Generative AI and Creative Thinking in Art Education: A TPACK-Based Theoretical Framework

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Abstract

As a conceptual study, this paper proposes an integrated framework based on TPACK theory, aiming to integrate generative AI into the field of art education and help cultivate creative thinking of art teachers. Through interdisciplinary literature analysis, the study redefines generative AI as a technical knowledge form that dynamically interacts with teaching strategies and subject content. The framework advocates that educators regard AI tools as collaborative partners to enhance students' creative thinking ability. The conceptual model promotes the development of creative ability and the improvement of critical digital literacy by integrating AI-assisted teaching, subject content knowledge and ethical reflection (covering issues such as the definition of creative ownership and the examination of bias). The actual cases and empirical evidence in the article further confirm the applicability of the model in real classroom scenarios. This study not only lays a theoretical foundation for subsequent empirical exploration, but also provides operational practical inspiration for the curriculum design of art teacher education.

Keywords: Generative AI; TPACK; Creative Thinking; Art Education

1. Introduction

Artificial intelligence (AI) is advancing at an astonishing pace, especially breakthroughs in the field of generative technology, which has brought new opportunities and challenges to the educational scene. Today, tools such as ChatGPT, DALL.E, and Midjourney are no longer exclusive to a niche group; they have become widely popular and can generate text, images, and multimedia content by simulating human creativity. Zawacki-Richter et al., (2019) pointed out that in the post-epidemic era, education is continuing to evolve towards a more flexible and technologically integrated model, and these generative AI tools are increasingly seen as partners with both cognitive and creative functions in the teaching environment. It is particularly worth noting that the deep integration of generative AI and art education has opened up broad space for re-exploring the path to cultivate students' creative thinking, and the development of creative thinking is precisely the core goal of aesthetic learning.

Art education has long been closely linked to the cultivation of imagination, the improvement of expression skills, and the shaping of divergent thinking. However, as early as 2002, Eisner pointed out that traditional art classes, especially in vocational education or teacher training scenarios, often over-emphasize skill reproduction, standardized assessment,

and the pursuit of results-oriented, which may restrict true creative exploration. Today, the integration of generative AI has injected new possibilities into art education-it is expected to revolutionize the traditional teaching paradigm by providing learners with new tools for conceptualization, creative experimentation, and work criticism. As Madaan et al., (2024) proposed, students can use AI to achieve multiple creative practices: let AI generate multiple visual interpretations of a concept, analyse the composition rules of artistic styles, or deconstruct and reorganize existing works of art. In this way, learners can be exposed to creative processes that transcend their own technical limitations and style preferences. Although generative artificial intelligence has shown significant technological application potential in the field of art education, the theoretical guidance framework for its deep integration with teaching practice still needs to be systematically constructed.

In response to the shortcomings of this theoretical research, this paper takes the Technology Pedagogical Content Knowledge (TPACK) framework proposed by Mishra and Koehler (2006) as the theoretical basis and constructs a new conceptual analysis framework. The study aims to explore how art educators can cultivate students' creative thinking ability through the effective integration of generative artificial intelligence. The core of the TPACK framework proposed by Mishra and Koehler is to emphasize the interdependence of teachers' understanding of technology knowledge, teaching methods and subject content. When applied to the field of art education, it provides a structured perspective from which the educational functions of generative AI can be accurately matched with creative learning goals. This paper systematically analyzes the generative AI tools in the TPACK model and discusses in depth from a theoretical level how to use these technologies in a targeted manner to enhance students' creative thinking ability. According to the theory of Runco and Jaeger (2012), the creative thinking ability mentioned here not only covers the ability to create original works, but also includes the ability to establish novel connections, conceive multiple possibilities, and express aesthetic intentions.

As a conceptual study, this paper focuses on the interpretation of the potential value of generative artificial intelligence in the cultivation of creative thinking of reserve teachers in art education. Although the research belongs to the category of theoretical construction, the framework system proposed is formed by systematically integrating the interdisciplinary research results of artificial intelligence technology, creative thinking theory and art education and teaching knowledge. Different from the empirical research path, this study adopts a theory-driven methodology. First, it extracts common research topics, teaching practice difficulties and teaching design principles from existing academic achievements and then integrates the elements with the help of the analytical framework of the TPACK (Technology -Pedagogy - Content Knowledge) model, and finally constructs a set of theoretical systems that can guide artificial intelligence-assisted creative teaching. This conceptual research foundation aims to provide a theoretical reference for subsequent empirical research and curriculum development in the field of professional art teacher education.

2. Literature Review

In recent years, the integration of artificial intelligence and education has become the focus of widespread attention in the academic community. Zawacki-Richter et al., (2019) argued that as generative AI technology demonstrates increasingly complex capabilities in simulating

human output, its application in education is receiving increasing attention. In teaching and learning scenarios, artificial intelligence is no longer just seen as a tool for automation or evaluation, but as a co-creation partner for knowledge building, problem solving, and cognitive stimulation. Marrone and Hill (2022) believes that with the continuous emergence of models capable of generating text, images and soundscapes, educators are beginning to explore new teaching opportunities to help students think development, especially those involving creativity and imagination. process. In this broad research area, art education provides rich research soil for exploring how artificial intelligence supports high-level cognitive results. Creative thinking, as the core content of aesthetic and expressive learning, has traditionally attracted much attention, and now it is expected to achieve new breakthroughs with the help of artificial intelligence.

Creative thinking in art education has long been regarded as a multi-dimensional process that covers fluency, originality, flexibility and exposition. Guilford made this view as early as 1950, and Runco and Jaeger agreed in 2012. In 2005, Craft pointed out that in contemporary education concepts, creativity is no longer a talent unique to a few talents, but a set of skills and traits that can be cultivated through well-designed courses and reflective practice. However, Bequette and Brennan (2023) found through empirical research that in many classrooms, especially in vocational education and teacher education, the actual effect of creativity cultivation is often difficult to achieve expectations. These courses may focus more on technical transfer and compliance with stylistic norms, leaving students limited space for divergent thinking and personal experimentation. In this context, the emergence of generative AI has brought opportunities and challenges. Manu (2024) believes that on the one hand, it raises concerns about the authenticity, authorship and artistic judgment of art works; on the other hand, it also provides learners with powerful tools to reimagine, recombine and expand visual creativity in unprecedented ways.

At present, academic circles have discussed the application of generative AI in art classrooms from various perspectives. Ho et al., (2019) emphasize the motivational and exploratory benefits of these tools for students with limited technical drawing or rendering skills. With AI tools, students can bypass some mechanical creative barriers and explore art forms, styles and concepts more freely. There are also scholars who hold different views. Fisher, J. A. (2023) advocate that generative AI be regarded as a “creative provocateur”, that is, as an external force that stimulates new creative ideas, encourages the juxtaposition of visual elements, or guides students to critically reflect on aesthetic decisions. Although generative AI has shown much potential in art classrooms, there is still a lack of a structured teaching model to guide how to effectively integrate it into teaching practice, especially how to align it with clear creative learning goals.

Mishra and Koehler developed the Technological Pedagogical Content Knowledge (TPACK) framework in 2006, which argues that one possible way to address this gap is to apply the TPACK framework. TPACK proposes that effective technology integration in education requires an in-depth and detailed understanding of the dynamic relationships between content knowledge (CK), teaching knowledge (PK), and technological knowledge (TK). TPACK does not regard technology as a simple add-on, but emphasizes the need for careful cross-integration between various knowledge areas so that these three knowledge areas can together provide the basis for teaching decisions. In the field of art education, using the TPACK framework means that when selecting digital tools, we cannot just focus on the novelty of the tool, but also consider its support for expression skills, whether it can deepen conceptual understanding, and whether it can stimulate students’ creativity.

Recently, many literature has begun to explore how to better adapt TPACK to creative disciplines. Kara, S. proposed in 2021 that in the art teacher education process, the TPACK model can help prospective teachers develop the confidence and flexibility to try new technologies, while also ensuring that the integrity of art is not affected. In 2023, Tusiime et al., also emphasized that TPACK-based teaching has the potential to narrow the gap between digital literacy and creative expression, allowing students to use technology as a medium of conception rather than just for creative output. However, most of this kind of research is currently abstract, and there is still a lack of specific frameworks when applying TPACK to the specific background of generative AI. Therefore, there is an urgent need for a theory to illustrate the connection between generative AI tools, TPACK-based instructional design, and the cultivation of creative thinking in art education.

3. Conceptual Framework

To conceptually explore the potential of generative AI to foster creative thinking in art education, this paper uses the TPACK framework as a theoretical foundation. The TPACK model proposed by Mishra and Koehler in 2006 points out that the key to achieving effective integration of technology in teaching lies in the teacher's deep understanding and simultaneous mastery of CK, PK and TK. These three core areas intersect to form a knowledge base that enables educators to design and conduct meaningful learning activities. This cross-fertilization is particularly important in the field of art education, because teaching the creative process requires not only solid subject expertise and sound instructional strategies, but also the ability to select and apply relevant technologies to support students open-ended exploration and expression. In this study, the integration of generative AI was clearly classified as TK in the TPACK framework. TK refers to the knowledge system required to select, understand and use digital tools to effectively support learning activities. Generative AI tools that can generate images, texts or multimodal works based on user instructions fit the definition of this knowledge category.

However, the potential of generative AI tools in education is not determined solely by their technical performance, but also by whether they can be closely integrated with teaching strategies and content knowledge designed to promote students' creative engagement, thereby linking these strategies with subject characteristics. For example, in a digital illustration course, if teachers want to explore surrealist aesthetics with the help of image generation models, they must not only be familiar with the stylistic characteristics of surrealism but also understand the algorithmic logic that affects the results of AI generation. More importantly, the application of generative AI in art education and teaching must be guided by the fundamental principle of cultivating creative thinking habits. This requires that the teaching tasks designed cannot remain at the level of passive acceptance or pursuit of superficial novelty, but should guide students to criticize, reconstruct and expand the content generated by AI.

From this theoretical perspective, the TPACK framework not only constitutes the theoretical framework of teachers' knowledge structure but also becomes an important basis for the design of learning scenarios. In such a teaching environment, artificial intelligence technology should be positioned as a tool to empower human creativity, rather than a replacement. Specifically, the teaching knowledge dimension plays a key role in guiding students to interact with AI tools - students can regard AI as a creative collaboration partner, a source of inspiration, or an extension of their own imagination. In addition, the content knowledge elements in the TPACK framework can ensure that the application of generative artificial intelligence in art education does not deviate from the essence of the subject and avoid

falling into the misunderstanding of technology supremacy. In the context of art education, in addition to technical skills and historical knowledge, the teaching content also includes the cultivation of aesthetic judgment ability, the formation of personal artistic style, and the improvement of cultural literacy.

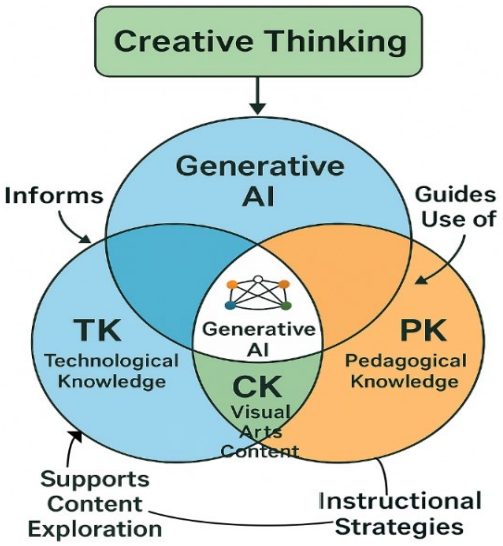
The TPACK framework is often seen as the intersection of three areas: content, pedagogy, and technology. However, its value lies not only in defining these knowledge areas, but also in its insight into the dynamic interactions between them. Koehler and Mishra pointed out in 2009 that to achieve effective technology integration, teachers must make decisions based on the actual teaching environment, in which technology tools, teaching intentions, and subject goals always influence each other. This interaction is not a simple superposition, but a process of mutual stimulation - teaching strategies often change due to the new possibilities brought by technology, and conversely, teaching needs will also drive the adaptive adjustment of technology.

In the field of art education, this dynamic dependency is particularly evident. Art creation itself is a process of repeated adjustment and mutual feedback between conception, technical practice, and teaching guidance. Therefore, we should not regard the TPACK framework as a fixed knowledge system, but as a flexible ecosystem that can generate new knowledge. This system is essentially a heuristic teaching design method, with which educators can continuously optimize AI-assisted teaching to promote learner-centered, real-world artistic exploration.

To integrate the above theoretical research results, this study proposes a conceptual model that integrates generative AI into the TPACK framework for intuitive presentation. As can be seen from Figure 1, generative AI belongs to the category of TK, however, its teaching value is reflected in the visual arts education scenario through dynamic interaction with PK and CK.

Figure 1

TPACK-Based Conceptual Model for Integrating Generative AI into Art Education.



This model highlights the role of generative AI in building a bridge between teaching strategies and teaching content in specific fields, ultimately helping to cultivate students creative thinking. This visual framework educators with a practical perspective to aligner

chaological advantages with teaching goals and subject depth.

Therefore, teachers need to be able to guide students to understand the ethical, cultural, and conceptual implications of using artificial intelligence in creative work. This Figure 1 TPACK-based conceptual model for integrating generative AI into art education includes exploring topics such as authorship, originality, and the boundaries between human-created and machine-generated artworks, which are, as Manu pointed out in 2024, core points in contemporary discussions of digital aesthetics. This framework conceptualizes generative AI as a form of TK that interacts dynamically with PK and CK in visual arts education. Through their integration, instructional strategies can be developed to enhance students' creative thinking.

To strengthen the conceptual framing with empirical grounding, the procedural steps underpinning the AI-enhanced TPACK model must be explicitly articulated and validated through classroom-based evidence. For instance, Kong, Yang, and Yeung (2024) described iterative design cycles in which STEM teachers trialed AI components and refined pedagogical strategies based on structured feedback. Chen (2022) used mixed methods analysis of teacher reflection diaries to verify the core structure of the model. Similarly, Ruthmann and Mantie (2017) explained the interactive relationship between technology, content, and teaching methods through case-based music education research, while Wijaya (2020) used observation records to evaluate digital teaching practices. These empirical studies provide specific verification cases and rich support for theoretical propositions.

By organically combining the application of generative AI with the three interrelated dimensions of the TPACK framework, this conceptual framework provides a new perspective for evaluating and designing teaching strategies that promote creative thinking in art classrooms. Rather than being limited to specific tools or preset outcomes, the model guides educators to think deeply about the inherent connection between the potential of technology, teaching goals, and art subject content. In the process, it constructs an implementation path that is both flexible and principled, organically integrating emerging artificial intelligence technologies into the complex practice of cultivating creativity for future art educators.

4. Proposed TPACK-Based Approach

Based on the TPACK framework, this section proposes a flexible teaching strategy to help art educators integrate generative AI into the cultivation of creative thinking. This strategy abandons the mechanical application of fixed teaching models and instead emphasizes the dynamic coordination of technical knowledge (TK), pedagogical knowledge (PK) and subject content knowledge (CK). In this design, generative AI is not used as a terminal tool, but as a creative collaborator to support exploration, experimentation and iteration in the process of artistic development.

The close fit between pedagogical knowledge (PK) and creative teaching strategies is crucial. Referring to the theoretical model of Runco and Jaeger (2012), creative thinking is regarded as a multidimensional ability covering fluency, originality and flexibility - these dimensions of ability naturally match the functional characteristics of AI tools. Taking the mixed media painting workshop as an example, after students generate a variety of composition schemes with the help of AI tools, they screen and refine elements to construct personalized visual narratives. By designing such structured and open tasks, educators can guide students to criticize, reconstruct and expand AI-generated content, so that the generation system can be transformed into an effective tool to support the development of higher-order thinking.

Content knowledge (CK) is the foundation of discipline, ensuring the coherence of concepts and techniques. In the field of art education, CK covers the understanding of aesthetic theory,

historical context, symbolic system and media dimension. Generative AI is not intended to replace these knowledge systems, but to provide a new path for exploring and expanding the boundaries of knowledge. For example, students can use generative AI to generate visual elements that fit the conceptual theme and then deconstruct and reconstruct them through traditional and digital means. As shown in the fashion design project of Lee and Suh (2023), this fusion effectively optimizes the entire process from creative conception to material landing. In addition, the studies of Sang et al. (2018) and Syukri et al. (2023) have confirmed that embedding AI tools into collaborative critical cycles can cultivate students' deeper artistic perception and iterative learning ability.

Crucially, this teaching model deeply integrates moral reflection with the cultivation of critical digital literacy. Teachers need to guide students to clarify the boundaries between human and machine creation, analyze the implicit bias of algorithms, and examine the social impact of AI-generated visual content. Modular criticism models or real-time formative feedback mechanisms such as those proposed by DeWitt and Alias (2021) can not only promote responsible technological exploration but also avoid shallow application or improper use of AI. These ethical considerations are by no means subsidiary content but are the core of cultivating educators who have the ability to master the AI era and have both vision and creativity.

This model organically integrates TK, PK and CK into teaching design, transforming teachers into designers of transformative learning experiences. It not only enables prospective teachers of professional art education to creatively use generative AI, but also encourages them to examine, reconstruct and expand the possibilities of technology applications from both teaching and artistic dimensions.

5. Conclusion

This paper constructs a conceptual framework based on the TPACK model, aiming to integrate generative AI into the field of art education. By integrating technical knowledge, pedagogical knowledge and subject content knowledge, the framework advocates the use of AI as a catalytic tool to stimulate students' fluency, originality and flexibility in expression, rather than a means to replace human creativity. The framework also emphasizes ethical considerations, including the definition of creative ownership, cultural bias and the rational use of technology, so as to promote digital literacy while promoting creativity. In order to promote the in-depth integration of theory and practice, subsequent research can examine the application effect of the framework in real teaching scenarios through empirical methods such as classroom case analysis, teacher reflection records or experimental design. Specifically, it can focus on the impact mechanism of AI-assisted tasks on creative achievements, the strategic path for educators to cope with ethical challenges, and the model's support model for curriculum innovation. Such research will provide a basis for the effectiveness verification of the framework and help its promotion and application in the field of art teacher education.

References

Bequette, J. W., & Brennan, C. (2008). Advancing media arts education in visual arts classrooms: Addressing policy ambiguities and gaps in art teacher preparation. *Studies in Art Education, 49*(4), 328-342. https://doi.org/10.1080/00393541.2008.11518745

Craft, A. (2005). Creativity in schools: Tensions and dilemmas. Routledge. https://doi.org/10.4324/9780203357965

Eisner, E. W. (2003). The arts and the creation of mind. *Language Arts, 80*(5), 340-

344.https://publicationsncte.org/content/journals/10.58680/la2003322

Fisher, J. A. (2023). Teaching Creatives to be AI Provocateurs: Establishing a Digital Humanist Approach for Generative AI in the Classroom. *Tradition Innovations in Arts, Design, and Media Higher Education, 1*(1), 5.https://doi.org/10.9741/2996-4873.1002

Guilford, J. P. (1967). Creativity: Yesterday, today and tomorrow. *The Journal of Creative Behavior, 1*(1), 3-14. https://doi.org/10.1002/j.2162-6057.1967.tb00002.x

Ho, L. H., Sun, H., & Tsai, T. H. (2019). Research on 3D painting in virtual reality to improve students' motivation of 3D animation learning. *Sustainability, 11*(6), 1605.https://doi.org/10.3390/su11061605

Kara, S. (2021). An Investigation of Technological Pedagogical and Content Knowledge (TPACK) Competencies of Pre-Service Visual Arts Teachers. *International Journal of Technology in Education, 4*(3), 527-541.https://eric.ed.gov/?id=EJ1311027

Madaan, G., Asthana, S. K., & Kaur, J. (2024). Generative AI: Applications, models, challenges, opportunities, and future directions. *Generative AI and Implications for Ethics, Security, and Data Management,* 88-121.https://doi.org/10.4018/979-8-3693-8557-9.ch004

Manu, A. (2024). *Transcending imagination: Artificial intelligence and the future of creativity.* CRC Press. https://doi.org/10.1201/9781003450139.

Marrone, R., Taddeo, V., & Hill, G. (2022). Creativity and artificial intelligence—A student perspective. *Journal of Intelligence, 10*(3), 65.https://www.mdpi.com/2079-3200/10/3/65?trk=public_post_reshare-text#

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054.https://doi.org/10.1111/j.1467-9620.2006.00684.x

Runco, M. A., & Jaeger, G. J. (2012). The standard definition of creativity. *Creativity Research Journal, 24*(1), 92–96. https://doi.org/10.1080/10400419.2012.650092.

Tusiime, W. E., Johannesen, M., & Gudmundsdottir, G. B. (2022). Teaching art and design in a digital age: challenges facing Ugandan teacher educators. *Journal of Vocational Education & Training, 74*(4), 554-574. https://doi.org/10.1080/13636820.2020.1786439

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–where are the educators?. *International journal of educational technology in higher education, 16*(1), 1-27. https://doi.org/10.1186/s41239-019-0171-0.