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Unveiling the Canvas: Sustainable Integration of AI in Visual Art Education

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Abstract: The rapid advancement of technology is transforming the landscape of art education, fostering a new era of creativity and learning with a focus on sustainability. By optimizing resources and reducing the reliance on physical materials, AI-supported art education enhances sustainability, broadens accessibility, and lowers environmental impacts. Despite some research on the application of smart tools in art education, there remains a gap in robust evidence supporting their effectiveness and long-term impact. This study undertakes an in-depth examination of the intersection of sustainable technologies, pedagogical theories, and assessment methods within visual art education. By reviewing 685 research articles from the past decade, we ultimately filtered them down to 36 completely relevant studies that illuminate the technological advancements in teaching visual art. Our analysis focuses on emerging trends, the theoretical frameworks underpinning learning, hardware platforms, application categories, and dependent variables used to assess the impact on sustainability. Our findings indicate that the use of technology in art education is still in its nascent stages, yet it holds significant potential for sustainable development. These insights are crucial for developers and educators, offering guidance on creating user-friendly, interactive, and sustainable art education programs that enhance student comprehension and engagement beyond the current offerings.

Keywords: artificial intelligence; art education; visual art education

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1. Introduction

In recent years, artificial intelligence (AI) has drawn increasing attention from researchers who strive to make it possible for computers to carry out activities related to human intelligence, learning, and problem solving [1,2]. A novel and booming field of research that combines AI with education has emerged in response to rising needs in the education sector [3]. AI in education (AIEd) has undergone rapid progress, and interest in AIEd is now higher than ever. This is an area that combines computer science with statistics and education and is considered an active topic among researchers [4,5]. Learning analytics, pedagogical advances, educational data mining, and teaching have all benefited from the application of AI [4]. This boom promises to broaden learning options, improve individualized learning experiences, and produce desirable learning results [6].

Despite being an essential part of education, however, the application of AI in art education has rarely been considered in previous studies [7]. Some artists are already working with AI as a powerful tool [8], and there are now researchers focusing on AI-assisted art education. For instance, Yang [9] created an evaluation model that utilized an analytic hierarchy process (AHP) to improve the impact of teaching art major courses in colleges, and Chen et al. [10] developed a digital art ability training system for children with AI-assisted learning to offer guidance in color recognition and drawing. The majority of the research has focused on the development of applications, technological improvements, or research strategies, and various specific applications and measurement approaches have been proposed.

Following the latest trends in the use of AI apps around the world, the technologies used to implement AI have been discussed in several articles. A study by Zhai et al. [11]

found that the trends in the use of AI between 2012 and 2020 could be classified into four research areas: deep learning, neuroscience, swarm intelligence, and the Internet of Things. This finding was corroborated by Tahiru [12], who stated that the majority of AI research has advanced and is now popular in the era of Industry 4.0. The technologies employed in this field were the subject of a further investigation by Zhang and Aslan [6], who identified the six forms that are primarily used in AIEd: chatbots, expert systems, intelligent tutors, machine learning, personalized learning systems, visualizations, and virtual learning environments.

In addition, several theories have been applied to support the research process, such as behaviorism learning theory and constructive learning theory, among others. A systematic analysis by Chen et al. [13] found that only a few theories have been implemented in the design of AIEd programs. Among these theories were the learning style model (which is often used to classify students), situated learning theory, bi-directional theory, and movement-pattern perception theory. In addition, personalized learning has been mentioned in many AIEd studies, such as those by Mokmin and Masood [5] and Lakkah et al. [14]. However, from a review of these works, we found that there were very few papers that discussed the application of AIEd to art learning or the learning theories that can be implemented in the design of AI.

In view of the above, we address the following questions in this paper, with a focus on how AI is used in visual art education:

(1) What were the trends in the use of AI technologies in the field of art education between 2014 and 2023?
(2) What learning theories have been applied to the use of AI technologies in the field of art education?
(3) How are AI technologies being used in the field of art education?
(4) How are AI technologies being evaluated in the field of art education?

In this article, we carry out a systematic review of the existing literature on the use of AI technology in the field of art education in order to answer these questions. We aim to contribute to the extant body of knowledge on the application of new technologies in art for educational purposes.

The structure of this work is as follows. The literature on AI in art education is reviewed in Section 2. Section 3 describes our research strategy and aims to explain how our systematic review and analytical approach were applied. In Section 4, a filtered set of articles is analyzed to answer the four research questions (related to trends, learning theories, technologies, and evaluation). The results are discussed in Section 5, and we highlight the implications, opportunities for future research, and limitations of our work. Finally, we draw conclusions in Section 6.

2. Literature Review

2.1. AI in Education

The rise of deep learning technologies has accelerated the development of AI, which is transforming increasing numbers of fields [15]. Over the past several years, much attention has been paid to the emergence of AI applications in education [16].

AI technologies have had a profound impact on how we learn [13]. Although education is regarded as an essential component of human life and the pursuit of a better future, most teaching strategies are conventional and theory based, and individuals who are used to learning through experience frequently fail to learn as a result. The development of tailored learning has shown promise thanks to the use of AI technologies [17], and any learning approach can now be combined with AI to maximize learning outcomes [18]. Thus, the use of AI technologies has opened up a world of fascinating new ideas and novel ways to address problems in education and enhance learning.

2.2. AI in Art Education

AI has developed quickly in recent years and is likely to become an increasingly potent tool for artists; it may be used in a similar way as a high-end camera is used by a fine-art photographer [8]. AI has seldom been utilized in art classes [7]. However, traditional art education takes place in an art school or academy in the classroom, and this approach involves a demanding curriculum that emphasizes the mastery of technical abilities in areas such as sculpture, painting, and drawing. The curriculum is typically rigid and may not allow for individual expression or experimentation; it also often relies heavily on the opinions and guidance of a single teacher or institution, which can limit the student's exposure to diverse perspectives and approaches to art [4]. Furthermore, some traditional art programs may not adequately prepare students for the contemporary art world or the rapidly changing technological landscape. These issues have brought AI technology to the attention of art educators. It remains difficult to create AI-based learning systems through a collaboration of technical and art researchers, despite the fact that AI could be useful in art education, for example in the teaching of artwork appreciation.

To the best of our knowledge, there has been no thorough analysis of the use of AI in visual art education, and its efficacy, the learning theories involved, and the evaluation methodologies that can be used are all still unknown. In order to investigate the efficacy of AI-based visual art learning, learning theories, and evaluation methods, this study presents a systematic review.

3. Methodology

To achieve the objectives of this study, a systematic review process was applied using the suggested reporting items for systematic reviews and meta-analysis (PRISMA) review protocol, which includes a search strategy, selection criteria, and data extraction and analysis procedures [19].

Studies of how AI has improved the teaching of visual arts were found through a methodical search of a variety of databases, including Web of Science, Scopus, PubMed, and Google Scholar, and the papers chosen were published between 2014 and 2023. During the electronic scanning phase, the following keyword search keywords were employed: "artificial intelligence" OR AI AND (educat* OR learn* OR train* OR teach*) AND (art OR draw* OR paint* OR "art design").

Table 1 lists the inclusion and exclusion criteria for this investigation. The search results included peer-reviewed scientific papers and conference papers published between 2014 and 2023 in English. Following the recent developments in AI technology, interest in AIEd has gradually grown, and a search of papers from the last decade provided complete coverage of relevant research, although the vast majority of the articles were published within the last three years. Due to the novelty of AI technologies, the inclusion of conference papers was necessary.

Table 1. Research criteria applied.

Inclusion Criteria	Exclusion Criteria
Full-text papers published in a peer-reviewed journal or global conference proceedings	Papers published as reports, letters, papers, book chapters, conferences, or simple summaries
Focus on AI as a primary technology	AI not the leading technology investigated in the study
Focus on the use of AI technology in the visual art education field	AI not implemented in the field of art education
Published between 2014 and 2023	Not published between 2014 and 2023
Written in English	Not written in English

It was necessary to use the search term "art OR draw* OR paint* OR "art design" to reduce the number of publications that were unrelated to art (such as music, dance, or literary arts). To enable a more thorough search for articles relating to education, the search term "educ* OR learn* OR train* OR teach*" was used. The exclusion keywords were discovered through a series of search experiments and a careful analysis of the outcomes.

Figure 1 illustrates the process used in the literature review and shows the stages of article identification, screening, eligibility, and inclusion.

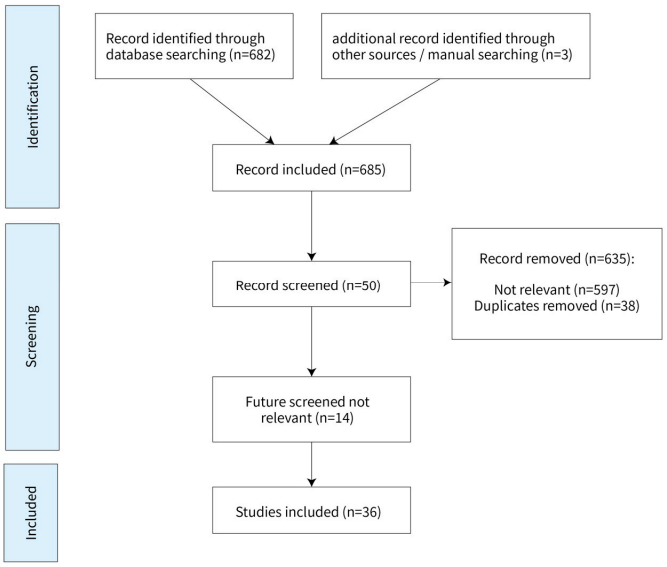

Figure 1. Flow chart for the PRISMA-based selection process.

An initial search of web databases using the aforementioned keywords gave rise to a total of 682 articles. Three further articles were drawn from additional records located either manually or from other sources/manual searches.

We then read the 685 abstracts and marked them as either relevant or not relevant. Many of the articles were related to the keywords of the search term but did not meet the needs of the study due to the variety of meanings involved; for example, some contained the keyword "deep learning" rather than focusing on the learning process of students. A few other articles for which the full text was not available were also removed at this stage.

After the screening process based on the predetermined criteria, 597 articles were found to be unrelated to the keywords, 38 articles were removed due to duplication, and 50 articles were considered to meet the requirements. In the final step, we read the content carefully and screened the articles further to ensure they were relevant to the topic. A total of 36 articles were eventually identified, and the remaining 14 articles were excluded.

4. Results and Analysis

In this section, the results are presented and discussed in relation to the research questions.

4.1. Trends (RQ1: What Were the Trends in the Use of AI Technologies in the Field of Art Education between 2014 and 2023?)

Of the 36 articles included in our analysis, 69% were published in journals and 31% in conference proceedings (Table 2). Our search window was 2014–2023. After screening, we identified 36 articles on this topic that were published during the period from 2014 to 2023, and these could be divided into three main categories. The first category was related to theory and analysis, and these articles proposed strategies and made suggestions for practical development and application. The second category focused on describing the development and design process and did not consider testing of student use or effect (or

did not mention testing), while articles in the last category described a specific development process and carried out student testing to verify the effectiveness of the proposed system.

Table 2. Year of publication and source type.

Year of Publication	Number of Articles	Percentage
2023	5	14%
2022	16	44%
2021	7	19%
2020	7	19%
2019	1	3%
Source type		
Journal	25	69%
Conference	11	31%

As a new technology, AI has only been available for art education research since 2019, and this field has been growing rapidly ever since, with seven articles published in both 2020 and 2021. In 2022, the number of articles increased significantly to 16, whereas up to 2023, 5 articles had been published. As can be seen in Table 2, the overall number of articles was not very large. However, this field started to receive attention from researchers in 2019, and the level of interest is increasing. This finding answers the first research question by showing that although there has been little research on the use of AI technology in art education until now, research interest in this area is growing rapidly.

Regarding the educational level (Table 3), most of the studies focused on higher education, with 19 articles (53%) focusing on higher arts education. For example, Chen et al. [10] designed a cycle-consistency network-based model for creating the fusion works of Tibetan painting styles in the education of Chinese ethnic painting, and Deng and Wang [20] invited 90 university students to test the online model development of Korean art learning. In 2022, Zhao [21] considered 100 sophomores in a university art design course and divided them into two groups for testing. He and Sun [22] worked with 60 art and design students at a university to test their satisfaction with their developed AI teaching system.

Table 3. Educational levels.

Educational Level	Number of Articles	Percentage
1. K12 education	6	17%
1.1. Primary school students	5	14%
1.2. High school students	1	3%
2. Higher education	19	53%
3. Adult education	1	3%

A lesser number of articles (14%) referred to primary school students. For example, Sun et al. [23] considered 96 children aged between five and thirteen, while Zhang et al. [24] conducted a 2 × 2 study with 64 children aged between six and ten. There was one article (3%) that referred to high school students [25], and one of the authors chose higher education. The use of AI technology to assist in art learning is more prevalent in university and primary school teaching, with most attention being paid to art education at the university level.

4.2. Learning Theories (RQ2: What Learning Theories Have Been Applied to the Use of AI Technologies in the Field of Art Education?)

The literature on AI-assisted learning content created for visual arts education or the design of AI-based applications is surprisingly lacking in descriptions and applications of learning theories (Table 4). Of the 36 articles, only 5 (14%) mentioned learning theories. The articles that did mention learning theories included the behaviorist learning theory [22], the

constructivist learning theory [26], the reinforcement learning theory [25], and observation learning [27]. One article mentioned a relevant learning model called the TPACK model (Technological Pedagogical Content Knowledge model), which is shown in Figure 2 [28]

Table 4. Literature and learning theories.

	Learning Theory	Author	Description
1	Behaviorist learning theory	He and Sun [22]	Based on the behaviorist learning theory, the corresponding learning model is to cover the student model. If the correct rate of the question is lower than a certain percentage when learning a certain knowledge point, you let the students repeat the knowledge point. Since there is no analysis of the mistakes made by the students, there is no way to give targeted learning guidance. In order to overcome the shortcomings of covering the student model, the teacher analyzes and summarizes the mistakes made by the students, contrasts the correct problem-solving method, and obtains the corresponding defects of different types of errors.
2	Constructivist learning theory	Lee et al. [26]	The tenet of constructivism is that knowledge is not passively received but built up by the cognizing subject. Thus, the learners in constructivism-based education aim to communicate with each other through experience-based opinions and form a horizontal communication that makes meaning. AI technology can adjust various contexts and tailor learning to each visitor to make it technologically possible to provide various learning experiences.
3	Observation learning	Fan and Zhong [27]	Observational learning causes behavioral change, not the imitation of models' behaviors. It involves studying someone else's work, understanding the students' creative thinking, and then recreating it in one's style, called observational learning.
4	Reinforcement learning theory and constructive learning theory	Rong et al. [25]	All behaviors are composed of reflexes, and people strengthen the depth of learning in the process of continuous stimulation and feedback. Regarding the constructive learning theory, while learning new knowledge, students should analyze and compare it with previously learned knowledge, identify their rationality and the similarities and differences, process and refine the knowledge freely, and finally complete the learning process.
5	Technological pedagogical content knowledge	Tang et al. [28]	Based on the traditional design studio as the center, integrating the TPACK technology integration model, building an online design studio for teaching, and combining design project practice.

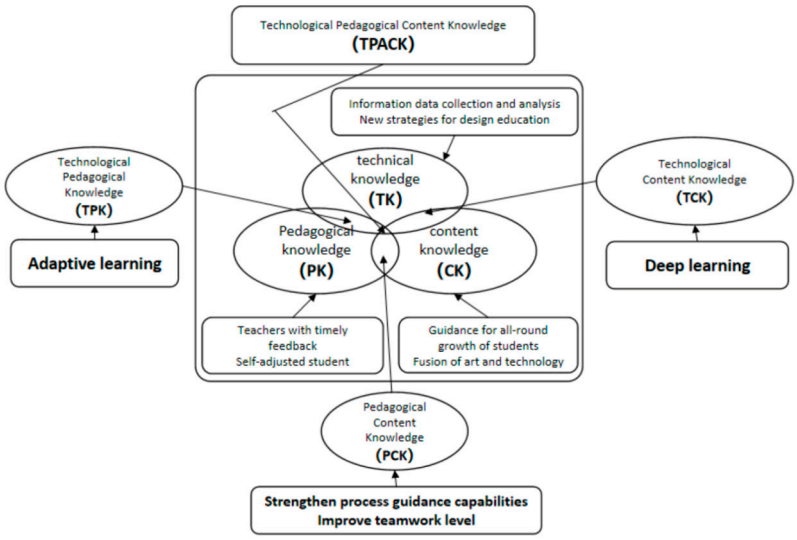

Figure 2. New strategies for designing education in the context of artificial intelligence technology [28].

4.3. Hardware Platform and Application Category (RQ3: How Are AI Technologies Being Used in the Field of Art Education?)

As shown in Table 5, 17 of these papers mentioned hardware platforms (48%). There are three main types of hardware platforms regarding AI applications: computers, mobile devices, and wearable devices and other smart hardware. Fifteen of these (42%) specified the use of a computer as a device; for example, Chiu et al. [29] created a deep-learning-based art learning system with the ability to provide instant feedback and individualized guidance. Huang et al. [30] proposed an intelligent hand-painting teaching system based on AI edge computing technology and used gesture tracking and gesture recognition techniques in their system for primary school students.

Table 5. Hardware platform.

Hardware Platform	Number of Articles	Percentage
Computers	15	42%
Mobile devices	1	3%
Wearable devices and other smart hardware	1	3%
No mention	19	53%

Two other articles specified mobile devices (iPads) and wearable devices and other smart hardware (AR glasses) as devices, accounting for 6% of the total. Zhang et al. [24] developed StoryDrawer, a co-creative system for an iPad that supports visual storytelling for children through collaborative drawing between children and AI. Chen et al. [10] developed a digital art ability training system for children with AI-assisted learning using smart glasses to recommend colors to guide learners to learn color recognition and drawing. In general, the computer is still the most frequently used tool for AI-assisted art education.

More than half (53%) of the articles did not specify a particular device that should be used. Although almost all AI-related technologies are inseparable from the use of computers, these papers are marked as "no mention" in the figure below.

The application category of AI in arts education was mentioned in 27 articles, including AI algorithms supporting learning models or frameworks (36%), AI-driven learning systems (31%), and using with existing AI platforms (8%), as shown in Table 6.

Table 6. Application category.

Application Category	Number of Articles	Percentage
AI algorithms supporting learning models or frameworks	13	36%
AI-driven learning systems	11	31%
Using with existing AI platforms	3	8%

The most numerous application category is AI algorithms supporting learning models or frameworks. In this category, Chen et al. [31] have been noted for proposing a Tibetan Painting Style Fusion (TPSF) model, which leverages neural networks to swiftly amalgamate the painting styles of Tibetan Thangka and other ethnic styles. Also, a number of studies [7,9,32–34] used an AHP to create related models or frameworks. For example, Fan and Zhong [27] also contribute to this category by establishing an AHP and grey clustering-based performance analysis model to enhance AI's effectiveness in art instruction.

Another group of studies concentrated on detailing the development process of AI-driven learning systems. Deng and Wang [20] propose a personalized intelligent art learning model based on AI that establishes an online platform for Korean art learning. Similarly, Chiu et al. [29] developed a deep-learning-based art-learning system providing instant feedback and personalized guidance, showcasing the system's ability to tailor the educational experience to the individual needs of learners. Suo and Shang [35] created an online management system for teaching painting, and Zhong [36] created an interactive learning system for art education and research that included online learning, assignments, exams, and other features.

There are also several articles on the category using with existing AI platforms. Research like that of Sun et al. [23] falls under this category, where they suggest using an existing AI platform's trained style to process images as a tool to assist children in learning to paint. The authors of [37] extend the application of existing AI platforms by producing a multitude of images with Midjourney focused on craft design, thus demonstrating the versatility of AI in creative design and education.

In addition to this, some articles are not mentioned. Some of these articles focused on analysis, and others suggested application strategies [38]. For instance, Kong et al. [7] analyzed the current state of the application of AI in art teaching and proposed application strategies such as increasing adaptability, improving the intelligent teaching of art, and enhancing the learning experience. Leonard [39] adopted a post-human perspective to explore the impact and suggestions of digital technology on art education.

4.4. Evaluation (RQ4: How Are AI Technologies Being Evaluated in the Field of Art Education?)

In most of the eight articles in which a technology was tested using a questionnaire, multiple variables were tested to examine the effectiveness of AI-based art education from different perspectives (Table 7). Achievement was the most widely considered variable in the questionnaire, with 14% of the studies including this aspect. The next most popular variables were satisfaction (8%) and attitude (6%). There were also articles that considered variables such as motivation, interest, continuous learning intention, learning experience, technology acceptance, self-efficacy, and imagination.

Table 7. Dependent variables.

Dependent Variable	Number of Articles	Percentage
Achievement	5	14%
Satisfaction	3	8%
Attitude	2	6%
Motivation	1	3%
Interest	1	3%

Table 7. *Cont.*

Dependent Variable	Number of Articles	Percentage
Continuous Learning Intention	1	3%
Learning Experience	1	3%
Tech Acceptance	1	3%
Self-Efficacy	1	3%
Imagination	1	3%

5. Discussion

5.1. Implications

Art education is a wide-ranging subject; however, in this paper, broader fields of art such as music, dance, film, and literature were excluded, and we focused on visual arts such as painting and design.

With regard to the choice of research subjects, we observed that primary school students and university students were the focus of most studies, with university art education receiving the most attention. This may be due to the novelty of AI technology. In art education at the university level, and especially in design education, students often use computer software to learn and create; they are curious about the use of new technologies such as AI and are willing to experiment with and explore them as an aid. In the future, the integration of AI technology with university art courses may have great scope for development.

In regard to learning theories, we noted that most of the articles in the literature did not mention these. Of the articles that did mention learning theories, some interpreted them from the perspective of behaviorism and constructivism, while others started from theories related to art learning. In general, most of the articles focused on the development of functions and the design of systems, and there was little research on the integration of theory and practice or how theory can guide concrete practice.

The vast majority of articles specified computers as devices to be used to support AI, probably due to the popularity of computers and the fact that almost all technology development currently requires the use of computers, meaning that the functionality that can be achieved by using them directly is maximized. In contrast, the use of iPads, AR glasses, etc., may require additional development, and the price of these devices is also a factor that affects practical applications. However, these devices also have advantages that computers do not, such as portability and a combination of reality and virtual reality, and have considerable potential for development. In order to enhance learning performance, it is advisable to adopt many types of hardware and to combine various types of AI software. Our research findings suggested that hardware had a substantial impact on the effectiveness of AI [18]. In the future, the use of different devices may introduce additional changes to AI-based art education.

Questionnaires were the most popular method of evaluation, although expert evaluation was also another method that was used. A total of 13 different variables were covered in the questionnaires reported in the 32 selected papers (including interest, learning experience, creativity, etc.), indicating that many of these variables received interest from researchers. Half of the articles focused on learning effectiveness, indicating that a topic of primary interest to researchers was how to maximize the effectiveness of AI and improve the quality of learning.

5.2. Research Agenda and Recommendations

There is no doubt that AI is a topic of intense research interest and is likely to be the subject of future trends. AI will play a significant role in the appreciation and production of visual art, a quintessential creative activity [8]. It has already been proven effective in many studies and will not replace or harm students; at the same time, it can be used alone or in combination with other methods to produce a compelling learning experience [40]. Our analysis of the literature shows that there is increasing interest in applying AI technology to visual arts education; at the same time, however, there is a low level of maturity in the field.

Firstly, the theory of AI for educational applications is not sufficiently advanced, and most articles have not considered analysis and design from a theoretical perspective. The development of learning theories and models for AI applications in art education is a task for future research.

Future work on AI-assisted art learning needs to build on existing research, and articles with good theoretical foundations and learning designs can provide a universal basis for this research. Hence, research should focus on theory as well as the design of learning materials, learning content and learning processes rather than simply giving a description of the system development process; researchers should also explore better ways of applying AI as a new technology for practical learning.

Secondly, in order to find the most effective methods of practice and application, practical student testing and assessment are necessary. Validity is usually the most important aspect of a researcher's focus, but self-efficacy, intention to continue learning, and other explorations of different aspects of student learning have also attracted attention. Student learning in the arts should be evaluated from multiple perspectives based on a combination of quantitative and qualitative methods and should explore different factors such as learning outcomes, student attitudes and motivation, innovation and creativity, and the impact of subsequent learning. It is also worth considering assessment from the perspective of different roles, such as teachers in addition to learners. Furthermore, conducting longitudinal studies would provide valuable insights into the long-term effects of AI integration in art education, allowing researchers to better understand its sustained impact on student learning and development.

Thirdly, as a remarkable new technology, AI is developing at an amazing pace. Advances in this field will further facilitate art education and offer more possibilities for art education. Researchers should keep up with the development trends and constantly update and enhance their research. Additionally, fostering collaboration between art educators and AI researchers can play a crucial role in the development of more effective AI tools. Such interdisciplinary partnerships can bridge the gap between technological innovation and educational needs, ensuring that the tools developed are both technically advanced and pedagogically sound.

In the future, the ultimate goal is to apply AI technology to actual art education courses. As a teaching aid, AI technology may act as an intelligent teacher, assisting students in the art creation and design process, inspiring them, or helping them to iterate and upgrade their work. Specific methods of use will need to be further explored by researchers to find the most effective ways to help students learn. Future research could also explore the application of formal methods for AI-based technique verification to ensure the reliability and robustness of AI tools in art education.

When comparing the findings of this systematic literature review with other major reviews in the field, it was found that Song and Wang's [3] bibliometric analysis of global AI research in education provided a broad overview of trends over the past two decades, revealing significant growth in AI adoption in a variety of educational contexts and identifying unique challenges and opportunities in the field of education. Additionally, Zawacki-Richter et al. [16] highlight the limited involvement of educators in AI research in higher education, a finding echoed in this review, which also identifies gaps in the active participation of arts educators in the development and implementation of AI tools. This study supports and extends their findings by emphasizing the need for greater educator engagement, particularly in the context of arts education. Overall, this study not only confirms previous findings in the broader field of educational AI but also provides new insights into its application in arts education, thus contributing to a more nuanced understanding of the role of AI in different educational settings.

At the moment, AI is difficult and relatively expensive to develop, and researchers should therefore start with small steps, such as using existing technology platforms for testing or exploiting open-source features for development. In addition, more variables should be measured to explore the most effective aspects of AI in arts education.

Teachers should not resist trying our new ideas in art education. Topics that will be worth investigating include how best to use AI technology to help improve the curriculum, how to design it, and what theories to use to support it.

5.3. Limitations

Due to the nature of the review, selection, and filtering processes, our work has several limitations. We have only focused on the application of AI to visual art education, although there are many fields of art education, such as music, dance, and so on. Studies in these areas of the arts are also numerous. Chen and Huang [15] conducted a review of existing children's music learning systems based on AI technology. Kang et al. [41] developed online AI software for dance learning and considered mimesis, generative, and reflexive methods and other approaches to learning, which can also offer inspiration for AI-assisted visual arts learning.

This study only summarized papers on related topics published between 2014 and March of the current year, 2023. With the explosion of AI applications such as ChatGPT, Midjourney, etc., it is likely that there will be more technological advances and practical applications in the future.

6. Conclusions and Future Research

With the rapid development of AI technology and the growing interest in this field, the potential of this area has been recognized, and it is believed that the number of related studies will increase significantly in 2023. Although AI technologies are beginning to be applied to different areas of the visual arts, the maturity level of this field is still low. Most research has been carried out to test and in some cases develop strategies, and little has been carried out in regard to specifically using learning theory to guide development. Relatively few research works have actually focused on teaching and learning, and detailed tests and quantitative analyses have not been carried out, which may hinder the rapid diffusion and use of AI technology in practical teaching and learning.

AI-assisted education is developing rapidly in many areas, but art learning is different. There is usually no right or wrong way to create art, although students need certain methodological guidance, practice in basic skills, and individual creativity, and the role of AI technology in offering assistance is more likely to involve inspiring students in the art learning process, providing personalized assistance, aiding practice, helping students improve their work, etc. AI-assisted art teaching is still in its infancy, and more exploration is needed as to how it can be better used and better designed for curricula.

The integration of AI in art education significantly enhances sustainability by optimizing resources and broadening accessibility. AI reduces reliance on physical materials and allows for personalized, efficient learning experiences that can adapt to evolving needs. This approach not only lowers the environmental impact but also extends educational opportunities to a wider audience, including those in remote areas. By supporting personalized learning paths, AI fosters long-term engagement and retention, contributing to a more sustainable and inclusive educational model.

There are few articles that have used learning theories to guide AI-based art learning, and detailed explanations of how learning theories can be specifically applied to AI in art learning are lacking, although this is a meaningful area of research. The AI-based art learning model that has emerged could be extended to replicate existing results and to help more teachers and developers design and use AI technologies, thereby contributing to the development of art education, and especially visual arts education.

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