JAE: Journal of Applied Education, 2025. 3(6): 63-74.

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JAE
Journal of Applied Education
https://so16.tci-thaijo.org/index.php/JAE/index

Research Article

The Effectiveness of Design Thinking in Enhancing Grade 2 Students' Artistic Creativity

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ABSTRACT

This article aimed to investigate the efficacy of Design Thinking in enhancing the artistic creativity of 80 Grade 2 students in Xiamen, China. Using a quasi-experimental, pre-test-post-test control group design, two classrooms were randomly assigned to either a traditional, teacher-centered instructional model or a student-centered model based on the Design Thinking framework. Artistic creativity was quantitatively assessed using a scoring rubric. Paired-samples t-tests confirmed that both methods yielded significant pre-to-post-test improvements. However, an independent-samples t-test on post-test scores revealed that the Design Thinking group (M = 17.73, S.D. = 0.82) scored statistically significantly higher than the traditional group (M = 17.28, S.D. = 1.11), t(71.66) = -2.067, p = .042. The findings demonstrate that although structured practice is beneficial, Design Thinking exhibits greater effectiveness in cultivating higher-order creative competencies, particularly fluency and flexibility, due to its iterative and problem-solving-oriented learning process. This study provides empirical evidence for the integration of Design Thinking into primary art education to better foster the innovative skills required for 21st-century learners.

Keywords: Design Thinking, Creativity, Comparative Study, Visual Arts, Primary Education

Introduction

In recent years, the field of education has increasingly emphasized the cultivation of students' creative thinking, particularly in the domain of arts education. Creative thinking is regarded as a core competency essential for problem-solving, self-expression, and the development of innovative abilities (Pasarin-Lavin et al., 2021). At the elementary education stage, fostering students' artistic creative thinking is crucial, as it not only influences their future cognitive development but also plays a significant role in their emotional expression and personal growth. However, traditional approaches to arts education often focus on imitation and skill acquisition rather than encouraging independent thinking and innovative expression (Setyosari et al., 2023). As a result, many students lack the ability to actively explore and create, resulting in a lack of diversity in artistic expression and constraining their potential for innovation.

In recent years, Design Thinking (DT) has increasingly been integrated into educational practice as an innovative pedagogical approach (Brown, 2008) Originally applied in product design and business innovation, Design Thinking has gained recognition in classrooms given its focus on human-centered

Received: 23 October 2025;
Revised: 25 December 2025;
Accepted: 29 December 2025

ISSN: 2985-2307 (Online)

problem-solving and iterative refinement (Calavia et al., 2021). In arts education, Design Thinking-based curricula encourage students to explore proactively, experiment with new ideas, and continuously refine their work. This approach shifts away from traditional teacher-directed instruction, promoting student autonomy and enhancing their independent creative capacities (Li & Zhan, 2022). Through divergent thinking, rapid prototyping, and reflective improvement, students are afforded greater freedom to explore various forms of artistic expression, ultimately fostering their artistic creative thinking (Guilford, 1967)

Despite the vast potential of Design Thinking in arts education, research on its application among lower elementary school students, particularly second-grade students, remains limited (Calavia et al., 2021). Traditional arts curricula often employ fixed themes and standardized works, offering limited opportunities for students to explore and experiment with new creative ideas (Onen, 2025). Additionally, many teachers have not received systematic training in Design Thinking pedagogy, posing challenges for implementation and further hindering its broader integration into elementary arts classrooms (Pasarin-Lavin et al., 2022). Furthermore, Henriksen et al. (2017) emphasize that Design Thinking offers a powerful framework for addressing 'problems of practice'—the complex and often ambiguous challenges inherent in educational settings that require creative and non-linear solutions.

Another critical issue is how to systematically and scientifically evaluate the development of creative thinking among lower elementary school students. Unlike academically oriented subjects, creative thinking is a multidimensional construct encompassing originality, fluency, flexibility, and elaboration (Brown, 2008). Therefore, a key challenge in current arts education research is developing systematic and scientifically grounded evaluation methods for assessing the impact of Design Thinking-based arts curricula on students' creative thinking. Additionally, variables including students' interest in the curriculum, their level of engagement, and teachers' perceptions of its effectiveness and sustainability directly influence its long-term educational value (Hsia et al., 2021).

Accordingly, the present study is critically necessary to bridge both theoretical and practical gaps by formulating and implementing a Design Thinking-based learning management model aimed at systematically and sustainably enhancing the artistic creativity of lower primary students.

Research Objectives

1. To compare the artistic creativity of Primary 2 (Grade 2) students before and after undergoing learning management through the traditional method.

2. To compare the artistic creativity of Primary 2 (Grade 2) students before and after undergoing learning management through Design Thinking.

3. To compare the artistic creativity of Primary 2 (Grade 2) students who received instruction through the traditional method with those who were taught using a Design Thinking approach.

Research Methodology

The study employed a quasi-experimental, adopting the Pretest-Posttest Control Group design. The research methodology is as follows:

1. Participants and Sampling

The study's population consisted of 400 Grade 2 students across seven classrooms at Huli No. 2 Experimental Primary School in Xiamen, Fujian Province, China, during the 2024–2025 academic year. This school was selected due to its established and progressive arts education program, which provided a suitable context for investigating creative pedagogies.

A sample of 80 students was selected using cluster random sampling, where two intact classrooms were randomly chosen. This method was employed for logistical feasibility and to minimize disruption to the school schedule. The two classrooms were then randomly assigned to either the control group (n = 40), which received traditional instruction, or the experimental group (n = 40), which was taught using the Design Thinking model. This sampling and assignment strategy aimed to ensure baseline equivalency between the groups, thus supporting the study's internal validity.

2. Research Instruments

The instruments employed in this study were systematically categorized to serve both the experimental implementation and the data collection processes. These instruments encompassed learning management plans, assessment tools, and qualitative research instruments, as detailed below:

2.1 Instructional Plan: Two distinct 12-hour instructional plans were developed for the control and experimental groups, each organized into four lessons.

- Traditional Instructional Plan: This plan followed a conventional, teacher-centered approach focused on skill acquisition and model replication. The curriculum consisted of four lessons: (1) Artistic Foundations and Appreciation, (2) Skills Acquisition and Imitation Practice, (3) Creative Practice and Expression, and (4) Reflection and Evaluation.
- Design Thinking Instructional Plan: This plan employed a student-centered framework guided by the five stages of Design Thinking. The curriculum also consisted of four lessons: (1) Fundamentals of Artistic Creation and Design Thinking, (2) Applying Design Thinking: From Ideas to Initial Sketches, (3) Improving Creative Works: Feedback and Techniques, and (4) Presentation, Reflection, and Finalization. The instructional plans were developed through a systematic design process to ensure instructional quality, alignment with research objectives, and consistency in instructional duration and content coverage. Both lesson plans were designed for a total of 12 instructional hours and organized into four lessons, ensuring comparability between the two instructional approaches.

2.2 Artistic Creativity Assessment Tool

To measure students' artistic creativity, a quantitative assessment tool was developed in the form of a scoring rubric. The rubric was designed to evaluate students' final artwork based on four established dimensions of creativity: Fluency, Flexibility, Originality, and Elaboration. Each dimension was rated on a 5-point scale (from 1 = Needs Improvement to 5 = Excellent), yielding a maximum possible score of 20. The detailed criteria for each score level are specified in the Instrument Development section.

The research instruments were developed through a systematic validation process, including expert review and pilot testing. Both the Traditional and Design Thinking instructional plans

underwent rigorous development, with feedback from five experts, resulting in a perfect Item-Objective Congruence (IOC) of 1.00. The plans were then piloted with Grade 2 students, and final revisions were made based on classroom observations. The scoring rubric for assessing artistic creativity was also developed and validated in a similar manner, achieving an IOC of 1.00 and pilot-tested with 43 students to ensure clarity and reliability.

3. Research Hypothesis

3.1 The artistic creativity of Primary 2 (Grade 2) students was higher after than before undergoing learning management through the traditional method at a significance level of .05.

3.2 The artistic creativity of Primary 2 (Grade 2) students was higher after than before undergoing learning management through the Design Thinking at a significance level of .05.

3.3 The artistic creativity of Primary 2 (Grade 2) students who learning management through Design Thinking was higher than that of those who learning management through traditional method at a significance level of .05.

4. Data Collection

The data were collected in three distinct phases. First, after securing administrative approval from the school, the artistic creativity pre-test was administered to all 80 participating students in both the control and experimental groups. Second, the 12-hour instructional interventions were implemented over the specified period, with the control group receiving the traditional plan and the experimental group receiving the Design Thinking plan. Throughout this phase, student engagement was monitored via classroom observation. Finally, upon completion of the interventions, the artistic creativity post-test was administered to both groups to collect the final outcome data.

5. Data Analysis

All quantitative data were analyzed using SPSS Statistics (Version 26) to address the three primary research questions. First, descriptive statistics (mean and standard deviation) were calculated for all pre-test and post-test scores to summarize the performance of each group. To test for statistical significance, inferential tests were conducted with an alpha level set at $p < .05$. Specifically, two paired-samples t-tests were used to compare the pre-test and post-test scores within each group (addressing Research Questions 1 and 2), while an independent-samples t-test was performed to compare the post-test scores between the control and experimental groups (addressing Research Question 3). Beyond statistical significance, the practical significance of the findings was evaluated. Normalized Gain (N-Gain) was calculated to assess the relative improvement in creativity, using the formula: N-Gain = (Post-test Mean – Pre-test Mean) / (Maximum Score – Pre-test Mean), and interpreted based on Hake's (1998) criteria (Low < 0.3; Medium 0.3 to < 0.7; High ≥ 0.7). Additionally, Cohen's d was calculated to determine the effect size of the mean differences, with its magnitude interpreted using Cohen's (1988) conventions (Small = 0.2; Medium = 0.5; Large = 0.8). A 95% confidence interval for Cohen's d will also be reported to indicate the precision of the effect size estimate.

Conceptual Framework

The literature review in this chapter discusses the use of Design Thinking and Creative Thinking in primary art education, highlighting how both concepts effectively enhance students' creativity and problem-solving skills.

Design Thinking is an iterative process that focuses on creativity and problem-solving through structured steps, including Empathize, Define, Ideate, Prototype, and Test (Li & Zhan, 2022; Brown, 2008). The use of Design Thinking in primary art education helps develop creativity and problem-solving skills, as well as interdisciplinary collaboration (Srisawat & Wannapiroon, 2022). However, there is a research gap regarding its application in primary education, particularly in art education (Su & Xu, 2020).

Creative Thinking is a key cognitive skill that involves generating multiple solutions to open-ended problems, such as Divergent Thinking, which encourages new ways of thinking and problem-solving (Guilford, 1967; Piaget, 1964). In art education, creative thinking fosters imagination and problem-solving skills. Approaches like STEAM, which integrates art with science, technology, engineering, and mathematics, support interdisciplinary problem-solving (Ramírez-Montoya et al., 2022). Digital technologies such as AI, VR, and 3D modeling are reshaping artistic expression and allowing students to engage in creative processes that transcend traditional boundaries (Richardo et al., 2023).

Based on the literature review, Design Thinking and Creative Thinking are consistently identified as effective pedagogical approaches for fostering students' creativity and problem-solving abilities. While Creative Thinking emphasizes divergent thinking and idea generation, Design Thinking provides a structured, iterative learning process that translates creative ideas into tangible outcomes. However, empirical evidence examining the effectiveness of Design Thinking in enhancing artistic creativity at the lower primary level remains limited. Therefore, this research aims to assess the impact of Design Thinking on the artistic creativity of second-grade students and to generate practical insights for optimizing primary school art education curricula.

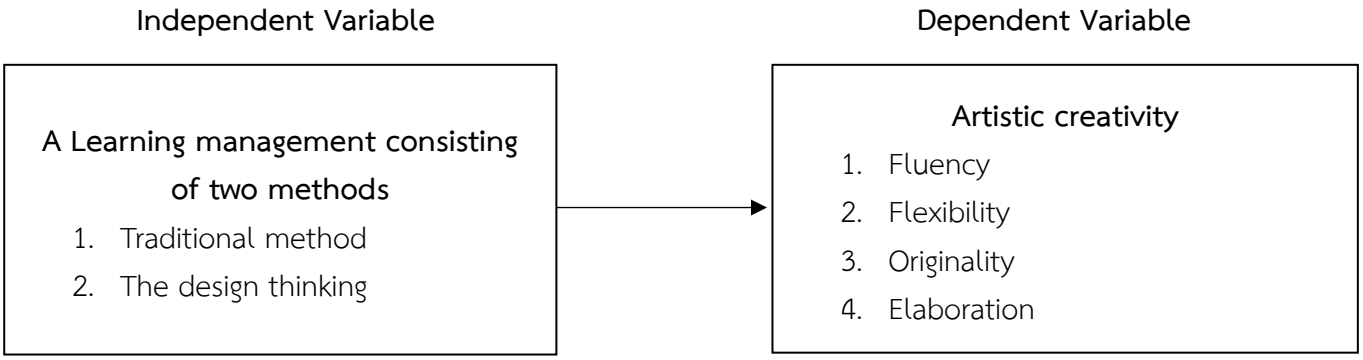

Figure 1 Conceptual of the Study

Research Results

Based on the findings, the study revealed the following results:

1. To compare the artistic creativity of Primary 2 (Grade 2) students before and after undergoing learning management through the traditional method.

The results from the paired-samples t-test indicated that the post-test artistic creativity scores of students who received instruction through the traditional method were significantly higher than their pre-test scores. Specifically, the mean post-test score (M = 17.28, S.D. = 0.82) was greater than the pre-test score (M = 15.13, S.D. = 1.34), t(39) = 14.760, p < .001.

The improvement represented a very large effect size (Cohen's d = 1.75) and a moderate normalized gain (N-Gain = 0.44). These results indicate that traditional learning management contributed to enhancing students' artistic creativity to a moderate extent, suggesting that even conventional instructional methods can positively influence creative skill development among primary school learners.

Table 1 Comparison of Pre-Test and Post-Test Artistic Creativity Scores for the Traditional Method Group

The learning management through the traditional method	Number of Units (n)	Mean ($\bar{x}$)	Standard Deviation (s)	Computed t-value (t)	Degrees of Freedom (df)	Sig. (p-value)	Cohen's d	N-Gain
Before	40	15.13	1.34	14.760*	39	< .001	1.75	0.44
After	40	17.28	0.82					

2. To compare the artistic creativity of Primary 2 (Grade 2) students before and after undergoing learning management through Design Thinking.

The paired-samples t-test results for the Design Thinking group revealed that students' post-test artistic creativity scores were significantly higher than their pre-test scores. The mean post-test score (M = 17.73, S.D. = 0.82) exceeded the pre-test mean (M = 15.60, S.D. = 1.22), t(39) = 17.744, p < .001.

This difference demonstrated an extremely large effect size (Cohen's d = 1.66) and a moderate-to-high normalized gain (N-Gain = 0.48). The findings suggest that the Design Thinking model was highly effective in enhancing creative thinking and artistic expression among students, reflecting the model's ability to promote problem-solving, empathy, and iterative creation in the learning process.

Table 2 Comparison of Pre-Test and Post-Test Artistic Creativity Scores for Design Thinking

The learning management through design thinking	Number of Units (n)	Mean ($\bar{x}$)	Standard Deviation (s)	Computed t-value (t)	Degrees of Freedom (df)	Sig. (p-value)	Cohen's d	N-Gain
Before	40	15.60	1.22	17.744*	39	< .001	1.66	0.48
After	40	17.73	0.82					

3. To compare the artistic creativity of Primary 2 (Grade 2) students between those learning management through the traditional method and those learning management through Design Thinking.

An independent-samples t-test was conducted to compare post-test artistic creativity scores between the two groups. The results revealed that students taught through Design Thinking scored slightly higher (M = 17.73, S.D. = 0.82) than those taught through the traditional method (M = 17.28, S.D. = 1.11), t(71.66) = -2.067, p = .042. While the difference is statistically significant (p < .05), the observed mean difference of 0.45 points is relatively small, indicating a modest effect.

Despite this marginal difference in raw scores, the effect size, as measured by Cohen's d, was medium (d = 0.46), suggesting a moderate practical significance of the findings. In addition, the normalized gain (N-Gain), which measures the improvement from pre-test to post-test relative to the maximum possible gain, further supports the findings. The Design Thinking group exhibited a slightly higher normalized gain (N-Gain = 0.48) compared to the traditional group (N-Gain = 0.44). This indicates that while the absolute difference in scores between the groups is small, the Design Thinking approach led to a more effective improvement in artistic creativity.

These results highlight that Design Thinking can provide more effective improvements in fostering artistic creativity than traditional methods, particularly when considering the normalized gain. The learner-centered nature of Design Thinking, which emphasizes exploration, collaboration, and reflection, appears to support better creative development over time. Therefore, while the raw score difference may seem modest, the structure and approach of Design Thinking contribute to more meaningful improvements in creativity, suggesting that such methods could be considered more effective in the long term.

Table 3 Comparison of Post-Test Artistic Creativity Scores Between Traditional and Design Thinking Groups

Learning Management	Number of Units (n)	Mean ($\bar{X}$)	Standard Deviation (s)	Computed t-value (t)	Degrees of Freedom (df)	Sig. (p-value)	Cohen's d	N-Gain
The traditional method	40	17.28	1.11	-2.067*	71.66	0.042	0.46	0.44
The design thinking model	40	17.73	0.82					0.48

Discussions

Findings and Discussion for Objective 1 The study found that students who underwent learning management through the traditional method showed a statistically significant improvement in their post-test artistic creativity scores compared to the pre-test. This result supports Hypothesis 1, which predicted that the artistic creativity of Primary 2 (Grade 2) students would increase after undergoing learning management through the traditional method. This improvement demonstrates that the teacher-directed and structured approach remains effective in fostering foundational creative skills among young learners. The success of the traditional method may stem from its organized and sequential nature, which typically includes stages such as perception and appreciation, skill acquisition, imitation, and creation. These stages provide students with systematic practice in a safe environment, fostering technical mastery and

confidence before progressing to more complex tasks. This finding aligns with the study by Yildiz & Yildiz (2021), who reported that well-structured and disciplined classroom instruction enhances students' creative development, especially in the early stages of skill formation, where learners rely on clear guidance and repetitive practice to build a strong foundation for future creative growth. Therefore, this study confirms that the traditional teaching method effectively promotes the artistic creativity of Primary 2 students.

Findings and Discussion for Objective 2 The study found that students who underwent learning management through Design Thinking showed a statistically significant improvement in their post-test artistic creativity scores compared to the pre-test. This result supports Hypothesis 2, which predicted that the artistic creativity of Primary 2 (Grade 2) students would increase after learning through Design Thinking. This improvement can be explained by the core structure of the Design Thinking process, which emphasizes divergent thinking, originality, and complex problem-solving through iterative stages: Empathize, Define, Ideate, Prototype, and Test. These stages encourage students to explore ideas freely, experiment with solutions, and learn from trial and error within real-world contexts. This process provides a student-centered, inquiry-based learning environment, allowing learners to identify problems, generate solutions, and refine ideas independently. Such a learning approach fosters deeper engagement and higher levels of creative expression. The result is consistent with the study by Seevaratnam et al. (2023), which found that Design Thinking significantly enhances systematic creativity and problem-solving skills. Additionally, the findings align with the work of Ramírez-Montoya et al. (2022), who confirmed that Design Thinking promotes the development of creativity and innovation skills across various educational levels. Therefore, this study confirms that the use of Design Thinking effectively enhances the artistic creativity of Primary 2 students.

Findings and Discussion for Objective 3 When comparing the two instructional methods, students in the Design Thinking group scored higher on post-test artistic creativity than those in the traditional method group, although the size of the difference was moderate. This result supports Hypothesis 3, which predicted that the artistic creativity of Primary 2 (Grade 2) students who underwent learning management through Design Thinking would be higher than those who underwent learning management through the traditional method. This finding shows that Design Thinking has an advantage in promoting creativity, even though the improvement is incremental rather than drastic. This may be due to the participatory and reflective nature of the Design Thinking learning process, where students take ownership of defining problems, generating solutions, and refining their ideas through iterative stages. This learning approach helps develop fluency, flexibility, and elaboration, which are key components of creative thinking, more effectively than imitation-based traditional instruction. These results align with the study by Jordanous & Keller (2016), which stated that Design Thinking enhances creativity through collaborative and self-reflective learning. They also corroborate the findings of Baldassarre et al. (2024), who noted that the Ideate and Prototype stages promote cognitive flexibility and adaptive thinking. Furthermore, the Test stage provides constructive feedback, driving continuous creative refinement. Therefore, it is confirmed that Design Thinking is more effective than traditional methods in enhancing the artistic creativity of Primary 2 students.

Originality and Body of Knowledge

This study is original in exploring the use of Design Thinking to enhance artistic creativity among second-grade students, an area with limited research. The study compares the impact of Design Thinking with traditional methods in fostering creativity, finding that Design Thinking effectively develops students' creativity and problem-solving skills by promoting active, participatory, and iterative learning. This research fills a gap in the literature on assessing creativity in primary art education and offers practical applications for integrating Design Thinking into art curricula. It provides new insights for educators and policymakers in developing creative education strategies.

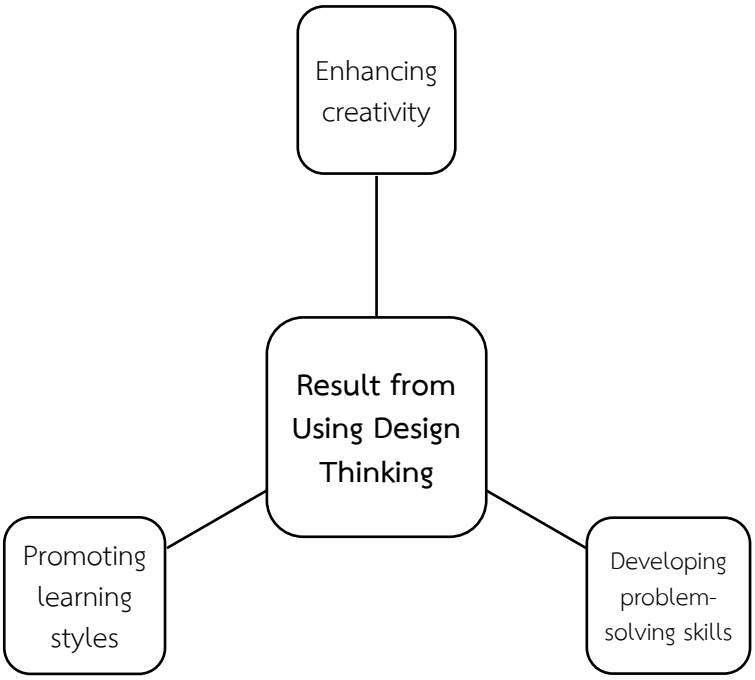

Figure 2 Originality and Body of Knowledge

Conclusions

This study aimed to evaluate the comparative efficacy of Design Thinking versus traditional pedagogy for enhancing artistic creativity in second-grade students. The findings revealed two key outcomes: first, both instructional methods resulted in statistically significant improvements in students' creativity scores from pre-test to post-test. Second, and more importantly, the Design Thinking group demonstrated a significantly higher level of artistic creativity in their post-test scores compared to the traditional method group.

The superiority of the Design Thinking model can be attributed to its core mechanics, which fundamentally differ from traditional pedagogy. While the traditional method effectively builds a foundational skillset through structured practice, the Design Thinking process actively cultivates the multifaceted dimensions of creativity: fluency, flexibility, originality, and elaboration. Its initial stages, Empathize and Define, empower students to find their own creative problems, fostering originality. Subsequently, the Ideate phase encourages divergent thinking to build fluency and flexibility, while the final Prototype and Test stages promote hands-on elaboration through an iterative feedback loop. This

study, therefore, concludes that Design Thinking is not just an alternative but a more potent methodology for systematically developing higher-order creative competencies in young learners.

The findings offer significant implications for educational practice. While traditional instruction remains valuable for establishing foundational artistic skills, educators are encouraged to integrate student-centered, problem-solving frameworks like Design Thinking to elevate students beyond basic proficiency. A robust pedagogical model could involve using traditional methods to build technical skills, followed by Design Thinking projects that challenge students to apply those skills in novel, creative ways. This integrated approach could provide a balanced curriculum that fosters both technical mastery and innovative thinking.

This study also opens several crucial avenues for future research. Longitudinal studies are needed to determine the sustained effects of Design Thinking on students' creative development over time. Furthermore, and critically, this study was conducted in a well-resourced experimental school. Future research must therefore address the issue of equity and accessibility by replicating this study in more diverse socioeconomic settings, particularly in under-resourced schools that lack specialized materials or extensive teacher training. Such investigations are essential to determine whether the benefits of Design Thinking are robust enough to transcend resource limitations. Finally, future studies could employ a mixed-methods approach to provide a richer, more qualitative understanding of how the creative process unfolds for young learners within these varied contexts.

Recommendations

1. Policymaking Recommendations

1.1 Teachers should integrate the Design Thinking model into art classes by explicitly designing learning activities that guide students through the five stages of empathizing, defining, ideating, prototyping, and testing. Teachers should allocate time for idea exploration, peer discussion, and iterative revision, rather than focusing solely on the final artwork. This approach can support students in developing fluency, flexibility, and originality through hands-on creative processes.

1.2 Curriculum designers should incorporate Design Thinking principles into primary art curricula by embedding open-ended tasks, problem-based projects, and reflective activities. Learning objectives should explicitly address higher-order creative competencies, such as idea generation, adaptation, and elaboration, alongside technical skill development. Clear instructional guidelines and exemplar activities should be provided to support consistent classroom implementation.

1.3 School administrators should support the implementation of Design Thinking by providing professional development opportunities for teachers focused on student-centered and inquiry-based art instruction. Additionally, administrators should ensure access to flexible classroom materials and allocate sufficient instructional time to allow iterative creative activities, feedback, and reflection to take place effectively.

2. Recommendations for Future Research

2.1 Future research should examine the application of Design Thinking across different subject areas and grade levels to determine whether its effects on creativity and problem-solving skills are consistent beyond primary art education.

2.2 Further studies should employ mixed-methods or longitudinal designs to explore how Design Thinking influences the development of creative skills over time and to gain deeper qualitative insights into students' creative processes.

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