

Empowering Future Teachers: The Effectiveness of Project-Based Learning in Developing Creative Tendencies Among Pre-Service Early Childhood Teachers

Hong-Yan Ling^{1,2} & Jian-Hao Huang^{1,*}

¹Chinese International College, Dhurakij Pundit University, Bangkok, Thailand

²Rizhao Polytechnic, Rizhao, Shandong, China

*Correspondence: Chinese International College, Dhurakij Pundit University, Bangkok, Thailand

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Abstract

Creative tendencies are considered one of the key abilities in the field of preschool education and should be intentionally nurtured during the pre-service teacher training stage. However, traditional lecture-based teaching still dominates instructional practices, limiting opportunities for pre-service early childhood teachers to develop their creative tendencies. This study aims to explore the relationship between project-based learning (PBL) and creative tendencies, specifically examining the impact of PBL on the creative tendencies of pre-service early childhood teachers. A quasi-experimental design was employed with a total of 82 participants. The experimental group (EG) participated in a PBL-oriented Picture Book Design Course, while the control group (CG) received traditional lecture-based instruction. Analysis of pre-test and post-test data revealed that both groups showed significant improvement in creative tendencies after the intervention; however, the EG exhibited significantly greater improvement compared to the CG. Further comparisons of post-test scores showed that the EG significantly outperformed the CG in each subdimension of creative tendencies—risk-taking, curiosity, imagination, and challenge—as well as in the total score. The findings provide empirical support for PBL as an effective teaching strategy to systematically enhance the creative tendencies of pre-service early childhood teachers in Picture Book Design Courses. This study offers both theoretical grounding and practical insights for curriculum development and teaching innovation in early childhood education.

Keywords: creative tendencies, pre-service early childhood teachers, picture book design course, project-based learning (PBL)

1. Introduction

PBL is a learner-centered teaching method that emphasizes guiding learners to solve complex problems in real situations and construct meaningful knowledge through inquiry, cooperation and practice (Farrow et al., 2024). PBL originates from rich theoretical research and educational practice and has been widely used in different disciplines and educational stages (Chen et al., 2020; Saad & Zainudin, 2022). Compared with traditional lecture-based teaching, PBL can better promote learners' learning autonomy, deep learning ability and problem-solving ability (Dai et al., 2024).

For a long time, the curriculum has mainly relied on a teacher-centered knowledge transfer model, emphasizing systematic theoretical knowledge teaching (Birbili, 2013; Cheung, 2012), and paying less attention to pre-service early childhood teachers' creative tendencies in the learning process. Under this structured and highly standardized curriculum design, learners often lack the space for active exploration and practical innovation, which limits the cultivation of their creative tendencies (Liebech-Lien, 2020). Creative tendencies refer to the psychological characteristics and behavioral tendencies that individuals exhibit when facing problems or tasks, including risk-taking, curiosity, imagination and challenge (Dai et al., 2012). These traits are of critical professional development significance for pre-service early childhood teachers.

With the promotion of educational policies and the advancement of curriculum reform, creative tendencies have increasingly become one of the core objectives in preschool teacher training programs (Chien & Hui, 2010). Recent research and practice have highlighted that creative tendencies have been incorporated into the core indicators of early childhood education quality assessment and are recognized as a key dimension of teacher professional development (Ata-Akturk & Sevimli-Celik, 2020). In curriculum design, picture book production is regarded as a valuable learning activity that fosters the integration of knowledge, skills, and creative thinking due to its unique combination of artistic creation and instructional design (Amorati & Hajek, 2021). Within this context, PBL, a teaching strategy emphasizing authentic tasks, collaborative learning, and creative problem solving, is considered to potentially hold significant promise for enhancing the creative tendencies of pre-service early childhood teachers.

Although PBL has demonstrated its effectiveness in promoting creativity and learning motivation in many educational fields, there are still relatively limited empirical studies on its application in picture book production within preschool teacher training and its impact on creative tendencies. Therefore, this study aims to examine the impact of a PBL-oriented Picture Book Design Courses on pre-service early childhood teachers' creative tendencies in preschool education, hoping to fill the research gap in this field and provide empirical evidence and theoretical support for future curriculum design and instructional practice.

The purpose of this study is twofold. First, examine the effectiveness of a picture book production course based on PBL in enhancing creative tendencies among pre-service early childhood teachers. Second, investigate the differences between the experimental and control groups in both overall creative tendencies and their subdimensions following the PBL instructional intervention.

To achieve these objectives, the study is guided by the following research questions:

- (1) Can the application of PBL in a picture book production course significantly enhance the creative tendencies of pre-service early childhood teachers?
- (2) Are there significant differences between the experimental and control groups in terms of their overall creative tendencies and subdimensions following the PBL instructional intervention?

2. Literature Review

2.1 Project-based Learning

PBL is widely considered to be a task-driven teaching strategy that emphasizes a learner-centered inquiry process and applies knowledge to real-world challenges (Wijnia et al., 2024). In this teaching model, learners are no longer passive recipients of knowledge, but active participants in the process of solving complex problems, thereby cultivating their critical thinking, problem-solving skills, and intrinsic learning motivation (Chua, 2014). Compared with traditional teacher-centered, lecture-based instruction, PBL emphasizes learners' subjectivity and advocates that learner's active construction knowledge, develop comprehensive abilities, and form a deep understanding of subject content during project implementation (Hou et al., 2023).

PBL is usually carried out in a long-term project task. Learners need to complete results with demonstration value through group cooperation, cross-disciplinary resource integration, continuous exploration and periodic reflection (Kokotsaki et al., 2016). This process not only facilitates the internalization and transfer of learning content, but also strengthens the learners' sense of belonging and cohesion in the learning process (Belwal et al., 2020). During project implementation, the role of teachers also changes from traditional knowledge transmitters to learning guides and facilitators, responsible for designing learning situations close to reality, providing timely feedback, and supporting learners' continuous development in independent exploration (Pan et al., 2020).

According to Thomas (2000), effective PBL should have five key characteristics: the core of the project task, driving questions based on real problems, constructive inquiry and knowledge construction, learner autonomy in the learning process, and authenticity of learning tasks. These characteristics make PBL significantly different from the traditional teaching model dominated by teacher lectures.

Specifically, first, projects should be at the core of the curriculum structure, serving as the main axis for organizing teaching and learning activities, rather than as supplementary activities. Second, projects should be centered around challenging and authentic problems, and guide learners to explore the core concepts and principles of the subject in depth. Third, the learning process should emphasize constructive inquiry, where learners construct new knowledge by actively participating in problem solving, rather than just receptive learning. Fourth, PBL gives learners greater autonomy in the learning process, allowing them to take the lead in planning, decision-making, and executing tasks,

thereby cultivating their self-regulation and sense of responsibility. Finally, learning tasks should be highly authentic and closely related to life or professional fields to strengthen the contextual significance and application value of learning.

When the above elements can be effectively integrated and implemented, PBL not only helps to improve learners' mastery of subject knowledge, but also cultivates their collaborative communication, critical thinking, problem solving and innovation abilities, thereby supporting the full realization of learning goals (Tamim & Grant, 2013). In this process, the teacher's task is not only to set meaningful problem situations, but also to create a supportive learning environment to encourage learners to actively participate rather than passively accept instructional content (Hugerat, 2016).

It is worth noting that the implementation form of PBL is highly flexible. It can be presented as a structured project course or a relatively open inquiry task (Gallagher & Savage, 2020). But no matter what its specific form is, continuous problem-driven and in-depth exploration are always its core characteristics (Hung, 2011). In addition, in the construction of the PBL environment, teachers should attach importance to the formation of learning communities, actively encourage learners to collaborate with each other, gradually reduce dependence on teacher authority, and promote learners to regard peers as important learning resources (Papanikolaou & Boubouka, 2010). This transformation helps to enhance learners' learning confidence, build self-efficacy, and enhance their learning motivation, ultimately achieving the transformation and application of knowledge (Mahasneh & Alwan, 2018).

2.2 PBL in Preschool Teacher Training Courses

Studies have shown that PBL has a positive impact on the academic performance of learners at different educational stages and in various subject areas (Chen & Yang, 2019; Kokotsaki et al., 2016; Santhosh et al., 2023). As preschool teacher training courses gradually incorporate PBL, they have shifted from traditional knowledge transfer to a teaching model that focuses more on practical ability and the all-round development of students. However, many pre-service teachers reported that although they have a good grasp of theoretical knowledge, they have fewer opportunities for practical application (Baysura et al., 2016). Existing studies have preliminarily explored the effectiveness of PBL in such courses. For example, Brown and Jain, 2020 explored the learning experience of pre-service teachers in completing project activities with young children and evaluated the teaching performance, attitudes and knowledge changes of 55 pre-service teachers after applying PBL. The results showed that teachers' understanding, confidence and cognitive benefits of PBL were significantly improved. Schina et al. (2021) explored the current status of research in preschool teacher training and showed that PBL is considered the most effective training strategy because of its emphasis on practical operation, collaboration and innovative thinking, demonstrating its great potential in preschool teacher training. Hojeij et al. (2021) implemented PBL in a children's literature course by asking pre-service early childhood teachers to create original electronic storybooks as the final project, and the results showed that this teaching model can stimulate learners' autonomy, peer cooperation, and cultural integration awareness, while effectively improving their learning motivation.

PBL has also been shown to deepen pre-service teachers' understanding of early childhood education theory and promote the connection between theory and practice, thereby enhancing their teaching design and career adaptability (Saad & Zainudin, 2024). With the rapid evolution of information technology, PBL has become a teaching model with high application potential in pre-school teacher training courses. However, although the application value of PBL in the field of education is increasingly recognized, there is still a lack of sufficient empirical research support for its effectiveness in teaching picture book production in preschool teacher training courses.

2.3 PBL as a Potential Teaching Strategy to Enhance the Creative Tendencies of Pre-service Early Childhood Teachers

Creative tendencies are regarded as a positive thinking trait, which is manifested in the flexibility, uniqueness and novelty of individuals in facing problems, as well as the ability to find innovative solutions in complex or uncertain situations (Huang et al., 2021). For pre-service early childhood teachers, individual creative tendencies not only reflect their cognitive and affective development, but also play a vital role in their ability to design innovative instructional activities and respond effectively to the diverse developmental needs of children in future educational practice (Avsec & Sajdera, 2019; Lee & Kemple, 2014). Curiosity, adventurous spirit, imagination and adaptability to challenges are all core creative traits valued in preschool education, which help pre-service teachers demonstrate professional judgment and innovative thinking in real teaching fields (Alkuş & Olgan, 2014; Ata-Akturk & Sevimli-Celik, 2020; Cheung et al., 2019).

Although the importance of creative tendencies has been increasingly recognized, in actual teaching, how to

systematically and effectively cultivate the creative tendencies of pre-service early childhood teachers is still a challenge, especially in the absence of appropriate teaching strategies and practical support (Ayyildiz & Yilmaz, 2021). As a real-world problem-oriented teaching model, PBL has been widely proven to effectively promote learners' creative and critical thinking in other educational stages and subject areas (Meng et al., 2023; Ulger, 2018). Through task-driven, collaborative inquiry and reflection integration, PBL emphasizes the combination of knowledge construction process and real situations, and is considered to have teaching characteristics that stimulate innovation potential (Chen et al., 2022). However, systematic empirical research on the impact of PBL on the creative tendencies of pre-service early childhood teachers remains relatively limited, highlighting the urgent need for further exploration and validation.

2.4 The Potential of Applying PBL in Picture Book Design Courses within Preschool Teacher Training in China

Although PBL has been widely applied in the field of education, empirical research on its impact on the creative tendencies of pre-service early childhood teachers remains limited. PBL emphasizes interdisciplinary integration, situational tasks, and reflective learning, and is believed to foster innovative thinking and problem-solving skills—qualities that align closely with the "ability-oriented" and "practice-oriented" goals of China's preschool education curriculum reform (Chen et al., 2017; Li & Chen, 2017). In the field of early childhood education in China, picture books are not only widely used as essential media for supporting language, art, and social learning in kindergarten curricula, but also serve as a comprehensive tool for promoting children's holistic development (Qiming & Renganathan, 2024). Accordingly, picture book design courses are not merely art-based classes; rather, they represent an integrated teaching practice that combines knowledge from multiple disciplines, including children's literature, art education, pedagogy, and linguistics (Hsiao, 2010). This interdisciplinary nature makes such courses an ideal platform for the effective implementation of PBL.

In preschool teacher training programs, picture book design courses are intended to cultivate pre-service teachers' ability to integrate creative thinking and aesthetic judgment into the development of instructional resources, with an emphasis on their multidimensional application in collaborative work and instructional design (Liu et al., 2024). Such courses align with the child-centered philosophy of kindergarten curricula and reflect current educational policy priorities regarding teacher competency development. This approach stands in marked contrast to Western early childhood education programs, which tend to focus more on general design and technology courses (Cheung et al., 2019). In some Chinese universities, picture book design courses are typically regarded as either core professional courses or specialized electives, aiming to systematically enhance pre-service early childhood teachers' capacity for curriculum development and innovative pedagogy in response to the increasingly diverse developmental needs of young children (Zhang, 2022; Zhang et al., 2021; Zhang, 2023).

By incorporating a PBL approach into picture book design courses, students are given opportunities to develop their problem-solving, creative thinking, and teamwork skills through engagement in authentic, problem-driven projects (Meng et al., 2023). For example, in the actual teaching process, students are required not only to complete tasks such as story development, character design, and illustration, but also to integrate repeated feedback from peers and instructors in order to revise and refine their work continuously (Chen et al., 2022). The integration of PBL not only helps address the current gap in fostering creative tendencies within preschool teacher education, but also enhances pre-service teachers' ability to translate theoretical knowledge into practical instructional strategies, aligning with China's growing demand for high-quality early childhood educators in the new era (Blaisdell et al., 2024). In sum, the application of PBL in picture book design courses within China's preschool teacher training programs demonstrates strong feasibility and significant potential for broader implementation, offering meaningful support for the development of pre-service teachers' creative tendencies and comprehensive professional competencies.

3. Methods

3.1 Research Design

This study adopted a quasi-experimental design to explore the impact of different teaching strategies on the creative tendencies of pre-service early childhood teachers. The changes in the creative tendencies of pre-service early childhood teachers in the two groups were compared through pre-tests and post-tests, aiming to evaluate the actual effect of the teaching intervention.

The EG participated in a ten-week PBL course, which took the creation of original picture books as the core task. The students were required to complete the theme conception, content design and physical production of the picture books based on group cooperation, and the results were displayed and shared at the end of the course. The course

design emphasized problem-solving orientation, creative thinking application and teamwork process, with the aim of stimulating pre-service early childhood teachers' creative potential through the guidance of real tasks. In contrast, the CG received traditional lecture-based teaching, with teacher explanation and technique demonstration as the main teaching methods, and learned the knowledge and skills of picture book production through imitation and repeated practice. This model is teacher-centered and emphasizes the systematic knowledge transmission and skill mastery training. To enhance the rigor of the research design and minimize potential confounding variables during the instructional process, this study maintained a high level of consistency across both instructional conditions. Key elements such as the instructor, course content, instructional hours, and assessment criteria were kept identical between the two groups, thereby controlling for teacher effects and curriculum variation that could otherwise influence the results. Participants in both groups were divided into voluntary teams of three to five members and engaged in picture book creation tasks with comparable content and difficulty levels, in order to reduce the potential impact of instructional design differences on outcome interpretation. In addition, creative tendencies were measured using a standardized instrument with established reliability and validity (see Section 3.7 Measurement Tools). All pre- and post-tests were administered under identical testing conditions to minimize measurement bias and ensure the reliability of the data collected.

3.2 Participants

This quasi-experimental study was conducted in a vocational college in Shandong Province, China. Two intact classes of preschool education students enrolled in the Picture Book Design Course were selected as the research participants. The selection was based on the following inclusion criteria: (1) full-time enrollment in the course during the study period; (2) prior experience in foundational painting courses and kindergarten internships; and (3) voluntary participation with informed consent to complete the study. The two classes were assigned to the experimental and control groups respectively.

Data were collected from September 2024 to January 2025, involving a total of 82 pre-service early childhood teachers from the 2023 cohort of a vocational college in Shandong Province, China. To ensure consistency in academic background and professional knowledge, all participants were enrolled in the same early childhood education program and took a ten-week Picture Book Design Course, which was a compulsory component of their curriculum, consisting of four 45-minute sessions per week. Based on the teaching method, participants were assigned to two groups: the experimental group (EG), comprising 42 students who received PBL-oriented instruction, and the control group (CG), comprising 40 students who received traditional lecture-based teaching.

3.3 Research Hypothesis

This study aims to explore the impact of PBL on the creative tendencies of pre-service early childhood teachers in Picture Book Design Courses within early childhood education. First, it is hypothesized that there will be significant within-group differences in the PBL teaching group, with higher scores in each subdimension of creative tendencies (including curiosity, adventurous spirit, imagination, and challenge) and in the total score after the experimental intervention compared to before. Second, it is hypothesized that there will be significant between-group differences after the intervention, with the PBL teaching group scoring significantly higher in each subdimension and in the total score of creative tendencies than the traditional lecture-based teaching group.

3.4 Data Collection Procedure

The data collection for this study was divided into two phases, one before the course and one after the course, to meet the requirements of pre-test and post-test comparisons in quasi-experimental design. Before the course began, the teacher explained the purpose, research process, and participant rights of the study to the pre-service early childhood teachers, and invited them to participate in the study voluntarily. For those who agreed to participate, the teacher immediately distributed the relevant research materials and provided guidance on how to complete them.

After the ten-week course, all participants completed the creative tendencies measurement questionnaire again as post-test data to facilitate the comparison and analysis of the differences between the pre-test and post-test (see Figure 1 for the specific data collection process).

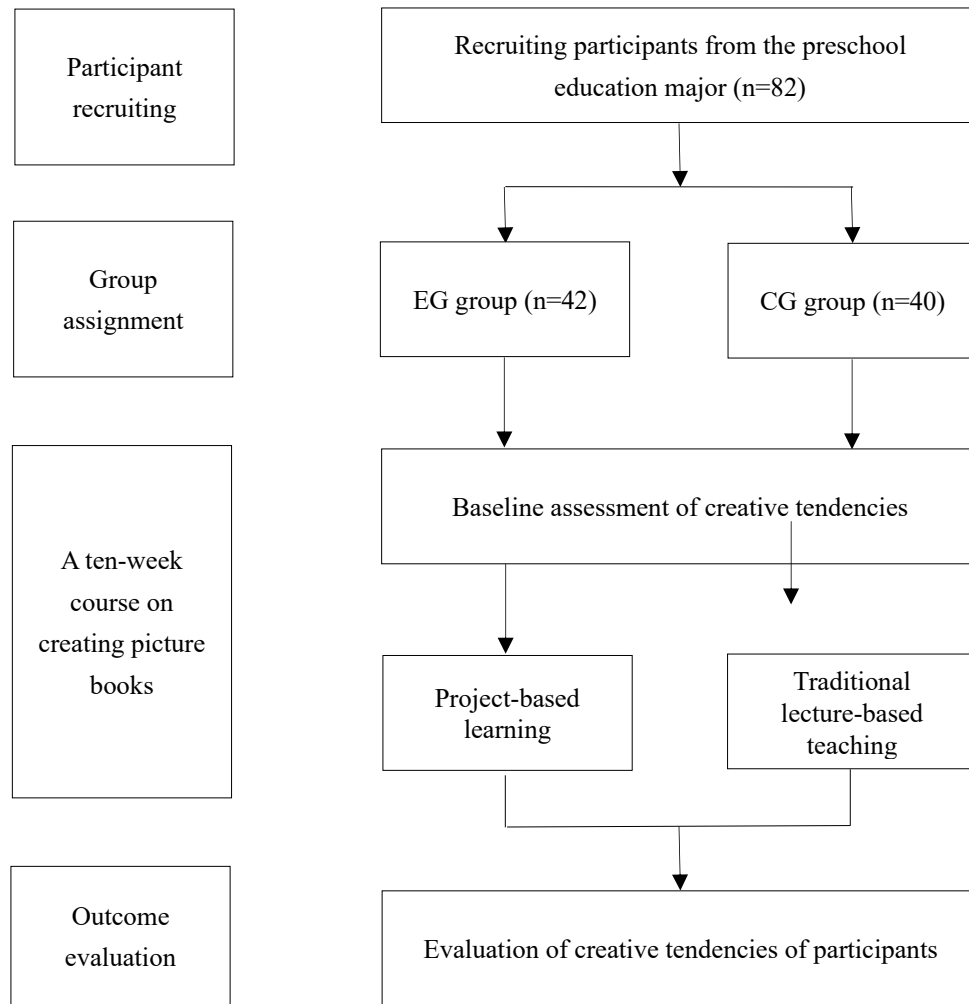


Figure 1. Participant Flow Chart; EG refers to the experimental group receiving project-based learning (PBL), and CG refers to the control group receiving traditional lecture-based teaching

3.5 Picture Book Design Course Based on PBL

To investigate the effects of different instructional approaches on the creative tendencies of pre-service early childhood teachers, this study designed and implemented a ten-week picture book design course grounded in the principles of PBL. The experimental group received instruction through the PBL approach, while the control group was taught using traditional lecture-based methods.

At the beginning of the course, the instructor provided the experimental group with a systematic introduction to the principles of PBL, the learning process, and the assessment criteria to help students understand the task-oriented learning model and the importance of teamwork. Based on their individual interests, artistic styles, and personality traits, students formed self-selected groups of three to five members, maintaining consistent group membership throughout the semester. Each group was responsible for creating a picture book centered on a self-chosen theme, which involved key tasks such as story development, illustration design, and narrative writing. To ensure fairness in participation and the quality of collaboration, group members took turns serving as team leader at different stages of the project and were responsible for documenting each member's contributions, which served as part of the final assessment criteria.

The course was structured around five clearly defined and sequential stages of PBL: (1) problem analysis, (2) planning, (3) exploration and implementation, (4) communication and sharing, and (5) feedback and evaluation (see Appendix for details). Each stage was designed with corresponding learning objectives and instructional activities, emphasizing task orientation, collaborative interaction, and creative thinking. The structure aimed to gradually guide learners from passive problem observers to active creators throughout the learning process.

Stage 1: Problem Analysis (Week 1)

This stage focuses on stimulating learners' motivation and guiding them in the initial construction of their creative problem. The instructor introduces the fundamental elements of picture book creation, such as story structure and visual style, and explains narrative strategies through the analysis of classic picture books. Within their groups, learners engage in brainstorming and information gathering to discuss potential themes, target audiences, and visual presentation approaches. They also identify possible challenges and issues that may arise during the creative process, thereby laying a solid foundation for the subsequent stages of the project.

Stage 2: Planning (Week 2)

In this stage, students develop a project proposal outlining task allocation, timeline, and required resources, along with a draft of their story, including character design, visual style, and scene planning. Through the analysis of classic picture book examples, the instructor guides students in understanding how to convey educational meaning through the integration of visual and textual elements. Learners also present their initial ideas during cross-group sharing sessions, fostering creative exchange and collaborative thinking.

Stage 3: Exploration and Practice (Weeks 3–8)

This stage serves as the core implementation phase of the PBL course, during which learners progressively carry out their picture book creation tasks according to the project plan. Instructional activities include material exploration (such as collage, hand drawing, and digital media), as well as exercises in color theory and visual perception. Based on peer and instructor feedback, students revise their drafts and refine their content. Additionally, classmates are invited to role-play as young children and participate in trial readings of the picture books. Feedback from these sessions is used to further adjust and enhance the work, improving both its developmental appropriateness and educational impact.

Stage 4: Communication and Sharing (Week 9)

This stage aims to encourage learners to present and reflect on their creative outcomes. Each group showcases its design process and conceptual rationale, detailing the journey from initial theme development to final production. During the presentations, both the instructor and peers provide constructive feedback, enabling students to evaluate their work from alternative perspectives. In addition, class-wide discussions and peer observations foster deeper creative thinking and critical reflection among learners.

Stage 5: Feedback and Evaluation (Week 10)

This final stage focuses on the consolidation of learning outcomes and the development of self-awareness regarding the creative process. Learners engage in self-assessment, peer evaluation, and receive instructor feedback to reflect on their individual contributions to the team and their creative performance throughout the course. Each group reviews the challenges encountered and successes achieved during different project stages, documents the evolution of their creative thinking, and summarizes key learning gains. Additionally, students submit individual reflection reports to consider how their course experience may inform and support future creative endeavors.

Overall, the course design emphasizes learner-centered, problem-oriented, and task-driven instructional principles. By engaging students in authentic creative contexts and structured group collaboration, the course fosters integrated development across cognitive, skill-based, and affective domains.

3.6 Measurement Tools

The pre-test and post-test stages of the teaching experiment, this study used the Creative Tendencies Scale compiled by Williams (1980) as the main measurement tool to evaluate pre-service early childhood teachers' creative tendencies before and after the course. The scale contains 50 items, divided into four subdimensions: (1) risk-taking (11 items), (2) curiosity (14 items), (3) imagination (13 items), and (4) challenge (12 items). Pre-service early childhood teachers were asked to respond based on their personal characteristics and score using a three-point Likert scale (1 = completely inconsistent, 2 = partially consistent, 3 = completely consistent). A higher total score indicates a higher level of creative tendencies (Xu et al., 2023).

The validity of this scale has been empirically established among college student populations (Liu et al., 2020). In the present study, its structural validity was further examined. The KMO measure of sampling adequacy was .815, and Bartlett's test of sphericity was significant ($\chi^2 = 2653.874$, $df = 861$, $p < .001$), indicating the suitability of the data for factor analysis. Principal component analysis revealed four extracted factors, which together accounted for 61.262% of the total variance. The rotated component matrix indicated that all items had factor loadings above .40 on their respective dimensions, with loadings ranging from .658 to .841 for the Risk-Taking dimension, .580 to .792

for Curiosity, .680 to .823 for Imagination, and .647 to .787 for Challenge. The reliability analysis further demonstrated a high level of internal consistency for the scale, with Cronbach's α coefficients ranging from .902 to .951 across the four subdimensions, and an overall Cronbach's α of .954 for the entire scale. In summary, the scale demonstrates strong construct validity and measurement consistency, making it a reliable and effective instrument for assessing creative tendencies in educational research contexts.

3.7 Ethical Considerations

This study has passed the ethical review process of the affiliated university and has been formally approved. The research team attaches great importance to the privacy protection and data security of the participants. All collected data have been anonymized, removing all personally identifiable information, and are used solely for academic research purposes. Access and analysis are limited to the research team members. Before data collection, the researchers fully explained the purpose, implementation process, and personal participation rights of this study to all pre-service early childhood teachers, and clearly informed them that participation was entirely voluntary and that they could withdraw freely at any stage of the research process without suffering any negative consequences or penalties.

3.8 Data Processing

To ensure rigorous data processing and analysis, this study employed SPSS statistical software as the primary tool, a commonly recommended software in quantitative research (Bryman & Cramer, 2012). The overall analysis strategy incorporated both descriptive statistics and inferential statistics to provide a comprehensive understanding of the data distribution and to test the research hypotheses. Descriptive statistics (e.g., means, standard deviations) were used to summarize and describe the central tendency and variability of the creative tendencies scores at both the pre-test and post-test stages (Marshall & Jonker, 2011).

Inferential statistics were employed to examine significant differences in creative tendencies scores within and between groups, thereby addressing the study's research questions regarding the effectiveness of the teaching interventions ((Marshall & Jonker, 2010). Specifically, paired sample t-tests were used to analyze whether the creative tendencies scores of each group (EG and CG) changed significantly between the pre-test and post-test phases, reflecting the potential effect of the teaching method over time. Furthermore, independent sample t-tests were conducted to determine whether significant differences existed in post-test creative tendencies scores between the two groups after the intervention, thereby comparing the relative effectiveness of the two teaching approaches.

4. Results

4.1 Characteristics of Participants

During the study, a total of 82 sophomores majoring in early childhood education participated in the Picture Book Design Course, and the questionnaire response rate reached 100%. Among them, 77 (93.90%) were female and 5 (6.10%) were male. All participants were enrolled in the same university and had similar academic backgrounds and learning experiences. In terms of gender distribution, the EG ($n = 42$) and the CG ($n = 40$) were highly comparable. The results of Fisher's Exact Test showed that there was no significant difference in gender composition between the two groups (bilateral $p = .672$; unilateral $p = .477$), ensuring that the subsequent comparisons between the groups had statistically equal initial conditions (see Table 1).

Table 1. Comparison of Gender Between the EG and the CG

Characteristics		EG group ($n = 42$)	CG group ($n = 40$)	Fisher's Exact Test	
		Frequency	Frequency	Exact significance (two-tailed)	Exact significance (one-sided)
Gender	Male	2	3	.672	.477
	Female	40	37		

Note: Fisher's Exact Test was applied because more than 50% of the cells had expected counts less than 5; EG = experimental group (PBL); CG = control group (traditional lecture-based teaching)

4.2 Comparison of Baseline Creative Tendencies Scores and Level Distribution Between the Experimental Group and the Control Group

In the pre-intervention stage, the EG and the CG performed similarly in the scores of the four subdimensions of creative tendencies (risk-taking, curiosity, imagination, and challenge) and their total scores, and the difference between the two groups did not reach a statistically significant level (see Table 2). Specifically, the mean scores of the EG in risk-taking ($M = 1.812$), curiosity ($M = 1.815$), imagination ($M = 1.758$), challenge ($M = 1.611$), and overall creative tendencies ($M = 1.754$) were comparable to those of the CG, which scored similarly in risk-taking ($M = 1.683$), curiosity ($M = 1.750$), imagination ($M = 1.702$), challenge ($M = 1.658$), and total creative tendencies ($M = 1.701$). The results of the independent sample t-test showed that the t-values for the two groups across each subdimension and the total score ranged from 1.038 to -0.420, indicating that the differences were not statistically significant and that the creative tendencies levels of the two groups of pre-service early childhood teachers had good initial comparability before the intervention. This result provides a reliable basis for the subsequent analysis of the teaching intervention effect.

Table 2. Baseline Comparison of Creative Tendencies Scores Between the Experimental and Control Groups

Creative tendencies	EG group ($n=42$) $M \pm SD$	CG group ($n = 40$) $M \pm SD$	t
Risk-taking	1.812 ± 0.595	1.683 ± 0.525	1.038
Curiosity	1.815 ± 0.548	1.750 ± 0.466	0.574
Imagination	1.758 ± 0.551	1.702 ± 0.596	0.441
Challenge	1.611 ± 0.501	1.658 ± 0.518	-0.420
Overall score	1.754 ± 0.407	1.701 ± 0.386	0.602

Note: EG = experimental group (PBL); CG = control group (traditional lecture-based teaching)

4.3 Analysis of Intra-group Changes in Creative Tendencies of the Two Groups

The data in Table 3 and Table 4 show that the creative tendencies of the EG and the CG improved to varying degrees after the teaching intervention. For the EG, after the PBL course intervention, the scores of the four sub-facets as well as the total score all showed a highly significant improvement, and the t-values of all variables reached a statistically significant level. Specifically, risk-taking ($t = 7.178$, $p < .001$), curiosity ($t = 7.084$, $p < .001$), imagination ($t = 6.048$, $p < .001$), challenge ($t = 9.500$, $p < .001$) and overall creative tendencies score ($t = 14.619$, $p < .001$) all showed significant teaching effectiveness (see Table 3), indicating that PBL teaching has a significant promoting effect in promoting multi-faceted creative development.

Pre-service early childhood teachers under the traditional teaching model also showed a certain degree of improvement. Among them, the scores of risk-taking ($t = 2.242$, $p < .050$), curiosity ($t = 2.055$, $p < .050$), imagination ($t = 2.484$, $p < .050$), challenge ($t = 2.791$, $p < .010$) and overall creative tendencies ($t = 4.900$, $p < .001$) were all statistically significant, but the average score increase and statistical effect were lower than those of the EG (see Table 4). This shows that although traditional courses can also promote the development of pre-service early childhood teachers' creative tendencies to a certain extent, their influence is relatively limited compared with PBL teaching.

Table 3. Within-group Change of Creative Tendencies in the EG

EG group ($n=42$)	$M \pm SD$	Standard error	t
Risk-taking	0.659 ± 0.595	0.918	7.178***
Curiosity	0.606 ± 0.554	0.086	7.084***
Imagination	0.560 ± 0.600	0.093	6.048***
Challenge	0.762 ± 0.520	0.080	9.500***
Overall score	0.638 ± 0.283	0.436	14.619***

Note: EG = experimental group (PBL); *** $p < .001$

Table 4. Within-group Variation in Creative Tendencies in the CG

CG group ($n = 40$)	$M \pm SD$	Standard error	t
Risk-taking	0.183 ± 0.517	0.082	2.242*
Curiosity	0.194 ± 0.596	0.094	2.055*
Imagination	0.223 ± 0.568	0.090	2.484*
Challenge	0.278 ± 0.630	0.100	2.791**
Overall score	0.219 ± 0.283	0.045	4.900***

Note: CG = control group (traditional lecture-based teaching); *** $p < .001$, ** $p < .010$, * $p < .050$

4.4 Comparison of Creative Tendencies Scores Between the EG and the CG After Intervention

This study compared the performance differences in the scores of the four Subdimension of creative tendencies (risk-taking, curiosity, imagination and challenge) and the total score of the EG and the CG after the intervention. As shown in Table 5, the EG ($M = 2.392$) After the intervention, the total score of creative tendencies was significantly higher than that of the CG ($M = 1.920$), and the difference was highly statistically significant ($t = 5.995$, $p < .001$).

Further analysis showed that the EG also scored significantly better than the CG in all subdimensions, including risk-taking ($t = 6.509$, $p < .001$), curiosity ($t = 4.113$, $p < .001$), imagination ($t = 3.177$, $p < .010$), and challenge ($t = 3.635$, $p < .001$). These results clearly show that pre-service early childhood teachers who participated in the PBL Picture Book Design Course showed significant advantages in all subdimensions of creative tendencies and their total scores.

Table 5. The Comparison of Creative Tendencies Between EG and CG Groups After the PBL-guided Picture Book Design Course Intervention

Creative tendency	EG group ($n = 42$) $M \pm SD$	CG group ($n = 40$) $M \pm SD$	t
Risk-taking	2.471 ± 0.425	1.867 ± 0.415	6.509***
Curiosity	2.421 ± 0.482	1.944 ± 0.567	4.113***
Imagination	2.317 ± 0.512	1.925 ± 0.605	3.177**
Challenge	2.373 ± 0.561	1.936 ± 0.525	3.635***
Overall score	2.392 ± 0.313	1.920 ± 0.396	5.995***

Note: EG = experimental group (PBL); CG = control group (traditional lecture-based teaching); *** $p < .001$, ** $p < .010$

5. Discussion

The results of this study show that the creative tendencies of pre-service early childhood teachers in both the EG and CG improved to varying degrees after the teaching intervention. However, in contrast, the EG that received the PBL Picture Book Design Course showed higher scores in the four subdimensions of creative tendencies (risk-taking, curiosity, imagination, and challenge) and in their total scores, and the improvement was greater than that of the CG.

The simultaneous improvement of the creative tendencies of the two groups of pre-service early childhood teachers may be influenced by several common factors. First, picture book creation itself is a creative task that combines text and images, which has a high degree of creativity and encouraging pre-service early childhood teachers to exert their creative potential in story conception, character design, and visual presentation (Liu et al., 2018). Secondly, the ten-week course design provides sufficient time and repeated practice opportunities, which is in line with the time accumulation principle required for creativity development (Sweller, 2004). In addition, the immediate feedback and situational support provided by teachers in class may also effectively inspire pre-service early childhood teachers to explore multiple expressions and creative strategies (Hattie & Timperley, 2007; Horng et al., 2005).

Furthermore, the picture book creation task itself is open and exploratory, allowing the application of different strategies to solve problems in real contexts, thereby deepening creative thinking (Rindova & Martins, 2021). Even in traditional teaching situations, learning transfer effects may also occur through observing and imitating peer behaviors, thereby enhancing creative tendencies (Pick et al., 2024; Yeh et al., 2011), which may also partially explain why the CG of pre-service early childhood teachers did not receive PBL teaching but still made progress.

Nevertheless, the data from this study clearly show that the scores for the four subdimensions and the total score of creative tendencies in the EG after the intervention were significantly higher than those in the CG, indicating that the PBL teaching model offers greater benefits in enhancing creative tendencies. This result is also highly consistent with the research findings of existing literature, which support the effectiveness of PBL in the field of education, particularly in pre-service early childhood teacher training programs (Brown & Jain, 2020; Hojeij et al., 2021; Schina et al., 2021). A possible reason is that previous studies have pointed out that the key to the effectiveness of PBL lies in its emphasis on knowledge construction-oriented and real-world situation-oriented learning design, which can guide learners to actively participate in the learning process in tasks and stimulate creativity through continuous revision and reflection (Chang et al., 2022; Chen, 2022). In addition, PBL emphasizes the process of refinement and continuous revision of results. Through repeated cycles of peer review and teacher feedback, learners can gradually optimize their works and deepen their understanding and interpretation of creative content and performance strategies (Papastergiou, 2005).

6. Research Limitations and Future Directions

The participants in this study were drawn from a vocational college in Shandong, China. Therefore, the external validity of the results may be limited by the geographical location and the specific characteristics of the participant group. When applying the findings to other educational settings or cultural contexts, their applicability should be interpreted and evaluated with caution. This study primarily used questionnaires to assess the creative tendencies of pre-service early childhood teachers. While this method effectively captures participants' subjective evaluations and psychological traits, it lacks direct observation and empirical evidence related to their actual creative behaviors during the picture book production process, as well as the dynamic development of work quality and practical performance. Future research could consider incorporating multiple qualitative methods, such as content analysis of students' work, classroom interaction observations, and in-depth interviews, to gain a more comprehensive understanding of how PBL functions in picture book production courses and its underlying impact mechanisms.

7. Impact and Suggestions

This study provides empirical evidence that a PBL-oriented Picture Book Design Course can significantly enhance the creative tendencies of pre-service early childhood teachers, encompassing key dimensions such as risk-taking, curiosity, imagination, and challenge. In other words, incorporating PBL strategies into preschool teacher training programs not only strengthens pre-service teachers' creative tendencies but also addresses the urgent demand for educators equipped with innovative thinking in contemporary early childhood education. In contrast, traditional classroom teaching models remain predominantly teacher-centered, emphasizing knowledge transmission and imitation, which has led to limited effectiveness in fostering learners' creativity (Tan, 2018). For an extended period, preschool teacher training programs in China have focused primarily on theoretical instruction, offering limited opportunities for pre-service teachers to engage in practical exploration and creative practice. This issue has become a significant constraint on their professional development (Luo et al., 2020). Although educational reforms advocate for enhancing practical and applied competencies, teacher-led instructional models continue to dominate, making it challenging to fully meet the expectations for cultivating innovative educators in preschool education. Therefore, this study recommends that PBL approaches be more actively integrated into curriculum design, emphasizing learner-centered participation, problem-solving, and creative expression to cultivate preschool teachers with strong creative tendencies. Future curriculum development should also explore integrating PBL with situated learning and interdisciplinary design to further enhance pre-service teachers' creative tendencies in authentic teaching contexts, thereby responding to the diverse demands for high-quality educators in the contemporary field of preschool education.

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Appendix

PBL Framework for the Picture Book Design Course

Teaching stage	Teaching Activities	Learning objectives
Phase 1 (Week 1) Analytical Questions	1. Introduce the basic elements of picture book creation (such as story structure, images, and style).	1. Understand the core components of picture book creation.
	2. Appreciate classic picture books and explain narrative strategies.	2. Clarify the core issues and challenges faced in creation.
	3. Learners are divided into groups (3-5 people in each group) to discuss the creative theme, potential audience and visual expression through brainstorming and data exploration, and identify challenges and problems in the creation.	3. Establish the direction and goals of picture book creation.
Phase 2 (Week 2) Develop a plan	1. Develop a project plan to clarify the division of tasks, schedule and required resources.	1. Clarify the creative path and goals.
	2. Design a story draft (character setting, visual style and scene planning).	2. Improve learners' mastery of various elements of picture book creation.
	3. Analyze classic picture book cases to help learners understand how to combine visuals and text to convey educational implications.	3. Enhance the ability of cross-group collaboration and creative development.
	4. Encourage sharing of preliminary ideas and creative plans across groups.	
Phase 3 (weeks 3–8) Exploratory Practice	1. Experiment with a variety of materials and visual styles.	1. Improve learners' picture book creation ability and artistic expression.
	2. Complete the picture book text creation and illustration design.	2. Improve the quality of the work and enhance its educational function through feedback and correction.
	3. Conduct multiple rounds of sketch revisions and story optimization, and strengthen narrative logic and visual consistency through feedback from classmates and teachers.	3. Strengthen learners' creative practice.
	4. Invite students to play the role of children to try reading the picture book and adjust the content of the work based on feedback.	
Phase 4 (Week 9) Communication and Sharing	1. The groups will present their works and introduce their creative process and design concepts.	1. Enhance learners' ability to present their works and communicate.
	2. Accept feedback from peers and experts.	2. Improve creative quality and creative thinking through external feedback.
	3. Promote learners' creativity and thinking through experience exchange and observation within the class.	3. Deepen reflection and learning through peer communication.

Appendix

PBL Framework for the Picture Book Design Course (continue)

Teaching stage	Teaching Activities	Learning objectives
Phase 5 (Week 10) Feedback Assessment	<ol style="list-style-type: none"> 1. Learners conduct self-evaluation, peer evaluation and teacher evaluation to assess their individual contribution to the team and learning outcomes. 2. Review the creative process, analyze task challenges and successful experiences, and integrate learning gains. 3. Submit a personal learning reflection report and think about the potential for future creative applications. 	<ol style="list-style-type: none"> 1. Evaluate individual contributions and group collaboration. 2. Connect learning experiences with future creative development.

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