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ENHANCING CHILDREN'S ARTISTIC CREATIVITY THROUGH ARTIFICIAL INTELLIGENCE TECHNOLOGY IN CHINESE PRIMARY SCHOOLS

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ABSTRACT

Existing studies lack discussion on challenges in fostering Chinese children's artistic creativity and offer no clear conclusions on AI's impact. This study explores the challenges in cultivating children's artistic creativity in primary schools in China and the impact of digital technology on this process. This study will be conducted through a systematic literature review and induction, current problems will be analysed, strategies will be proposed from a theoretical perspective, and future development trends will be analysed. The finding reveals that through a scoping review of 16 relevant studies, it was found that AI technology plays three leading roles in enhancing children's artistic creativity: as a tool, tutor, and medium. AI as a tool helps generate creative ideas, as a tutor provides guidance and support, and as a medium facilitates learning and collaboration. The study highlights the significant role of AI in stimulating children's interest and enhancing their artistic creativity while noting potential risks, such as increased cognitive load and copyright issues. The research concludes that while digital technology, especially AI, offers substantial benefits for children's artistic creativity, its application requires careful consideration of pedagogical strategies and ethical issues. Future research should continue to explore the effective integration of AI in art education to enhance children's creative abilities.

Keywords: Artistic Creativity, Chinese Children, Art Education, AI, Digital Technology.

INTRODUCTION

The artistic creativity of children has significant value for their improvement. The early age of the children is fit for artistically improving their behaviour (Sutapa et al., 2021). The current era is based on artificial

intelligence (AI), and improving students' creativity with AI is necessary. Similarly, AI integration into the Chinese education system is needed to improve students' artistic creativity (Cao, X 2024).

In China, integrating digital technology and artificial intelligence (AI) in art education has been a growing area of interest. Several studies have explored the potential of AI to enhance children's artistic creativity while also highlighting the challenges and ethical considerations associated with its use (Fan, 2023; Yang, 2022; Yim, 2024). Meanwhile, there are gaps in the existing studies as there is limited debate about the problems in cultivating Chinese children's artistic creativity. Similarly, the studies have no conclusive argument regarding the impact of AI on children's artistic creativity. In addition, the studies in literature have no rational discussion on applying AI to cultivating Chinese children's artistic creativity. Finally, there is also emerging but no comprehensive debate on the future development direction of AI and children's artistic creativity cultivation.

The main objective of this paper is to examine the challenges of fostering artistic creativity among primary school children in China and investigate how digital technology influences this process. It also seeks to propose strategies to effectively boost children's artistic creativity using digital technology, which can provide references for children's art educators and related researchers. This research is designed to answer the following three questions:

RQ1: What are the specific roles of AI technology in supporting and enhancing children's artistic creativity?

RQ2: What is the impact of AI as a digital technology on the creative arts for children?

RQ3: What pedagogical principles and strategies are used to integrate AI technology into art education to enhance children's artistic creativity?

The present research holds significant value in enhancing the artistic creativity of students in China. This study provides a new teaching model for art education in primary schools.

RELATED WORKS

Gardner (2006) stated, "In our interconnected global society, creativity is highly sought after, nurtured, and commended" (Parker, 2008, p. 77). Studies have shown that artistic creativity can improve children's communication ability (Wright, 2010) and intermediary thinking ability (Behnamnia et al., 2020), cultivate their appreciation of different viewpoints, develop cultural knowledge, and enhance imagination and creativity (Clark & Grey, 2013), explore aesthetics and artistic language (Kukkonen & Chang-Kredl, 2018), cultivate critical literacy (Crafton et al., 2009), and also provide emotional support (Kaimal et al., 2016). Artistic creativity is significantly associated with children's motor skills, abstract thinking and healthy emotional responses (Lynch, 2017). Artistic creativity is the ability to judge visual phenomena, create visual artworks, and convey visual information, and also performance and communication ability. It is also an ability to deal with problems in the future (Qian, 2015).

The lack of understanding of AI and effective strategies for using AI in the visual arts are the main problems in cultivating children's creativity. It also weakens students' creativity (Chen, 2020). Many schools focus only on developing children's art skills and lack the cultivation of pupils' creativity and imagination in art classes (Chen, 2020). Art education adopts traditional teaching methods that are very difficult to effectively improve students' artistic creativity (Cui, 2021).

By the end of 2020, Chinese schools, including teaching sites, had all been connected to the Internet. Schools that were previously unconnected have now achieved dynamic zero-disconnect status, with

99.92% having an export bandwidth of 100 Mbps. In addition, 98.35% of primary and secondary schools are equipped with multimedia classrooms, further strengthening the basic conditions for technology-enabled teaching (Ministry of Education, 2021). Through the support of policies and basic conditions, digital technology began to be applied in elementary and high schools.

In China, AI is mainly applied in college courses and is rarely used in visual art training in primary and secondary education. Thus, exploring the application of digital technology, such as AI, in nurturing Chinese children's artistic creativity is essential. Devising strategies to merge AI with conventional art education is also a significant subject.

METHODOLOGY

This study employed the scoping review method initially developed by Arksey and O'Malley in 2005 and refined by Levac et al. in 2010. The method comprises five key stages: (a) formulating research questions, (b) identifying relevant studies, (c) selecting studies, (d) charting data, and (e) summarising and reporting findings. A systematic search of digital libraries was performed to locate studies on applying digital technology in science education to foster social creativity. The Scopus database was launched by Elsevier in 2004 and is known for its comprehensive coverage and user-friendliness. Burnham (2006) was the primary source of articles in this field. Initially, the titles, abstracts, and keywords of potentially relevant studies were reviewed (Baer, 2014; Sternberg, 2022).

Keyword selection

In this first stage of the search method, this study identified the following set of keywords: "Artistic Creativity," "Children," "Art Education," "Artificial Intelligence," "AI Technology," "Digital Technology," "Creativity Enhancement," and "AI in Education." These keywords were relevant to the questions of this research. Based on the above keywords, this study formulated the following search strategies. The search string will be constructed to cover the main themes of the study:

Example Search String: ("Artistic Creativity" OR "Creativity" OR "Art Education") AND ("Artificial Intelligence" OR "AI Technology" OR "Digital Technology") AND ("Children" OR "Elementary Education").

Inclusion and Exclusion Criteria

Before screening studies from the database search, this study set exclusion criteria, much like in related research (Aguilar & Turmo, 2019).

Table 1

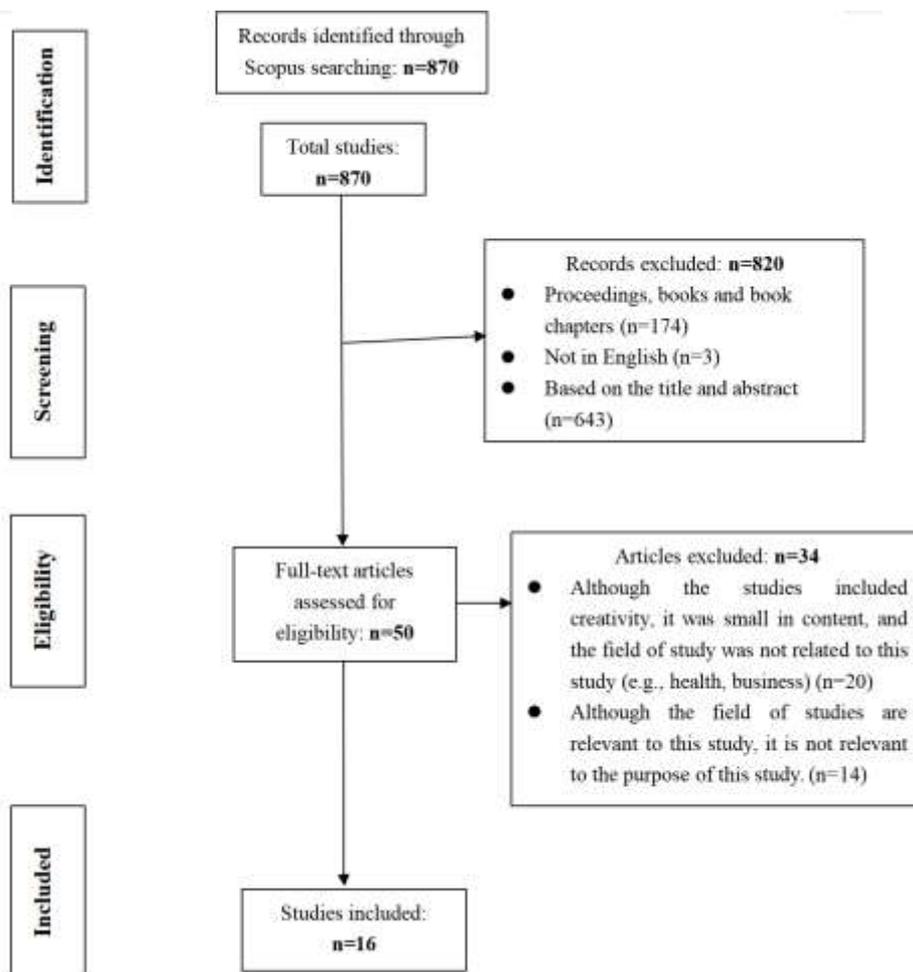
Inclusion and Exclusion Criteria

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none">• The research content of the studies was within the scope of artistic creativity.• Studies that are related to the domain of experimental science.	<ul style="list-style-type: none">• Conference papers were excluded, and peer-reviewed literature was used in this study.• Books and chapters were excluded because they require more effort than journal literature.

- Publications that were peer-reviewed.
- Studies focused on children or elementary education.
- Journal articles published between 2020 and 2024.
- Studies not in experimental sciences (e.g., studies focusing on social sciences were excluded).
- Research in fields unrelated to this study (e.g., medical or business papers excluded).
- Studies that were not written in English.

Figure 1

Selection process of the studies for review of this study



Data encoding and extraction

To address the research questions, information was extracted and coded from 16 selected studies focusing on three key aspects: the role of AI technology in enhancing children's artistic creativity, its forms and key features, and the pedagogical principles and strategies for its integration. A narrative synthesis approach, suitable for emerging fields and emphasising the relevance and contribution of studies over strict methodological criteria, was used to code data and identify research challenges and key themes (Aguilar & Turmo, 2019; Davis et al., 2009). Following the procedures of prior scoping reviews (Aguilar & Turmo, 2019; Davis et al., 2009; Davis et al., 2009), data were extracted from Scopus for further analysis.

Methodology Limitations

The methodology of this scoping review has several limitations that should be acknowledged. Firstly, the search for relevant studies was conducted using specific databases and keywords, which may have omitted some relevant studies. Despite the comprehensive search strategy, there is a possibility that studies not indexed in the selected databases or those using different terminology related to AI and creativity might have been missed. Secondly, the review was limited to studies published in English between 2020 and 2024. This time frame was chosen to ensure the relevance and timeliness of the findings; however, it may exclude valuable research conducted outside this period. Additionally, non-English studies were excluded due to practical constraints, potentially overlooking important contributions from non-English-speaking regions. Thirdly, while suitable for identifying key themes and trends, the narrative synthesis approach does not involve a formal quality assessment of the included studies. This means that the review does not evaluate the methodological rigour or reliability of the studies, which could affect the strength. Table 2 presents the current work used in the reviewing process.

Table 2

Summary of Reviewed Studies

References	Roles of AI in enhancing children's artistic creativity	Forms of AI technology
Ivcevic and Grandinetti (2024) (2022).	Medium, Tutor, Tool	AI technologies, including large language models (e.g., Chatgpt)
Wang (2024)	Medium, Tool	AI applications (e.g., PopBots, AI for Oceans, Teachable Machine)
Dakakni and Safa, (2023) (2022).	Tool	Virtual reality (VR)
	Medium, Tool	Generative AI: Generating creative ideas and responses
Fan (2023)	Medium, Tool	AI knowledge, skills, and attitudes (AI literacy), including using AI tools, computational thinking, and problem-solving
Haleem et al. (2022)	Tutor, Tool	Generative AI: Generating creative ideas and responses
Sanusi et al. (2024).	Tool	Digital technologies (e.g., IoT, VR)
Xiao et al. (2024)	Tool	Generative AI: Generating creative ideas and responses
Yim (2024)	Tool	Next-generation digital technologies (e.g., blockchain, AI, metaverse)
Rizk and Hillier, (2022)	Tutor, Tool	Arts-based pedagogy
Chiu, Xia, et al., (2023)	Medium, Tool	Digital technology: Enhancing classroom engagement through interactive tools and platforms
Aslan et al. (2024)	Tutor	AI technology: Enabling personalised learning
Kashyap (2021)	Tutor	Generative AI: Generating creative ideas and responses
	Medium, Tutor	Generative AI: Generating creative ideas and responses

Habib et al., (2024)	Tool	Generative AI: Generating creative ideas and responses
Rizvi et al. (2023)	Medium, Tutor	Interactive Programming

FINDINGS

The specific roles of AI technology in supporting and enhancing children's artistic creativity

To date, digital technology has been widely applied in education (Bereczki & Kárpáti, 2021; Haleem et al., 2022). After the emergence of AI technology, it has gradually been applied in artistic creativity teaching as an advanced digital technology (Chiu et al., 2023; Rizvi et al., 2023). After analysing the screened literature, it was found that AI technology mainly plays three specific roles in artistic creativity teaching, namely tool (n=12), tutor (n=7), and medium (n=7).

AI serves as a tool in supporting and enhancing children's artistic creativity

As shown in the literature analysis, the role of AI as a tool is the most common. In sociocultural theory, individuals learn and think using cognitive or thinking tools to internalise sociocultural elements (Saul, 2023), is an advanced digital technology. AI is currently widely used to shape and develop tools for creative acquisition (Aguilar & Pifarre Turmo, 2019). For instance, Dakakni and Safa (2023) utilised generative AI technology as a guiding tool to stimulate children's early artistic creativity. In China, thanks to the rapid development of 5G technology, Fan (2023) has used generative AI technology as an auxiliary tool to guide students to think creatively and enhance the participation and interaction of online students. According to Yim (2024) From the teachers' perspective, AI technology created art teaching materials, greatly enhancing primary school students' interest. In creative art, the performance of students has also improved significantly.

AI serves as a tutor in supporting and enhancing children's artistic creativity

Digital technology often serves as a tutor in creative activities (Aguilar & Pifarre Turmo, 2019), AI technology is no exception. Ivcevic and Grandinetti (2024) used AI technology to guide young children in generating poems, and AI-powered storytelling platforms allow children to create and refine stories with AI guidance. Wang (2024) integrated AI-powered immersive technologies into dance education, which helps children perform more standardised dance moves and enhances their interest in participation. In a study by Yang's (2022), children were guided by AI robots to classify foods and create music, which enhanced their creativity and collaborative skills.

AI serves as a medium in supporting and enhancing children's artistic creativity

Digital technology offers a variety of possibilities for creative learning, and AI, as a medium for creative thinking, provides adequate support for creative learning (Aguilar & Pifarre Turmo, 2019). Dakakni and Safa (2023) used AI tools like ChatGPT and Quillbot to assist with assignments and provide creative ideas, enhancing students' artistic creativity skills. Yang (2022) utilised AI as a medium to facilitate learning and collaboration, helping children explore new concepts and work together on creative projects. In art education, Yim (2024) employed generative AI technology to produce creative cues for children, enhancing their artistic creativity.

The influence of AI as a digital technology on children's arts creativity

Inspiring the artistic creativity of children

This study found through a literature review that AI technology is crucial in stimulating children's interest, significantly enhancing their artistic creativity. Research indicates that digital games can enhance students' learning by attracting their attention, boosting their motivation, and increasing their engagement (Behnamnia et al., 2020; Checa-Romero, 2016). A study involving 69 fifth-grade students found that those who used digital games for learning exhibited higher self-efficacy and performed better than those in the traditional teaching group in terms of both learning performance and motivation (Hung et al., 2014). 3D vision, animation, and interaction design produced by VR digital technology greatly increase the entertainment in the art learning process while also enhancing students' engagement and learning motivation (Cetinic & She, 2021). For example, one study found that a virtual art museum greatly stimulated children's interest in art learning and significantly impacted their subsequent art creation (Oksanen et al., 2023).

Helping children better understand and experience art

Understanding and experiencing art is necessary for in-depth understanding and creating art, crucial in cultivating children's artistic creativity. Compared with traditional art experience, the process of understanding and experiencing art through AI is more efficient (Habib et al., 2024). In recent years, the application of AI in the field of art understanding and experience has grown (Chiu et al., 2023). Tasks in this domain include the automatic classification of digital artworks, object detection, content-based and multimodal retrieval, quantitative analysis of features and concepts, and computational aesthetics (Cetinic & She, 2021). I have been utilised to create VR art installations and make historical cathedrals accessible through immersive technologies. It has also been employed to enhance user experiences (Hui et al., 2022) and explore the preservation and accessibility of cultural sites from home using immersive technologies, including AI, providing a powerful spiritual experience (Allal-Chérif, 2022). Furthermore, AI has been applied to improve user experience with a recommender system for artistic images in online art stores (Dominguez et al., 2020).

Helping children create better art

Creating art is the core of artistic creativity and embodies children's creative thinking and ability. Research shows that AI can effectively promote collaborative creativity, and students can collaborate with AI products under the organisation and guidance of teachers, which can effectively enhance students' creativity (Tang et al., 2022). As AI continues to evolve, AI-led digital technologies are becoming more personalised and easier to use. AI's increasing use in art has prompted a paradigm shift in the field, with artists such as Jon Rafman and Mario Klingemann leveraging techniques such as deep learning and artificial neural networks to create their work, arguing that AI will become the "new normal" (Harris, 2023). Some studies have applied AI digital technology to the classroom and found that it is of great help to visual art students and greatly improves their visual art creativity (Hutson & Lang, 2023). The emergence of generative AI technology offers significant potential to reshape the landscape of art and design education. It provides innovative approaches to enhance students' creativity and foster collaboration (Cotroneo & Hutson, 2023). In addition, other studies have shown that teachers instruct students to use generative AI tools to generate primary art products, which are then iteratively modified to produce new artworks (Kong, 2020).

Increasing children's cognitive load

From the literature, this study found that AI is not always helpful for children's creativity. Complex digital technology and excessive use of digital technology can increase a child's cognitive load (Tang et al., 2022). Recent studies have explored the effects of VR products on students' cognitive load and creativity. The immersive features of VR products, including sound, light, and 3D scenes, have been found to increase cognitive load, impacting students' creative motivation, thinking, and professional cognition, as well as the functionality and novelty of their designs (Chen et al., 2021). Additionally, technical issues associated with VR technology can interrupt the creative process and lead to the dismissal of viable ideas (Dobson & Littleton, 2016).

Many studies have shown that effectively using AI is important for improving children's creative ability (Chiu et al., 2023; Rohrmeier, 2022). For example, cognitive load theory can help educators analyse children's abilities and make appropriate use of AI (Skulmowski & Xu, 2022). More studies have shown that the scaffold teaching strategy has a good effect in technology-enhanced learning, which can guide educators to reasonably arrange digital technology to replace and assist in cultivating children's artistic creativity. This theory is very popular in technology-enhanced learning (Beed et al., 1991; Lee et al., 2023, 2023; Maksić & Jošić, 2021; Probine, 2022).

Authorship, Copyright and Ethical Issues

Although digital technology has brought much help and change to children's art creation, it also brings a lot of potential risks. As a branch of digital technology, AI tools are becoming increasingly important in art education and art creation. However, the current development of AI is not perfect. Currently, AI cannot solve the copyright problem of artistic works. Many AI tools use some artists' works for secondary generation, resulting in copyright infringement of the original works (Cetinic & She, 2021; Harris, 2023). In addition, there is no clear definition in the law, and people's attitudes towards AI works are vague, resulting in significant disputes over AI-generated art or art created by AI tools for secondary creation (Chiu et al., 2023; Qi, 2019).

The strategy of applying AI to the process of cultivating Chinese children's artistic creativity

Understanding the impact of AI on children's artistic creativity is crucial for educators. Some studies have employed quasi-experimental methods, such as pre- and post-test data comparisons. Instructional scaffolding theory is commonly used in the teaching and learning process, supported by AI. Additionally, several studies have explored the role of scaffolding in fostering creative learning within the educational environment. Through specially designed instructional scaffolding, students can be guided to solve problems creatively and enhance their scientific thinking ability (Ratnasari et al., 2019).

Before scholars can understand instructional scaffolding, it is necessary to understand the zone of proximal development (ZPD) theory. To properly set up an instructional scaffold during the incubation process, scholars need to understand the complete situation of children through ZPD.

The zone of proximal development (ZPD) theory

The Zone of Proximal Development (ZPD), introduced by the social constructivist psychologist Vygotsky (1896 - 1934), signifies the difference between a learner's current abilities when working alone and their potential capabilities when assisted by a more knowledgeable individual. It encompasses tasks beyond the learner's current capabilities but can be completed with appropriate assistance. The term "proximal" signifies that the learner is "nearly" proficient in these skills. The ZPD is where instructional interventions

are most effective, as it corresponds to the point where tasks are just beyond an individual's grasp. For learning to occur, scholars must be presented with tasks beyond their current abilities. These challenging tasks facilitate optimal cognitive development (Saul, 2023).

Instructional Scaffolding theory

Bruner et al. (1976) proposed Instructional Scaffolding. The concept of instructional Scaffolding initially emerged to illustrate how caregivers and educators offer dynamic assistance as young children build pyramid structures using wooden blocks (Wood et al., 1976). Scaffolding has three basic features that facilitate learning (Beed et al., 1991):

- One aspect concerns the relationship between students and authorities. This association necessitates collaboration for its efficiency.
- Firstly, the learning process should occur within the learner's immediate developmental zone. To achieve this, the expert must comprehend and incrementally surpass the learner's existing knowledge base.
- The third attribute of scaffolding is that as the learner's expertise improves, the scaffolding, which represents the professional assistance and direction, is progressively withdrawn.

While AI offers tools and platforms for creative learning, the lack of effective pedagogical strategies can limit its benefits. Educators need to understand how to integrate AI into the curriculum without overshadowing the development of children's inherent creativity (Chiu et al., 2023). Instructional scaffolding and zone of proximal development (ZPD) theories can help address this by providing structured support (Erickson & Ramson Hales, 2018; Saul, 2023).

Future development direction of technology-enhancing Enhancing Learning to enhance children's visual art creativity

With the rapid advancement of artificial intelligence (AI) and digital technologies, the future of art education in China is poised for significant transformation. The integration of these technologies offers promising prospects for enhancing children's visual art creativity through technology-enhanced Enhanced Learning (TEL). This section outlines the potential future developments and directions for leveraging AI in art education to foster creativity among children.

Generative AI (GenAI) technologies, which enable the creation of various types of content through simple text-based requests, are expected to play a pivotal role in art education. For instance, generative adversarial networks (GANs) are increasingly utilised in design workflows to boost creativity, productivity, and design horizons (Hughes et al., 2021). The integration of generative AI tools into educational curricula has advanced significantly. For example, ChatGPT, a GenAI-based chatbot, generates human-like conversational responses (Chiu et al., 2023). Such tools can help students generate creative ideas and refine their artistic expressions. However, research indicates that while most students value AI-generated exercises in the art-making process, their opinions are divided regarding whether these tools improve their final work or if they will continue using them post-class (Cotroneo & Hutson, 2023). This suggests a need for further investigation into AI's potential effects on artistic outcomes and sustained engagement.

While AI offers substantial benefits for enhancing children's artistic creativity, its application requires careful consideration of pedagogical strategies and ethical issues (Dobson & Littleton, 2016; Cetinic & She, 2021).

Future research should continue to explore the effective integration of AI in art education to enhance children's creative abilities. This includes investigating the potential of AI to improve artistic outcomes and sustained engagement (Cotroneo & Hutson, 2023). Additionally, research should focus on developing

pedagogical strategies that balance AI with traditional teaching methods, ensuring that technology supports rather than overshadows the development of children's creativity.

CONCLUSION

The future of art education in China is bright with the potential of AI and digital technologies to enhance children's visual art creativity. However, realising this potential requires careful consideration of pedagogical strategies, ethical issues, and equitable access to technology. By addressing these challenges and leveraging the strengths of AI, educators can create a more engaging and effective learning environment that fosters creativity and innovation among children. Future research and development should focus on optimising the integration of AI in art education, ensuring that it supports the holistic development of children's artistic skills and creativity.

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