that AI can generate ideas or assist people in creating captivating pieces can come in handy for artists seeking new avenues of expression. On the other hand, if people use text or art AI generators to either pass off the products as their own or to purposely steal work from others that is not right. For instance, one of the biggest issues with AI art is the fact that a majority of AI art generators use stolen art made by real artists without their permission." (Hutson, 2024, p.12)

Based on the case study, several recommendations have been made to achieve success in integrating AI tools into art history education. One recommendation is to use more advanced and sophisticated AI tools such as *Stable Diffusion* and *Dall-E 3* when creating digital images of artworks. These tools demonstrate a high ability to accurately interpret and process complex art-related prompts (Hutson, 2024, p.17). Another recommendation relates to student assignments. These assignments should enable students to develop a deep understanding of formal analysis and set clear goals for effectively using AI art generators. A further aspect concerns the creation of prompts by students. Providing education and guidance on prompt engineering is essential to help students create effective

and precise prompts. The same necessity applies to teachers. A final recommendation involves providing students with opportunities to closely examine artworks and offering them personal guidance to help them better understand AI's place in the art world. This will both increase their interest in art history and make them more confident in using AI tools to bring their artistic visions to life (Hutson, 2024, pp. 17-18).

One of the findings of this case study, which explores the potential and limitations of integrating AI tools into art history education, is that while AI can be a valuable tool for visual analysis of artworks, human expertise is still needed to fully understand artistic expression. Another finding is that students' learning outcomes in AI-supported learning environments are expected to improve both their analytical thinking skills and their deeper interest in art history. Based on the study results, researchers in the future of art history and education are advised to focus on further developing AI algorithms and investigating the long-term effects of AI on art history education

CONCLUSION, DISCUSSION AND RECOMMENDATIONS

In conclusion, this paper has delved into the transformative potential of artificial intelligence (AI) in art history education, shedding light on its multifaceted applications and impacts. Through a review approach, the research has synthesized existing literature and studies to provide valuable insights into the effective use of AI tools in education and art. The findings highlight the role of AI in offering personalized learning experiences, diversifying teaching methods, and streamlining education management. Additionally, the paper has addressed ethical considerations in AI-driven art production and its prospective impact on reshaping art history education. The study has contributed to the broader theoretical framework by emphasizing the transformative potential of AI in pedagogical processes.

The findings on how artificial intelligence supports personalized learning in education indicate that this technology has the potential to revolutionize education systems. In particular, learning materials and feedback tailored to students' interests and abilities have been observed to significantly improve learning processes. However, important issues such as the ethical use of artificial intelligence, data privacy, and changes in the role of teachers need to be examined in more depth.

Moving forward, it is recommended that future research continues to explore the multifaceted applications of AI in art history education, with a focus on addressing ethical issues, providing practical insights, and enriching the existing literature. Additionally, there is a need for further studies to examine the long-term impacts of AI on educational practices and artistic creation. It is imperative to define important concepts and terms used in the context of AI in art history education to provide clarity and understanding crucial for the study's framework and practical application. Furthermore, the effective and ethical use of AI tools in education and art should be a key focus for future research and educational practices.

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Ethical approval

This study does not require ethical approval.

Conflict of Interest

No conflict of interest.

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Appendix A: Applications of Artificial Intelligence in Artistic Endeavours

Category	Vehicle	Type
Image Recognition and Analysis Tools	Amazon Recognition	Cloud-based, Paid
	Art Recognition (<i>Also Forgery and Originality Detection</i>)	Web-based, Paid
	Google Arts & Culture (<i>Also Style and Period Recognition, Data Mining and Big Data Analysis, Digital Art History Education</i>)	Web-based, Free

	<p><i>Programs)</i></p> <p>IBM Watson Visual Recognition</p> <p>Microsoft Azure AI (<i>Also Style and Period Recognition, Data Mining and Big Data Analysis, Digital Art History Education Programs)</i></p> <p>OpenCV (<i>Also Data Mining and Big Data Analysis)</i></p> <p>StyleGAN (<i>Also Style and Period Recognition, Digital Art History Education Programs)</i></p>	<p>Cloud-based, Paid</p> <p>Cloud-based, Paid</p> <p>Local and Cloud hybrid, Free</p> <p>Partially web-based, Free</p>
Style and Period Recognition Tools	<p>Artbreeder</p> <p>Connoisseur</p> <p>DeepArt.io</p>	<p>Web-based, Free and Paid plans</p> <p>Cloud-based, Paid</p> <p>Web-based, Paid</p>
Data Mining and Big Data Analysis Tools	<p>Europeana</p> <p>Google BigQuery</p> <p>Knoedler Archive</p> <p>TensorFlow and PyTorch</p>	<p>Web-based, Free</p> <p>Cloud-based, Paid</p> <p>Web-based, Free</p> <p>Cloud-based, Free</p>
Digital Art History Education Programs	<p>Aiva (Artificial Intelligence Virtual Artist)</p> <p>Artstor Digital Library</p> <p>Artvive</p> <p>Khan Academy</p> <p>Smarthistory</p>	<p>Web-based, Paid</p> <p>Web-based, Paid</p> <p>Web-based, Free and Paid plans</p> <p>Web-based, Free</p> <p>Web-based, Free</p>

<p>Artificial Intelligence Tools for 3D Modeling</p>	<p>3DFY AI Autodesk Fusion 360 Meshy Rhino and Grasshopper</p>	<p>Cloud-based, Paid Cloud-based and local hybrid, Paid Cloud-based, Paid Cloud-based and local hybrid, Paid</p>
<p>Artificial Intelligence Tools for Virtual Reality</p>	<p>Cyberver HTC Vive Matterport Meta (Oculus) PlayStation VR Sketchfab Unreal Engine and Unity</p>	<p>Cloud-based, Paid Local-based, Paid Cloud-based and local hybrid, Paid Cloud-based and local hybrid, Paid Local-based, Paid Web-based, Free and Paid plans Cloud-based and local hybrid, Free and Paid plans</p>
<p>Fraud and Authenticity Detection Tools</p>	<p>Ars Longa AI AI Art Authentication Artemis Artory</p>	<p>Web and/or Cloud-based, Paid Cloud-based, Paid Web and/or Cloud-based, Paid Cloud-based, Paid</p>
<p>AI-Powered Commenting and Criticism Tools</p>	<p>AICAN ArtPI Artrendex Artifly DeepArt OpenAI GPT-4</p>	<p>Cloud-based, Paid Cloud-based, Paid Web-based, Paid Cloud-based, Paid Web-based, Paid Web-based, Paid</p>

	AI Curator	Web and/or Cloud- based, Paid
Voice Analysis Tools	<p>Eleven Labs</p> <p>Murph AI</p> <p>Lovo.ai</p> <p>Description</p>	<p>Web-based, Free and Paid plans</p> <p>Web-based, Free and Paid plans</p> <p>Web-based, Free and Paid plans</p> <p>Web-based, Free and Paid plans</p>
Text Analysis Tools	<p>Jasper</p> <p>Rytr</p> <p>Grammarly</p> <p>Quillbot</p> <p>Frase</p> <p>Pictory</p> <p>Synthesis</p> <p>VidIQ</p> <p>Tubular Labs</p> <p>Azure Video Indexer</p>	<p>Web- based, Paid</p> <p>Web-based, Free and Paid plans</p> <p>Web-based, Free and Paid plans</p> <p>Web-based , Free and Paid plans</p> <p>Web-based, Paid</p> <p>Video Analysis Tools</p> <p>Cloud-based, Paid</p> <p>Cloud-based, Paid</p> <p>Web-based, Free and Paid plans</p> <p>Web based, Paid, Cloud based, Paid</p>

The table shows many potential applications of AI in the arts. The term Web-based in the table means that an application or service can be accessed via internet browsers. Cloud-based is a technology where data and applications are stored and processed on servers without the need for a physical storage device. Local-based indicates that the service can be accessed on one's own device or on a local network without the need for an internet connection. Local hybrid is a combination of both local and cloud-based technologies.

Appendix B: Use of Artificial Intelligence in the Arts: Examples from Case Studies⁸

Case Study	Project Name	Scope	Application	Predicted Results	Source Recommendation
Analysis of Artworks with Google Arts & Culture	Google Arts & Culture	To provide ease of access to art lovers and researchers by bringing together millions of works of art in a digital environment. To analyse and classify works with artificial intelligence and machine learning techniques and to offer personalized recommendations to the user.	Using artificial intelligence algorithms developed by Google, features such as style, colour, and subject matter of the artworks were analysed. This data was used to develop features such as visual search and finding similar works to make it easier for users to discover the works.	Preserving millions of works of art in a digital environment and making them accessible. Enabling art lovers and researchers to examine works more easily and in depth. Accessing more information about works of art and making new discoveries thanks to artificial intelligence.	Google Arts & Culture official website, Google Research publications, related academic articles
Artful-Artificially Aided Art Education Application	Artful	A mobile application designed to improve drawing skills of children aged 7-14. The application analyses the artworks	The app analyses the student's uploaded artwork and provides feedback on perspective, proportion, colour	In a pilot study, students who used the app saw an average 20% increase in their drawing	The official website of the Artful application, the article "The Effectiveness of Artificial Intelligence - Powered Education

⁸The projects in the table are considered case studies because they are studies on the use of artificial intelligence in the field of art. In other words, they include data on the examination of a specific problem or situation, collection and analysis of data, evaluation of the results, and applicability to other fields.

		uploaded by users using a deep learning-based algorithm and provides real-time feedback.	harmony, etc. It also suggests personalized drawing exercises based on the student's interests.	skills. Students reported that the app was fun and motivating	Applications", user reviews in application stores.
DeepArt.io - Art Style Transfer	DeepArt.io	As an AI-based platform, allowing users to transform their own photos into different art styles.	Using deep learning techniques, especially style transfer algorithms, photos uploaded by users are reprocessed in accordance with the style of the selected artist.	It increased interaction with art by allowing users to see their own photos in different art styles. It opened a new dimension in art education and creativity. It became an interactive tool for those who wanted to learn more about art history.	DeepArt.io official website, related academic studies (if any), review articles about the platform
The Met's Art and AI Initiative	The Met's Art and AI Initiative	Analyse, preserve and exhibit art in museums using artificial intelligence technologies. Develop new tools for art historians and researchers.	Analysing features of artworks such as style, colour, and subject matter using deep learning algorithms. Creating high-resolution images of	More detailed examination of works of art has been made possible. New methods for the preservation	The Metropolitan Museum of Art's official website, academic publications, project-related blog posts and press releases.

		Provide a more interactive experience for visitors.	artworks. Developing virtual reality and augmented reality applications.	of works of art have been developed. Visitors have been offered a richer and more personalized museum experience. New opportunities have been created in the field of art education.	
Art Recognition- Visual Recognition and Analysis	Art Recognition	The project was developed to verify the originality of artworks and perform style analysis using artificial intelligence.	Classifying, analysing and providing information about works of art using artificial intelligence algorithms.	Better understanding of works of art, filling gaps in art history, use in art education.	Art Recognition official website, academic studies, related publications

Appendix C: Sample Survey Questions for AI-Enhanced Art History Education

Researcher Workflow:			
<ol style="list-style-type: none"> 1. A brief explanation of the purpose and significance of the survey. 2. Collecting demographic information (information such as age, gender, department, grade level to identify participants) 			
Section	Question Type	Sample Questions	Explanation
General Information and Perceptions	Open-ended, Likert	1. What is artificial intelligence and what does it do?	Measures participants' general knowledge and perceptions about artificial intelligence.

		<ol style="list-style-type: none"> 2. Have you heard of using artificial intelligence in art history class? 3. Is using artificial intelligence in art history classes good or bad? Why? 	
Use of Artificial Intelligence in Art History Classes	Open-ended, Likert	<ol style="list-style-type: none"> 1. In what subjects do you think artificial intelligence can be used in art history classes? 2. For example, what do you think of the idea of artificial intelligence deciding in which period a painting was made? 3. Do you think that thanks to artificial intelligence, we will be able to understand works of art more easily? Why? 	Measures participants' thoughts and expectations about the application of artificial intelligence to art history.
Learning Experience and Needs	Open-ended, Likert	<ol style="list-style-type: none"> 1. Would you like to use AI tools in your art history classes? Why? 2. Would you like to take an AI-powered art history class? 3. Do you think AI tools could make learning art history more fun? 	It identifies participants' views and needs regarding the impact of artificial intelligence on their learning experiences.
Concerns and Questions	Open-ended	<ol style="list-style-type: none"> 1. Could there be some negative aspects of using artificial intelligence in art history classes? What could these be? 	It reveals the concerns and questions that participants have about the use of artificial intelligence.

		<ol style="list-style-type: none">2. What is your biggest concern about the use of AI in art history classes?3. Could AI diminish the creativity and originality of artists?	
<p><i>Open-ended questions allow participants to express their thoughts in their own words. Likert questions are used to measure how much participants agree or disagree with a topic (Strongly Agree, Agree, Undecided, Disagree, Strongly Disagree). Tools such as Google Forms and SurveyMonkey can be used to create surveys with ready-made templates and analysis options.</i></p>			