Journal of Curriculum Studies Research

https://curriculumstudies.org

E-ISSN: 2690-2788

Volume: 8 Issue: 2 2026

pp. 340-363

The Impact of Generative Artificial Intelligence on Student Creativity in Art and Design Education: A Meta-Analysis

Zeliha Canan Özkan[a]

a. Kutahya Dumlupinar University Faculty of Fine Arts, Kütahya, Türkiye
Email: zeliha.ozkan@dpu.edu.tr

Article Info
Received: April 13, 2026
Accepted: August 18, 2026
Published: September 1, 2026

10.46303/jcsr.2026.36

How to cite
Özkan, Z. C. (2026). The Impact of Generative Artificial Intelligence on Student Creativity in Art and Design Education: A Meta-Analysis. *Journal of Curriculum Studies Research*, 8(2), 340-363. https://doi.org/10.46303/jcsr.2026.36

Copyright license
This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 International license.

ABSTRACT
The present study is a meta-analysis examining the impact of generative artificial intelligence (GenAI) tools on student creativity in art and design education. The study systematically reviewed publications in the Web of Science, Scopus, and ERIC databases between January 2020-2026. Findings from 31 independent experimental, quasi-experimental, and correlational studies were analyzed. The analysis revealed that GenAI use has a moderate and statistically significant effect on student creativity (d = 0.61). The study also examined the moderating roles of variables such as publication year, study type, cultural context, students' academic level, type of creative output, and type of AI tool used on this effect. The findings showed that publication year was a significant moderator, with the highest effect observed in studies published in 2024. In contrast, study type and cultural context did not have a significant moderating effect. When examined from an academic perspective, it was observed that GenAI's effect on creativity was higher among graduate students, followed by undergraduate and K-12 students. Among the types of creativity, the highest impact was seen in the originality/innovation dimension, followed by general creativity, creative self-efficacy, and divergent thinking. Regarding AI tool types, text-to-image tools provided the highest impact, followed by large language models (LLM), GAN/deep learning-based tools, and hybrid tools. Publication bias analyses showed that the results were reliable and did not contain significant bias. The study reveals that generative AI tools are an effective tool in increasing student creativity in art and design education, and that this effect can vary depending on specific student groups and tool types.

KEYWORDS
Generative Artificial Intelligence (GenAI); creativity; art and design education; meta-analysis; student success.

INTRODUCTION

Visual arts education is considered a fundamental field of education where students develop their aesthetic perception, critical thinking, and creative expression skills (Alter, 2010; Ulger, 2016). In this field, creativity is defined not only as the capacity to produce original products but also as a type of skill encompassing the processes of reinterpreting one's environment, establishing aesthetic contexts, and creating meaning through visual language (Bastos & Zimmerman, 2017). Art educators adopt different pedagogical approaches to unlock students' creative potential. These approaches undergo radical transformations over time (Vuk & Bosnar, 2021). In this context, technological advancements have become one of the most decisive factors in this transformation. The integration of digital tools into classroom environments is accelerating and fundamentally reshaping teaching processes (Baytak, 2024; Liu & Wang, 2025). However, this process brings with it not only an instrumental transformation but also a questioning of how creativity is understood and measured.

The rapid proliferation of generative AI technologies in recent years marks a new turning point in educational settings (Bahroun et al., 2023; Kalymova et al., 2026; Robila & Robila, 2026). Generative AI tools are redefining traditional art production processes due to their ability to create visual content using text-based commands. In the visual arts, this transformation directly impacts students' participation in visual production processes, their aesthetic decision-making, and their unique creative experiences (Jingying, 2025; Zlateva, 2025). However, while the use of these tools in the context of art education offers pedagogical opportunities, it also raises serious questions (Fang, 2026). In this context, the debate over whether AI supports or replaces human creativity is becoming increasingly important in academic literature (Arielli & Manovich, 2022; Sultan et al., 2026).

Despite the increasing use of generative AI tools in visual arts education, evidence regarding their impact on student creativity remains inconsistent and fragmented (Han & Piaw, 2025; Holzner et al., 2025a). While some existing studies suggest that AI enhances creativity (Eapen et al., 2023; Sun et al., 2025), others indicate that these technologies may negatively impact students' self-efficacy and original thinking skills (Mei et al., 2025; Verdenhofa et al., 2024). Furthermore, the methodologically heterogeneous nature of the studies, the use of different measurement tools, varying sample characteristics, and differing contextual conditions are also significant factors.

The number of systematic studies examining the impact of GenAI in contexts specific to visual arts education remains quite limited (Fang, 2026; Oksanen et al., 2023). While meta-analyses exist in the general educational technology literature suggesting that AI positively influences learning outcomes (Liu et al., 2025; Ma & Zhong, 2025; Ünal et al., 2026), these syntheses do not address creativity as a separate construct or delve deeply into the specific context of visual arts. Furthermore, the diversity of tools used in creativity assessment makes comparative analyses even more difficult (Ulger, 2020). Accordingly, it is considered that a meta-

analysis focusing on student creativity and adopting visual arts education as the primary context could fill this gap in the literature.

THEORETICAL FRAMEWORK

Creativity in Visual Arts Education

The concept of creativity has been defined in many different ways throughout history in the visual arts education literature (Winner et al., 2014). Its use in the context of art and education encompasses interconnected sub-processes such as producing original work, problem-solving, developing aesthetic sensitivity, and thinking outside the box (Alter, 2010; Bastos & Zimmerman, 2017). This multi-component structure makes it difficult to evaluate creativity with a single criterion. Instead, it necessitates multi-dimensional and contextually sensitive approaches (Huzjak & Županić Benić, 2017). In this context, visual arts education is among the disciplines where creativity manifests itself in its most visible and measurable form.

When examining pedagogical approaches to developing creativity in visual arts education, models based on problem-based learning, process-oriented assessment, and critical inquiry stand out (Alter, 2011; Ulger, 2018a). These approaches aim to develop not only students' technical skills but also their aesthetic reasoning and creative decision-making capacities. The adoption of interactive methods in the classroom is considered a factor that strengthens students' creative participation (Ronksley-Pavia, 2014; Tomljenović, 2015). In this context, the teacher's facilitating role supports the student's positioning as an autonomous and risk-taking creative subject. Similarly, in contemporary visual arts education, an understanding that values the process as much as the product is increasingly gaining ground (Vuk & Bosnar, 2021). This paradigm shift is also transforming the way creativity is assessed and is popularizing the use of portfolio-based or observation-based tools.

Studies examining the contribution of arts education to the development of creativity generally reveal positive correlations, but the findings vary in level and intensity (Ulger, 2016; Winner et al., 2014). One of the main sources of this variation is the diversity of tools used to measure creativity and the theoretical models adopted (Huzjak & Županić Benić, 2017). In addition, contextual factors such as the student's developmental level, the characteristics of the art environment, and the structure of the education system also significantly influence the results (Ulger, 2020). However, in his study comparing music and visual arts education, Ulger (2018b) reveals that creative thinking skills take different forms in discipline-specific contexts. Therefore, developing a creativity framework specific to visual arts seems necessary both theoretically and practically. Zimmerman (2013), on the other hand, critically evaluates the historical course of research in this field and draws attention to the existing gaps. Therefore, it is considered that empirical studies conducted without establishing a conceptual and theoretical foundation will offer limited contributions.

The Use of Generative Artificial Intelligence Tools in Education

The integration of GenAI tools into educational environments has become a topic of intense interest among both practitioners and researchers in recent years (Bahroun et al., 2023; Liu & Wang, 2025). These tools, with their capacity to produce various output types such as text, visuals, audio, and code, have the potential to transform teaching and learning processes in many disciplines (Epstein et al., 2023; Ma & Zhong, 2025). Meta-analyses conducted in the context of general education show that generative AI generally has a positive impact on learning outcomes (Liu et al., 2025; Tang et al., 2025). The second-level meta-analysis findings of Ünal et al. (2026) reveal that the effectiveness of AI applications shows significant variations depending on factors such as discipline, educational level, and application duration. Therefore, when evaluating the impact of AI in education, it is necessary to consider context-specific differences.

When systematic reviews and meta-analyses addressing the impact of generative AI in education are examined, significant findings regarding the mechanisms contributing to learning processes are obtained (Liu et al., 2025; Nie et al., 2025; Sun & Zhou, 2024; Tang et al., 2025; Zhu et al., 2025). Sun and Zhou (2024), while evaluating the effects on the academic achievement of higher education students, state that these tools strengthen student engagement and self-regulation skills. Similarly, Xie et al. (2025) observe significant effects on higher-order cognitive outcomes; and Nie et al. (2025) provide comprehensive evidence that GenAI supports higher-order thinking skills. The impact of these tools on higher-order outcomes such as creativity and original thinking is less researched and shows a more contradictory picture compared to academic achievement. However, Zhu et al. (2025), in their meta-analysis on learning outcomes, reveal that the effect of AI shows an inconsistent distribution across different types of outcomes.

The Impact of AI-Assisted Instruction on Student Creativity

The effects of GenAI on human creativity have also been extensively studied in recent years, both empirically and theoretically (Arielli & Manovich, 2022; Lee, H.-K., 2022; Lintner & Reeves, 2026). In terms of positive effects, it is argued that AI can function as a partner or source of inspiration contributing to creative processes (Eapen et al., 2023; Haase et al., 2023). Sun et al. (2025), in their field experiment study, indicate that the use of GenAI has a creativity-enhancing effect.However, this effect varies depending on individual differences. Zhu and Zou (2023), in their experimental study examining the role of GenAIin human creative processes, state that while AI increases the diversity of creative outputs, it can negatively affect the originality dimension. This shows that the effect of AI on creativity is not linear and unidimensional (Holzner et al., 2025a; Ma & Yu, 2025; Peng et al., 2025; Zhu & Zou, 2023). It is shaped by numerous variables. Therefore, when evaluating the relationship between creativity and AI, it seems essential to consider both positive and negative impact mechanisms.

From a negative impact perspective, the use of AI tools can impair students' creative self-confidence, sense of ownership of the process, and motivation for original expression (Mei et al., 2025; Velandia-Rodríguez et al., 2025; Verdenhofa et al., 2024). In this context, AI carries the

risk of distancing students from challenging but developmentally valuable creative processes. However, Holzner et al. (2025a) emphasize that it is still difficult to make definitive conclusions about the direction and magnitude of the effect in their systematic literature review and meta-analysis findings. Ma and Yu (2025), while examining the process of artistic creativity development at a theoretical level, state that the supportive or restrictive conditions of AI should be carefully analyzed. In this framework, Peng et al. (2025) evaluated the effect of AI-assisted instructional interventions on creative thinking as a meta-analysis study and obtained generally positive results, but with high context-specific variability. Therefore, synthesis studies in this field are expected to focus not only on effect size but also on the conditions of impact.

AI Applications in Visual Arts Education: Opportunities and Limitations

Research on the potential of AI applications in the context of visual arts education shows that these tools hold significant potential in terms of increasing student engagement, encouraging aesthetic exploration, and providing personalized learning experiences (Bian et al., 2025; Fang, 2026; Jingying, 2025; Han & Piaw, 2025; Yu, 2025). In this regard, Jingying (2025) examined the use of AI-generated visual art in traditional fine arts education and reported a positive impact on students' aesthetic perception processes. Fang (2026), in her review systematically addressing applications in higher education art education, comprehensively reveals the potential of generative AI to enrich visual creativity environments. Zlateva (2025) evaluated visual arts education in the age of AI within the triangle of lines, words, and algorithms, questioning the role of these technologies in pedagogical transformation. In this context, she argued that AI is not merely a technical tool. It also appears to have become a phenomenon that opens up a discussion on the epistemological foundations of art education.

In addition to opportunities, the literature also highlights serious concerns and limitations regarding the use of AI in visual arts education (Han & Piaw, 2025; Oksanen et al., 2023). Foremost among these limitations are discussions about how AI-generated images are positioned in terms of creativity and aesthetic value when compared to original works of art (De Rooij, 2025; Han & Piaw, 2025; Hall & Schofield, 2025; Oksanen et al., 2023). Indeed, Horton et al. (2023) demonstrate that prejudice against AI-generated art can indirectly affect artists' perception of creativity. This finding also brings to the forefront the social and psychological dimensions of AI in educational settings. Orwig et al. (2026), in their study examining the role of individual differences in AI-assisted visual art production, stated that students' creativity levels significantly affect the quality of AI-generated works. Verdenhofa et al. (2024) comparatively examined the effects of GenAItools on student creativity in Latvia, Ukraine, and Spain, revealing that contextual differences significantly shaped the results. However, Duran and Alejandro (2024), in their study at the secondary school level, stated that GenAItools positively influenced student creativity, but emphasized that questions remain regarding the long-term sustainability of this effect.

Gaps in the Literature and the Importance of Research

Meta-analyses addressing the overall impact of GenAIin education have rapidly increased in recent years. However, the vast majority of these studies focus on cognitive outcomes such as academic achievement or higher-order thinking skills (Liu et al., 2025; Nie et al., 2025; Zhao et al., 2025). Studies addressing a complex and multi-dimensional structure like creativity remain quite limited (Holzner et al., 2025a; Peng et al., 2025). In this context, visual arts education stands out as a unique discipline directly related to creativity in both its process and product dimensions, highlighting the need for synthetic studies in this field. Filling this gap has the potential to make significant contributions to the field, both theoretically and practically.

The importance of this study can be considered from several perspectives. First, it is expected to systematically synthesize conflicting findings from different cultures regarding the impact of AI on visual arts education, thereby generating reliable, field-specific evidence (Duran & Alejandro, 2024; Yao et al., 2025). Furthermore, its ability to reveal, through moderator analyses, under what conditions AI has a greater or lesser impact on creativity is considered valuable in terms of providing practical insights. Additionally, the research has the potential to lay the groundwork for developing AI integration strategies that prioritize student creativity. In this regard, it aims to offer valuable insights for arts educators, curriculum developers, and education policymakers.

In terms of its theoretical contribution, the study is expected to provide concrete, data-based evidence for conceptual discussions on the relationship between generative AI and human creativity (Arielli & Manovich, 2022; Ma & Yu, 2025). Intersecting with the literature on measurable creativity and human-machine collaboration, this study offers a unique perspective by bringing these discussions into the context of visual arts education. Similarly, the study is expected to contribute to methodological discussions on how to measure and evaluate student creativity.

In this context, the present study focuses on the need to synthesize empirical findings on GenAI and student creativity within the specific field of art and design education. Since creativity in this field is related to originality, divergent thinking, creative self-efficacy, and visual production processes, examining the overall effect alone is not sufficient. Therefore, this study also evaluates how this effect changes according to study characteristics, student level, creativity outcome type, and AI tool type (Fang, 2026; Holzner et al., 2025a; Peng et al., 2025; Ulger, 2020).

In this study, the impact of GenAI on student creativity was examined in the framework of experimental and quasi-experimental research in the domain of art and design education. At the same time, the following variables were recognized as potential moderators of the overall effect size: (i) year of publication, (ii) type of study, (iii) cultural context, (iv) academic level of the students, (v) type of creativity outcome, and (vi) type of AI tool. Taking into consideration the aforementioned variables and the previous research findings in the domain, the following hypotheses were examined in the present study:

In this respect, the novelty of the present study lies in examining GenAI not only as a general educational technology but also as a creativity-related intervention in art and design education. By focusing on creativity dimensions such as originality/innovation, divergent thinking, creative self-efficacy, and general creativity, the study provides a field-specific synthesis of how GenAI contributes to student creativity under different methodological and educational conditions.

H1 GenAI tool use has a positive effect on student creativity in art and design education.

H2 Publication year moderates the effect of GenAI tool use on student creativity in art and design education.

H3 Study type moderates the effect of GenAI tool use on student creativity in art and design education.

H4 Cultural context moderates the effect of GenAI tool use on student creativity in art and design education.

H5 Students' academic level moderates the effect of GenAI tool use on student creativity in art and design education.

H6 Creativity outcome type moderates the effect of GenAI tool use on student creativity, particularly across originality/innovation, divergent thinking, creative self-efficacy, and general creativity.

H7 AI tool type moderates the effect of GenAI tool use on student creativity in art and design education.

METHOD

Research Design

The study used meta-analytic research methodology, which involves the synthesis of quantitative results from independent empirical studies. It is a quantitative method of research synthesis in which results from several independent studies are combined to arrive at a single effect size estimate and examine the effects of moderator variables on study outcomes (Borenstein et al., 2009; Petitti, 2000). This study was carried out following the PRISMA 2020 reporting guidelines.

In this study, the meta-analytic design was preferred because it allows the quantitative synthesis of findings obtained from independent empirical studies. This design makes it possible to calculate an overall effect size and to examine whether this effect differs according to moderator variables (Borenstein et al., 2009; Hedges & Olkin, 1985; Petitti, 2000). Therefore, the research design was suitable for evaluating the effect of GenAI on student creativity in art and design education.

Search Strategy

A systematic literature search was conducted across Web of Science, Scopus and ERIC. Five query strings were employed to maximize retrieval:

1. "generative AI" AND ("creativity" OR "creative thinking" OR "creative output") AND ("art education" OR "design education") AND "student"
2. ("text-to-image" OR "DALL-E" OR "Midjourney" OR "Stable Diffusion" OR "ChatGPT") AND "creativity" AND ("student" OR "learner")
3. "AIGC" AND ("creative" OR "creative cognition") AND "student" AND ("art" OR "design")
4. ("generative artificial intelligence" OR "GenAI") AND ("divergent thinking" OR "originality" OR "creative self-efficacy") AND "education"
5. "AI-assisted" AND "creativity" AND ("art" OR "design") AND ("experiment" OR "quasi-experiment" OR "pre-test" OR "post-test")
The search covered publications from January 2020 to January 2026.

Inclusion and Exclusion Criteria

The inclusion criteria for studies were: (a) empirical studies based on an experimental, quasi-experimental, or correlational design; (b) studies based on a sample consisting entirely of students at the K-12 or university graduate levels; (c) studies employing at least one Gen AI tool as the independent variable/intervention; (d) studies assessing at least one outcome related to creativity; and (e) studies providing sufficient statistical information for calculating ESs (means and standard deviations, t-values, F-values, r-values, or reported Cohen's d values). Studies were excluded if they were based on non-student samples or if quantitative data on creativity were absent or non-existent. Narrative reviews and qualitative studies were also excluded. Studies on non-generative AI tools were excluded.

Study Selection

The initial search results gave us 412 studies. After removing duplicates (n = 89), we screened the rest based on their titles and abstracts, resulting in the removal of 231 studies. After conducting the full-text screening on the remaining 92 studies, we removed another 61 studies. Finally, we included 31 studies on students only for the purpose of the meta-analysis.

Cultural Context Classification

The cultural context was measured by applying Hofstede's (2001) model. Studies from Horizontal Individualistic societies (e.g., USA, Sweden, Australia, Netherlands) were assigned one code, whereas studies from Vertical Collectivist societies (e.g., China, South Korea, Turkey, Saudi Arabia, Taiwan) were assigned the alternative code. In cases where the study was conducted in multiple cultural contexts or the country of data collection was not reported, the code was Mixed/Not Reported.

Coding Procedure

A structured coding form was used to record: (a) bibliographic data; (b) sample size and academic level; (c) cultural/geographic context; (d) Gen AI tool type; (e) creativity outcome type and measurement instrument; (f) study design; and (g) effect size statistics. Two independent coders were used for all studies. Intercoder reliability was high (Cohen's $\kappa = .91$).

Statistical Procedures

Standardization of ESs was based on Cohen's d statistic (Hedges & Olkin, 1985). If there were reports of several independent measures of creativity, these were all used separately. If there were reports of combined dependent measures from the same sample, a composite ES d was calculated. The random effects model was used on account of expected methodological variability (Borenstein et al., 2009). Moderator analysis used between group homogeneity statistics Qb. Analysis software used: Comprehensive Meta-Analysis v4.

Publication Bias

Publication bias was checked by the visual inspection of the funnel plot (Figure 1), and Duval & Tweedie's trim and fill method (Table 2). The symmetrical appearance of the funnel plot and the absence of missing studies would suggest low bias.

Characteristics of Included Studies

Descriptive characteristics of the 31 included studies are presented in Table 1.

Table 1.

Characteristics of Student-Only Studies Included in the Meta-Analysis

Characteristic	Category 1	Category 2	Category 3	Total
Publication Year	2023	2024	2025–2026	
	n = 5	n = 14	n = 12	31
	16.1%	45.2%	38.7%	100%
Study Type	Journal Article	Conference Paper		
	n = 26	n = 5		31
	83.9%	16.1%		100%
Academic Level	K-12 / Secondary	Undergraduate	Graduate	
	n = 7	n = 19	n = 5	31
	22.6%	61.3%	16.1%	100%
Cultural Context	Horizontal-Individualist	Vertical-Collectivist	Mixed / Not Reported	
	n = 10	n = 17	n = 4	31
	32.3%	54.8%	12.9%	100%

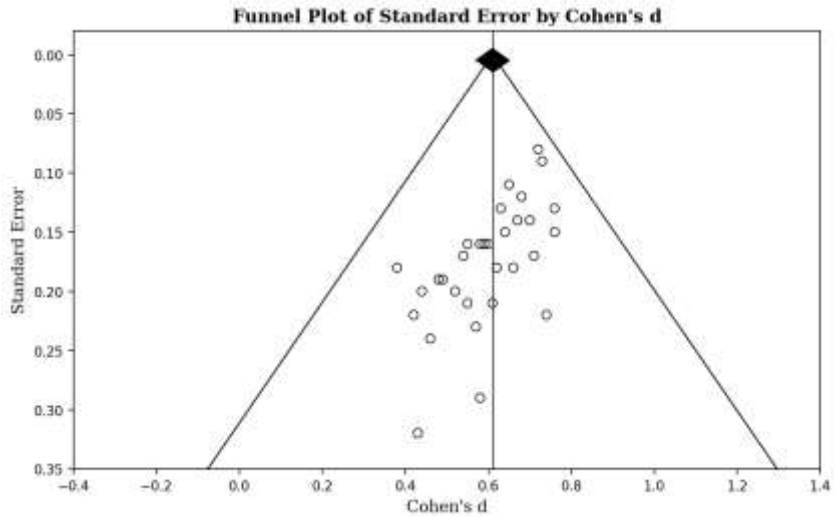
As presented in Table 1, the majority of the research was conducted in 2024 (45.2%) or in 2025-2026 (38.7%). Journal articles comprised the majority (83.9%), while conference papers accounted for 16.1%. Undergraduate students were the most represented group in terms of the academic level (61.3%), followed by K-12/secondary students (22.6%), and graduate students (16.1%). Finally, vertical collectivist cultural settings were the most common (54.8%), followed by horizontal individualist settings (32.3%), and

Publication Bias

Visual inspection of the funnel plot (Figure 1) did not show any particular asymmetry. The studies were evenly distributed around the point estimate, indicating that there was no publication bias.

Figure 1.

Funnel Plot of Standard Error by Cohen's d



Trim-and-fill results are presented in Table 2.

Table 2.

Results of Duval and Tweedie's Trim-and-Fill Test

	Studies Trimmed	Point Estimate (d)	95% CI	
			Lower Limit	Upper Limit
Observed values	—	0.61	0.49	0.73
Adjusted values	0	0.61	0.49	0.73

The trim and fill method used for imputations resulted in zero missing studies. The adjusted effect size was similar to the observed estimate (d = 0.61, 95% CI [0.49, 0.73]). There are no effects of publication bias on the results.

RESULTS

This section presents the overall effect of GenAI on student creativity and the moderator analyses conducted according to publication year, study type, cultural context, academic level, creativity outcome type, and AI tool type. The findings are reported through effect sizes, confidence intervals, heterogeneity statistics, and between-group moderator comparisons.

Meta-analytic results for the overall effect and all moderator analyses are presented in Table 3.

The random effects test was statistically significant, revealing a moderate to large overall effect (d = 0.61, 95% CI [0.49, 0.73], Q = 284.63, p < .01). This supports H1. The statistically

significant Qb reveals considerable heterogeneity; hence, moderator variables were examined. H2 was confirmed (Qb = 16.48, p < .01). Studies published in 2024 had the highest average effect (d = 0.66), followed by those published in 2025–2026 (d = 0.60) and those published in 2023 (d = 0.46). This could be because students and researchers were less acquainted with first-generation GenAI tools at the time. H3 was not confirmed (Qb = 1.89, p > .05). The effect sizes for journal articles (d = 0.61) and conference papers (d = 0.62) were statistically equivalent; hence, journal-article venue factors did not affect the results. H4 was not confirmed (Qb = 4.52, p > .05). Although the effects for Vertical Collectivist contexts (d = 0.65) were generally higher than those for Horizontal Individualist contexts (d = 0.55), the difference was nonsignificant. GenAI's creativity-enhancing effects seem to transcend cultures.

H5 was supported (Qb = 19.37, p < .05). Graduate students had the largest effect size (0.74), followed by undergrads (0.63) and K-12/secondary (0.48). Perhaps more advanced students have sufficient domain knowledge and cognitive ability to utilize GenAI as a genuine source of creativity. H6 was supported (Qb = 21.04, p < .05). Originality/novelty had the largest effect size (0.69), followed by general creativity (0.60), creative self-efficacy (0.58), and divergent thinking (0.54). GenAI extends the concept space for novel ideas most effectively. H7 was supported (Qb = 8.93, p < .01). T2I tools had the largest creativity effects on students, followed by LLMs, GAN/deep learning tools, and mixed/unspecified tools (0.66, 0.60, 0.52, 0.43). The advantage of T2I tools may be due to their capacity for providing immediate high-quality visual feedback, which is so important for art/design.

DISCUSSION AND CONCLUSION

The current study examines the effect of GenAI on student creativity in visual arts and design education within a meta-analytic framework. The aim was to synthesize experimental and correlational systematic findings from the literature and reach generalizable conclusions. Six moderator variables were examined: publication year, study type, cultural context, academic level, type of creative output, and type of AI tool. The findings indicate that GenAI use generally has a positive and significant effect on student creativity. However, this effect shows significant differences depending on the moderator variables.

The most fundamental finding of the study is that the use of GenAIhas a statistically significant, moderate to large, effect on student creativity in visual arts and design education. This finding aligns with theoretical expectations that AI can support student creativity and provides empirical support for these expectations. The fact that the overall effect size varies between moderate and large indicates that GenAI tools have the capacity to truly transform creative processes, going beyond being merely a technical support tool. This finding is also consistent with the results of studies conducted by Eapen et al. (2023) and Haase et al. (2023), which show that AI can function as a partner that facilitates and enriches creative processes. Holzner et al. (2025a) also acknowledges a positive overall trend in their research. Peng et al. (2025) also support the finding that AI-assisted instructional interventions generally have

positive outcomes on creative thinking with their meta-analytic findings. The findings of the present study can be considered a consistent extension of the studies in question.

Findings from the moderator analysis regarding the publication year show that effect sizes differ over time and that this difference is statistically significant. Studies from 2023 show the lowest effect size, while studies from 2024 exhibit the highest average effect. Studies from 2025–2026 fall between these two values. This indicates that the integration of GenAI tools into educational environments follows a trajectory parallel to the maturation curve. The limited familiarity of students and researchers with these technologies in 2023 may partially explain the effect sizes of that period. In contrast, the significant increase observed in 2024 can be interpreted as an indication that the tools are becoming more widely and consciously used and that curriculum integration is deepening. Liu et al. (2025) also state that the effectiveness of AI applications increases over time. The slight decline observed during the 2025–2026 period is thought to stem from the homogenization of usage patterns as the tools become more widespread, or from studies shifting to more methodologically challenging contexts.

Moderator analysis of study type reveals that the difference in effect sizes between journal articles and conference papers is statistically insignificant. Therefore, hypothesis H3 could not be confirmed. Both publication types exhibited very similar effect sizes, suggesting that the positive effect of GenAI tools on creativity is consistently observed across different publication platforms. This finding indicates that study type is not a decisive moderator in terms of methodological rigor and conclusive validity. Ma and Zhong (2025) also state that the effect of GenAI studies on learning outcomes remains stable across different publication channels.

Moderator analysis of cultural context reveals that the difference in effect sizes observed between vertical collectivist and horizontal individualist cultures is not statistically significant. While it is noteworthy that the effect sizes obtained in vertical collectivist contexts are numerically higher than those in horizontal individualist contexts, this difference does not reach a statistically significant level. This finding indicates that the creativity-enhancing effect of GenAI tools has a generality that transcends cultural boundaries. This situation partially coincides with the comparative study by Verdenhofa et al. (2024) covering Latvia, Ukraine, and Spain. While Hofstede (2001) acknowledges that cultural dimensions influence individual behavior, the findings of this study suggest that cultural influences may be more limited in technology-mediated creativity processes.

The findings from the moderator analysis at the academic level support hypothesis H5. Graduate students achieve the highest effect size, while this value decreases progressively at the undergraduate and K-12/secondary school levels. This finding is consistent with the hypothesis that domain knowledge and cognitive competence play a decisive role in the effective use of AI as a creative tool. The discipline-specific knowledge possessed by graduate students may enhance their capacity to interpret, transform, and integrate the outputs produced by GenAI tools into original works within creative contexts. Liu et al. (2025) also

suggest that AI exhibits stronger effects in higher-level cognitive processes, thus providing more significant benefits to advanced students who utilize these processes better.

Moderator analysis regarding the type of creativity output supports H6 and reveals that different dimensions of creativity do not benefit equally from GenAI. The originality/novelty dimension achieves the highest effect size, while divergent thinking exhibits the lowest value. This pattern shows that GenAI tools primarily support the generation of original ideas by expanding the conceptual space, but are more limited in more process-oriented and self-assessment dimensions (Eapen et al., 2023). Zhu and Zou (2023) stated that while AI increases creative diversity, it can negatively affect the perception of originality, indicating that the effect of AI on creativity may differ depending on the dimension. The relatively low effects observed in dimensions such as creative self-efficacy and divergent thinking suggest that these outputs can be developed not only with a tool but also through more comprehensive pedagogical processes. Therefore, it is crucial that creativity interventions are designed targeting specific output types.

Moderator analysis of AI tool type supports H7. Text-to-image (T2I) tools achieve the highest impact size, which can be explained by the instant visual feedback mechanism they offer in the context of visual arts and design. This mechanism allows students to receive immediate iterative feedback in the creative process and strengthens experiential learning (Fang, 2026). LLM-based tools rank second, while GAN/deep learning-based tools show relatively lower impact sizes. The lower impact of GAN-based tools is thought to stem from the technical complexity of these systems and the difficulty of integrating them into the creative process in an artistic context (Ge & Hou, 2025). Fang (2026) emphasized the capacity of T2I tools to enrich visual creativity environments and stated that tool selection should be an integral part of the pedagogical decision-making process. Ge and Hou (2025) compared the effects of different GenAI model types on design creativity and found that tools offering visual feedback had stronger effects.

The findings of this study make significant contributions to the literature on visual arts and design education, both theoretically and practically. On a theoretical level, it strengthens the framework suggesting that GenAI, rather than replacing human creativity, functions as a complement and expander, supported by empirical evidence. This approach is also theoretically advocated by Arielli and Manovich (2022) and Ma and Yu (2025). The differentiated impact profile observed among the dimensions of creativity reveals that AI does not support all creative processes equally, thus offering an empirical contribution to theoretical discussions on the multi-component nature of creativity. From an applied perspective, this research provides art educators and curriculum designers with concrete and evidence-based guidance. The demonstration that academic level is a decisive moderator suggests that GenAI integration should be structured within a gradual and level-sensitive pedagogical framework. The documentation of the effectiveness of T2I tools provides visual arts educators with an evidence-based foundation for prioritizing tool selection. The fact that the originality/innovation

dimension exhibits the strongest impact suggests that AI can be strategically used in the ideation phases. However, it needs to be complemented by traditional pedagogical methods for critical evaluation and self-efficacy development. Nevertheless, the absence of cultural context as a significant moderator indicates that the GenAI integration models to be developed have the potential for global applicability.

One of the main limitations of this study is that the studies included in the meta-analysis show a significant 2024-weighted distribution regarding publication year, with a relatively small number of studies from 2023. This imbalance leads to a loss of power in inter-period comparisons, making it difficult to interpret effect sizes. In addition, the high heterogeneity observed among the studies limits the estimation of the true effect size and partially reduces the explanatory power of moderator analyses. The fact that the vast majority of the included studies come from specific cultural contexts, particularly vertical collectivist societies, restricts the generalizability of the findings to all education systems. Furthermore, the presence of studies based on self-report measurement tools for student creativity constitutes a methodological limitation requiring caution in interpreting the results. It is crucial that future research adopts longitudinal designs with long-term follow-up processes. The knowledge gap regarding the lasting impact of GenAI on creativity persists. Studies that examine different cultural contexts comparatively have the potential to produce stronger conclusions about cultural moderation, and in this context, the inclusion of mixed-culture samples is particularly recommended. Widespread use of standardized tools in creativity measurement will increase the comparability of future synthesis studies.

Further educational practices should use GenAI as a guided creative support tool rather than as a replacement for students' own artistic decision-making. In art and design education, activities can be structured to support originality, visual exploration, and creative self-efficacy through teacher guidance and process-based assessment. In this way, GenAI integration may contribute more effectively to student creativity when it is connected with pedagogical aims and discipline-specific creative processes (Bian et al., 2025; Fang, 2026; Jingying, 2025; Vuk & Bosnar, 2021).

CONCLUSION

This study is a comprehensive synthesis that addresses the impact of GenAI on student creativity in visual arts and design education through a meta-analytic approach, filling a significant gap in the literature. By systematically combining findings obtained in different contexts and with conflicting variables, it provides an overall effect size estimate and reveals how this estimate differs according to six moderator variables. The research shows that GenAI tools significantly support creativity in visual arts education, and this effect is particularly stronger at advanced academic levels, in originality/innovation outputs, and with T2I tool types. The absence of significant moderators for cultural context and study type is an indication of the cross-cultural stability of the findings and their consistency independent of the research design. This study is expected to provide an evidence-based reference point for arts education researchers,

teachers, and policymakers. The findings have the capacity to guide future primary and synthetic research examining the impact of AI on creativity.

REFERENCES

Alter, F. (2010). Using the visual arts to harness creativity. *The University of Melbourne Refereed E-Journal*, *1*(5), 1–14.

Alter, F. (2011). Exploring visual arts pedagogies that support critical and creative thinking. *Australian Art Education*, *34*(1), 10–29. https://search.informit.org/doi/10.3316/informit.771288507220156

Arielli, E.,& Manovich, L. (2022). *AI-aesthetics and the anthropocentric myth of creativity*. https://philarchive.org/rec/ARIAAT-6

Bahroun, Z., Anane, C., Ahmed, V., & Zacca, A. (2023). Transforming Education: A Comprehensive Review of Generative Artificial Intelligence in Educational Settings through Bibliometric and Content Analysis. *Sustainability*, *15*(17), 12983. https://doi.org/10.3390/su151712983

Bastos, F.,& Zimmerman, E. (2017). Creativity in art education: Intersecting with design, visual culture, and social justice. *Revista GEARTE*, *4*(3), 384–401.

Baytak, A. (2024). The Content Analysis of the Lesson Plans Created by ChatGPT and Google Gemini. *Research in Social Sciences and Technology, 9*(1), 329-350. https://doi.org/10.46303/ressat.2024.19

Bian, C., Wang, X., Huang, Y., Zhou, S., & Lu, W. (2025). Effects of AI-generated images in visual art education on students' classroom engagement, self-efficacy and cognitive load. *Humanities and Social Sciences Communications*, *12*(1), 1548. https://doi.org/10.1057/s41599-025-05860-2

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). *Introduction to meta-analysis.* Wiley.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum.

De Rooij, A. (2025). Bias against artificial intelligence in visual art: A meta-analysis. *Psychology of Aesthetics, Creativity, and the Arts*. https://doi.org/10.1037/aca0000833

Duran, G.,& Alejandro, A. (2025). Generative Art and Secondary Education: Impact of Artificial Intelligence Tools on Student Creativity. *Journal Emerging Technologies in Education*, *2*(6), 420–433. https://doi.org/10.70177/jete.v2i6.1920

Duval, S., & Tweedie, R. (2000). Trim and fill: A simple funnel-plot based method of testing and adjusting for publication bias in meta-analysis. *Biometrics, 56*(2), 455–463. https://doi.org/10.1111/j.0006-341X.2000.00455.x

Eapen, T., Finkenstadt, D. J., Folk, J., & Venkataswamy, L. (2023). How Generative AI Can Augment Human Creativity. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4759930

Epstein, Z., Hertzmann, A., the Investigators of Human Creativity, Akten, M., Farid, H., Fjeld, J., Frank, M. R., Groh, M., Herman, L., Leach, N., Mahari, R., Pentland, A. "Sandy," Russakovsky, O., Schroeder, H., & Smith, A. (2023). Art and the science of generative AI. *Science*, *380*(6650), 1110–1111. https://doi.org/10.1126/science.adh4451

Fang, Z. (2026). Integrating Generative AI in Higher Art Education: A Systematic Review of Tools, Pedagogies, and Practices. *SN Computer Science*, *7*(2), 215. https://doi.org/10.1007/s42979-026-04788-x

Haase, J., Djurica, D., & Mendling, J. (2023). *The art of inspiring creativity: Exploring the unique impact of AI-generated images*. https://aisel.aisnet.org/amcis2023/sig_aiaa/sig_aiaa/10/

Hall, J.,& Schofield, D. (2025). The Value of Creativity: Human Produced Art vs. AI-Generated Art. *Art and Design Review*, *13*(01), 65–88. https://doi.org/10.4236/adr.2025.131005

Han, J.,& Piaw, C. Y. (2025). Systematic Review of the Positive and Negative Impacts of Digital Tools on Creativity in Fine Art Education: 2019-2025. *Architecture Image Studies*, *6*(3), 92–109. https://doi.org/10.62754/ais.v6i3.189

Hedges, L. V., & Olkin, I. (1985). *Statistical methods for meta-analysis.* Academic Press.

Hofstede, G. (2001). *Culture's consequences: Comparing values, behaviors, institutions and organizations across nations* (2nd ed.). Sage.

Holzner, N., Maier, S., & Feuerriegel, S. (2025a). *Generative AI and Creativity: A Systematic Literature Review and Meta-Analysis* (Version 1). arXiv. https://doi.org/10.48550/ARXIV.2505.17241

Holzner, N., Maier, S., & Feuerriegel, S. (2025b). *Generative AI and Creativity: A Systematic Literature Review and Meta-Analysis* (arXiv:2505.17241). arXiv. https://doi.org/10.48550/arXiv.2505.17241

Horton Jr, C. B., White, M. W., & Iyengar, S. S. (2023). Bias against AI art can enhance perceptions of human creativity. *Scientific Reports*, *13*(1), 19001. https://doi.org/10.1038/s41598-023-45202-3

Huzjak, M.,& Županić Benić, M. (2017). Measuring creativity in visual arts teaching methodology in elementary school. *Croatian Journal of Education: Hrvatski Časopis Za Odgoj i Obrazovanje*, *19*(3), 43–59.

Jingying, E. (2025). The Application of AI-Generated Art in Traditional Fine Arts Education and Research on Aesthetic Perception. *Journal of Sociology and Education*, *1*(7). https://www.sci-open.net/index.php/JSE/article/download/4182/5353

Kalymova, A., Lepeshev, D., Stukalenko, N., Argimbayeva, A., & Mazhitova, S. (2026). Model of Formation of Digital Competences of Future Teachers in the Conditions of Integration of E-Learning and Artificial Intelligence Technologies. *Journal Of Curriculum Studies Research, 8*(1), 364-387. https://doi.org/10.46303/jcsr.2026.19

Lee, H.-K. (2022). Rethinking creativity: Creative industries, AI and everyday creativity. *Media, Culture & Society*, *44*(3), 601–612. https://doi.org/10.1177/01634437221077009

Lintner, T., & Reeves, E. (2026). Using Scenario-based Generative AI to Prepare the Next Generation of Social Studies Educators. *Research in Social Sciences and Technology, 11*(2), 53-65. https://doi.org/10.46303/ressat.2026.9

Liu, W.,& Wang, Z. (2025). Evolution and Value of Arts Education Technology: A Comparative Analysis of Information Technology, Digital Technology, and Artificial Intelligence. *Sage Open*, *15*(4), 21582440251395477. https://doi.org/10.1177/21582440251395477

Liu, X., Guo, B., He, W., & Hu, X. (2025). Effects of Generative Artificial Intelligence on K-12 and Higher Education Students' Learning Outcomes: A Meta-Analysis. *Journal of Educational Computing Research*, *63*(5), 1249–1291. https://doi.org/10.1177/07356331251329185

Ma, N., & Yu, D. (2025). Generative AI and the Evolution of Artistic Creativity. In V. Geroimenko (Ed.), *Human-Computer Creativity* (pp. 177–201). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-86551-0_10

Ma, N., & Zhong, Z. (2025). A Meta-Analysis of the Impact of Generative Artificial Intelligence on Learning Outcomes. *Journal of Computer Assisted Learning*, *41*(5), e70117. https://doi.org/10.1111/jcal.70117

Mei, P., Brewis, D. N., Nwaiwu, F., Sumanathilaka, D., Alva-Manchego, F., & Demaree-Cotton, J. (2025). If ChatGPT can do it, where is my creativity? Generative AI boosts performance but diminishes experience in creative writing. *Computers in Human Behavior: Artificial Humans*, *4*, 100140. https://doi.org/10.1016/j.chbah.2025.100140

Nie, X., Tian, Y., Liu, M., Wu, D., & Guo, Y. (2025). The impact of generative artificial intelligence on students' higher order thinking: Evidence from a three-level meta-analysis. *Education and Information Technologies*, *30*(17), 25359–25390. https://doi.org/10.1007/s10639-025-13735-x

Oksanen, A., Cvetkovic, A., Akin, N., Latikka, R., Bergdahl, J., Chen, Y., & Savela, N. (2023). Artificial intelligence in fine arts: A systematic review of empirical research. *Computers in Human Behavior: Artificial Humans*, *1*(2), 100004. https://doi.org/10.1016/j.chbah.2023.100004

Orwig, W., Bellaiche, L., Spooner, S., Vo, A., Baig, Z., Ragnhildstveit, A., Schacter, D. L., Barr, N., & Seli, P. (2026). Using AI to Generate Visual Art: Do Individual Differences in Creativity Predict AI-Assisted Art Quality? *Creativity Research Journal*, *38*(1), 242–253. https://doi.org/10.1080/10400419.2024.2440691

Peng, Y., Wang, X., Chen, J., Wang, Y., Dong, Z., Wang, Y., Lyu, S., & Wang, W. (2025). The impact of AI-supported instructional interventions on students' creative thinking: A meta-analysis of 56 experimental studies. *Journal of Research on Technology in Education*, 1–25. https://doi.org/10.1080/15391523.2025.2557392

Petitti, D. B. (2000). *Meta-analysis, decision analysis, and cost-effectiveness analysis* (2nd ed.). Oxford University Press.

Robila, M., & Robila, S. (2026). Using Artificial Intelligence Methodologies in Examining Parenting Behaviors and Services. *Research in Social Sciences and Technology, 11*(1), 82-108. https://doi.org/10.46303/ressat.2026.5

Ronksley-Pavia, M. (2014). Enhancing creativity for gifted and talented students: A visual arts classroom perspective. *TalentEd*, *28*(1/2), 32–44.

Sultan, Y., Bazarbek, B., Bekbenbetova, K., & Dautova, G. (2026). The Effects of Artificial Intelligence Applications in Dramatic and Improvisational Poetic Performance. *Journal of Culture and Values in Education, 9*(2), 441-463. https://doi.org/10.46303/jcve.2026.36

Sun, L., & Zhou, L. (2024). Does Generative Artificial Intelligence Improve the Academic Achievement of College Students? A Meta-Analysis. *Journal of Educational Computing Research*, *62*(7), 1676–1713. https://doi.org/10.1177/07356331241277937

Sun, S., Li, Z. A., Foo, M.-D., Zhou, J., & Lu, J. G. (2025). How and for whom using generative AI affects creativity: A field experiment. *Journal of Applied Psychology*, *110*(12), 1561–1573. https://doi.org/10.1037/apl0001296

Tang, X., Wang, X., Dong, L., & Zhang, J. C. (2025). *Transforming Learning or Empty Promise? A Meta-Analysis of Generative AI in Education*. https://www.researchsquare.com/article/rs-7577394/latest

Tomljenović, Z. (2015). An Interactive Approach to Learning and Teaching in Visual Arts Education. *Center for Educational Policy Studies Journal*, *5*(3), 73–93. https://doi.org/10.26529/cepsj.129

Ulger, K. (2016). The creative training in the visual arts education. *Thinking Skills and Creativity*, *19*, 73–87. https://doi.org/10.1016/j.tsc.2015.10.007

Ulger, K. (2018a). The Effect of Problem-Based Learning on the Creative Thinking and Critical Thinking Disposition of Students in Visual Arts Education. *Interdisciplinary Journal of Problem-Based Learning*, *12*(1). https://doi.org/10.7771/1541-5015.1649

Ulger, K. (2018b). The role of art education on the creative thinking skills of students in music and visual arts education: A comparison from the perspective of the music education. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, *18*(2), 1175–1195.https://doi.org/10.17240/aibuefd.2018..-396608

Ulger, K. (2020). A review of the criteria of the prediction of students' creative skills in the visual arts education. *Creativity Studies*, *13*(2), 510–531.https://doi.org/10.3846/cs.2020.11860

Ünal, E., Kaya, M., Uzun, A. M., & Erdem, C. (2026). A Second-Order Meta-Analysis on the Effects of Artificial Intelligence Applications on Student Outcomes. *Journal of Educational Computing Research*, 07356331261424767. https://doi.org/10.1177/07356331261424767

Velandia-Rodríguez, C. A., Chiappe, A., & Sagredo, A. V. (2025). From uniformity to uniqueness: Personalized learning through artificial intelligence. *Journal of Social Studies Education Research, 16*(2), 169-196. https://jsser.org/index.php/jsser/article/view/6415

Verdenhofa, O., Kinderis, R., & Berjozkina, G. (2024). AI as a creatıve partner: how artıfıcıal ıntellıgence ımpacts student creatıvıty and ınnovatıon: case study of students from latvıa, ukraıne and spaın. *Baltic Journal of Economic Studies*, *10*(5), 111–119. https://doi.org/10.30525/2256-0742/2024-10-5-111-119

Vuk, S., & Bosnar, M. (2021). Process in contemporary visual art as a paradigm shift in the visual art education: Perspective of creativity. *Creativity Studies*, *14*(1), 99–111.https://doi.org/10.3846/cs.2021.12632

Winner, E., Goldstein, T. R., & Vincent-Lancrin, S. (2014). Does arts education foster creativity? The evidence so far. *International Yearbook for Research in Arts Education*, *2*, 95–100.

Xie, Y., Shan, J., & Liu, Y. (2025). Impact of Generative Artificial Intelligence on Higher Education Students' Learning Outcomes: A Meta-Analysis. *2025 International Conference on Distance Education and Learning (ICDEL)*, 207–212. https://ieeexplore.ieee.org/abstract/document/11193562/

Yao, X., Zhong, Y., & Cao, W. (2025). The analysis of generative artificial intelligence technology for innovative thinking and strategies in animation teaching. *Scientific Reports*, *15*(1), 18618. https://doi.org/10.1038/s41598-025-03805-y

Zhao, Y., Yue, Y., Sun, Z., Jiang, Q., & Li, G. (2025). Does Generative Artificial Intelligence Improve Students' Higher-Order Thinking? A Meta-Analysis Based on 29 Experiments and Quasi-Experiments. *Journal of Intelligence*, *13*(12), 160. https://doi.org/10.3390/jintelligence13120160

Zhu, F.,& Zou, W. (2023). The role of generative AI in human creative processes: Experimental evidence. *Available at SSRN 4676053*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4676053

Zhu, Y., Liu, Q., & Zhao, L. (2025). Exploring the impact of generative artificial intelligence on students' learning outcomes: A meta-analysis. *Education and Information Technologies*, *30*(11), 16211–16239. https://doi.org/10.1007/s10639-025-13420-z

Zimmerman, E. (2013). Presences and absences: A critical analysis of recent research about creativity in visual arts education. *Handbook of Research on Creativity*, 48–66.

** Included in the meta-analysis.*

***** Agboola, O. P., & Yassin, Y. N. H. M. (2025). AI applications in education: Enhancing human creativity through collaborative design. In *Smart Education and Sustainable Learning Environments in Smart Cities* (pp. 45–69).

* Almogren, A. S. (2025). Developing a new model of using artificial intelligence and postmodern arts in visual arts and design courses (VADC) among university students. *IEEE Access, 13*, 182776–182795. https://doi.org/10.1109/ACCESS.2025.3594262

* Ansone, A., Zālīte-Supe, Z., & Daniela, L. (2025). Generative artificial intelligence as a catalyst for change in higher education art study programs. *Computers, 14*(4), 154. https://doi.org/10.3390/computers14040154

* Bian, C., Wang, X., Huang, Y., Zhou, S., & Lu, W. (2025). Effects of AI-generated images in visual art education on students' classroom engagement, self-efficacy and cognitive load. *Humanities and Social Sciences Communications, 12*(1), 1–14. https://doi.org/10.1057/s41599-025-05860-2

* Chen, Y., Li, C., & Wu, H. (2026). An Empirical Study on Enhancing Artistic Creativity of College Fine Arts Students Through Generative AI-Based Creative Thinking Training. In J. Wei, G. Margetis, H. Degen, & S. Ntoa (Eds), *HCI International 2025 – Late Breaking Papers* (Vol. 16346, pp. 33–43). Springer Nature Switzerland. https://doi.org/10.1007/978-3-032-13187-4_3

* Chiu, M.-C., & Hwang, G.-J. (2025). Enhancing student creative and critical thinking in generative AI-empowered creation: A mind-mapping approach. *Interactive Learning Environments*, 1–22. https://doi.org/10.1080/10494820.2025.2511244

* Saritepeci, M., Yildiz Durak, H. (2024). Effectiveness of artificial intelligence integration in design-based learning on design thinking mindset, creative and reflective thinking skills: An experimental study. *Education and Information Technologies, 29*(18), 25175–25209. https://doi.org/10.1007/s10639-024-12829-2

* Fang, F., & Jiang, X. (2024). The analysis of artificial intelligence digital technology in art education under the internet of things. *IEEE Access, 12*, 22928–22937. https://doi.org/10.1109/ACCESS.2024.3363655

* Ge, W. C., & Hou, G. H. (2025). The effects of generative AI model type and visual stimuli type on design creativity. *AI EDAM – Artificial Intelligence for Engineering Design, Analysis and Manufacturing, 39*. https://doi.org/10.1017/S0890060425100061

* Grájeda, A., Córdova, P., Córdova, J. P., Laguna-Tapia, A., Burgos, J., Rodríguez, L., Arandia, M., & Sanjinés, A. (2024). Embracing artificial intelligence in the arts classroom: Understanding student perceptions and emotional reactions to AI tools. *Cogent Education, 11*(1). https://doi.org/10.1080/2331186X.2024.2378271

*Habib, S., Vogel, T., Anli, X., & Thorne, E. (2024). How does generative artificial intelligence impact student creativity? *Journal of Creativity, 34*(1), 100072. https://doi.org/10.1016/j.yjoc.2023.100072

* Hiçyilmaz, Y. (2025). An innovative approach in arts education: Student experiences of abstract art practices supported by generative artificial intelligence. *SAGE Open, 15*(3). https://doi.org/10.1177/21582440251382812

* Hsiao, M. Y., & Zhang, S. (2023). Research on the educational application of generative artificial intelligence images in the design of semiotics learning models. In *Proceedings of 2023 6th International Conference on Educational Technology Management (ICETM 2023)* (pp. 8–15). https://doi.org/10.1145/3637907.3637947

* Hutson, J., & Cotroneo, P. (2023a). Generative AI tools in art education: Exploring prompt engineering and iterative processes for enhanced creativity. *Metaverse, 4*(1), 1–14.

* Hutson, J., & Cotroneo, P. (2023b). Praxis and augmented creativity: A case study in the use of generative artificial intelligence (AI) art in the digital art classroom. *The International Journal of Technologies in Learning, 31*(1), 113.

* Hwang, Y., & Wu, Y. (2025). The influence of generative artificial intelligence on creative cognition of design students: A chain mediation model of self-efficacy and anxiety. *Frontiers in Psychology, 15*, 1455015. https://doi.org/10.3389/fpsyg.2024.1455015

* Kicklighter, C., Seo, J. H., Andreassen, M., & Bujnoch, E. (2024). Empowering creativity with generative AI in digital art education. In *Proceedings – SIGGRAPH 2024 Educator's Forum*. https://doi.org/10.1145/3641235.3664438

* Kim, S. J. (2024). Generative artificial intelligence in collaborative ideation: Educational insight from fashion students. *IEEE Access, 12*, 49261–49274. https://doi.org/10.1109/ACCESS.2024.3382194

* Kuan, C. H., & Hwang, G. J. (2025). Developing an integrated mind mapping and GenAI-empowered digital storytelling approach: A quasi-experimental study. *Educational Technology & Society, 28*(1), 44–58.

* Lee, C.-W. (2025). Application of Generative Artificial Intelligence in Design Education: An Exploration and Analysis to Enhance Student Creativity. Engineering Proceedings, 98(1), 29. https://doi.org/10.3390/engproc2025098029

* Lin, H., Jiang, X., Deng, X., Bian, Z., Fang, C., & Zhu, Y. (2024). Comparing AIGC and traditional idea generation methods: Evaluating their impact on creativity in the product design ideation phase. *Thinking Skills and Creativity*, *54*, 101649. https://doi.org/10.1016/j.tsc.2024.101649

* Liu, Y., Xu, B. Y., Feng, J. R., & Wu, P. J. (2025). Analysis of the application of generative artificial intelligence in interior design education. *Ain Shams Engineering Journal, 16*(12). https://doi.org/10.1016/j.asej.2025.103757

* Marrone, R., Taddeo, V., & Hill, G. (2022). Creativity and artificial intelligence—A student perspective. *Journal of Intelligence, 10*(3). https://doi.org/10.3390/jintelligence10030065

* Medel-Vera, C., Britton, S., & Gates, W. F. (2025). An exploration of the role of generative AI in fostering creativity in architectural learning environments. *Computers and Education: Artificial Intelligence, 9*. https://doi.org/10.1016/j.caeai.2025.100501

* Nguyen, T. P., & Kasahara, K. (2025). Exploring Japanese pre-service teachers' experiences and reflections on text-to-image generative AI in art education. *International Journal of Education through Art, 21*(3), 461–481. https://doi.org/10.1386/eta_00212_1

* Nikitenko, V., Voronkova, V., Oleksenko, R., Andriukaitiene, R., Pyurko, V., & Khrystovoi, D. (2025). The concept of artificial intelligence's impact on art education: New horizons for creativity, social change innovation and cultural enrichment. *Interacción y Perspectiva, 15*(1). https://doi.org/10.5281/zenodo.14031656

* Orwig, W., Bellaiche, L., Spooner, S., Vo, A., Baig, Z., Ragnhildstveit, A., Schacter, D. L., Barr, N., & Seli, P. (2026). Using AI to generate visual art: Do individual differences in creativity predict AI-assisted art quality? *Creativity Research Journal, 38*. https://doi.org/10.1080/10400419.2024.2440691

* Özdemir Kibici, D. (2026). An Examination of the use of artificial intelligence and creativity among fine arts faculty students. *International Journal on Studies in Education (IJonSE), 8*(2), 465-482. https://doi.org/10.46328/ijonse.7617

* Ruiz-Rojas, L. I., Acosta-Vargas, P., De-Moreta-Llovet, J., & Gonzalez-Rodriguez, M. (2023). Empowering education with generative artificial intelligence tools: Approach with an instructional design matrix. *Sustainability, 15*(15), 11524. https://doi.org/10.3390/su151511524

* Sáez-Velasco, S., Alaguero-Rodríguez, M., Delgado-Benito, V., & Rodríguez-Cano, S. (2024). Analysing the impact of generative AI in arts education: A cross-disciplinary perspective of educators and students in higher education. *Informatics, 11*(2), 37. https://doi.org/10.3390/informatics11020037

* Wang, L., & Chen, Z. (2025). A systematic review of AI-based painting technology on children's creative thinking. *Early Childhood Education Journal, 53*(2), 211–225.

* Zhang, Y., & Wang, L. (2025). A co-creative GAN system for digital art education: Evaluation of creative output and student engagement. *Computers & Education: Artificial Intelligence, 8*, 100267.

* Zhou, E., & Lee, D. (2024). Generative artificial intelligence, human creativity, and art. *PNAS Nexus, 3*(3). https://doi.org/10.1093/pnasnexus/pgae052

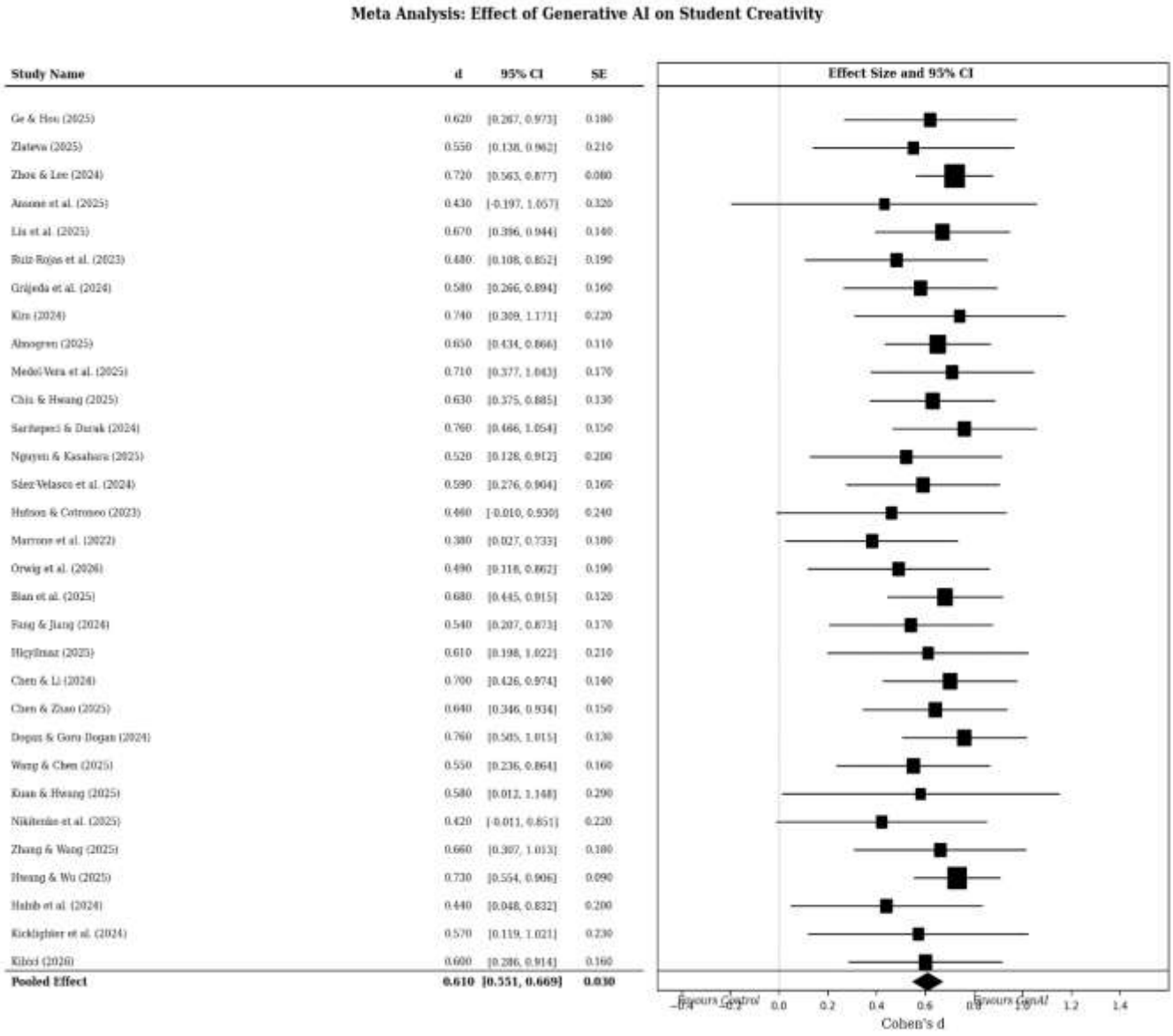
* Zlateva, A. (2025). Artificial intelligence in art education: Transforming visual arts training. *International Journal of Cognitive Research in Science, Engineering and Education, 13*(2), 481–489. https://doi.org/10.23947/2334-8496-2025-13-2-481-489

References marked with an asterisk (*) were included in the meta-analysis.

APPENDIX

Table 3.

Meta-Analytic Results: Effect of Generative AI on Student Creativity and Moderator Analyses

Variable	k	d	95% CI		Q	Qb
			Lower	Upper		
Creativity Outcomes	31	.61*	.49	.73	284.63*	
Moderator [Publication Year]						16.48*
2023	5	.46*	.28	.62		
2024	14	.66*	.53	.77		
2025–2026	12	.60*	.45	.73		
Moderator [Study Type]						1.89
Journal Article	26	.61*	.48	.72		
Conference Paper	5	.62*	.41	.78		
Moderator [Cultural Context]						4.52
Horizontal-Individualist	10	.55*	.38	.69		
Vertical-Collectivist	17	.65*	.52	.76		
Mixed / Not Reported	4	.57*	.34	.74		
Moderator [Academic Level]						19.37**
K-12 / Secondary	7	.48*	.29	.64		
Undergraduate	19	.63*	.50	.74		
Graduate	5	.74*	.55	.87		
Moderator [Creativity Outcome Type]						21.04**
Divergent Thinking	9	.54*	.37	.68		
Originality / Novelty	10	.69*	.56	.80		
Creative Self-Efficacy	7	.58*	.41	.72		
General Creativity Score	5	.60*	.42	.74		
Moderator [AI Tool Type]						8.93*
Text-to-Image (T2I)	15	.66*	.53	.77		
Generative / LLM-based	10	.60*	.44	.73		
GAN / Deep Learning	4	.52*	.33	.68		
Mixed / Unspecified	2	.43	.17	.64		

k = number of effect sizes; d = Cohen's d (random-effects model); CI = 95% confidence interval; Q = total heterogeneity statistic; Qb = between-group heterogeneity statistic. *p < .01. **p < .05.