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Development of an instructional model for college-level art and design courses based on project- and problem-based learning

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ABSTRACT

This study aims to develop a blended learning model, Project- and Problem-Based Learning (PPBL), which integrates project-based learning and problem-based learning into art and design courses in higher education. Using a mixed-methods approach, the study combines quantitative and qualitative data to conduct an "interaction design" teaching experiment in an art and design course at JT Vocational University in China. The quantitative results showed that the PPBL model significantly improved students' overall performance, particularly in creativity and innovation. Students from different majors also showed differences in the extent of improvement in their design skills. Qualitative interviews further revealed a shift in the teacher's role from knowledge transmitter to guide, facilitator, and partner. Based on these findings, the authors proposed a PPBL framework comprising five dimensions: real projects, driving questions, student practice, outcome showcase, and process evaluation. The model emphasizes hands-on practice and independent inquiry through authentic projects, helping to develop core competencies such as creativity, technical skills, and communication. By providing a structured, discipline-specific framework for blended pedagogical models and identifying differences across academic majors, this study offers a theoretical and practical foundation for future interdisciplinary and practice-oriented teaching reforms in creative higher education.

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1. Introduction

Art and Design are an interdisciplinary field that integrates artistic expression with technological innovation. In art and design education, both students' mastery of basic knowledge and their hands-on practice in the learning process, as well as the final results of the works created, are emphasized. In the past 20 years, global digital technology and artificial intelligence have developed rapidly, and digital media art, interactive design, and interactive media have become the emerging mainstream of art and design. This requires the introduction of new learning models in art and design education to transform the traditional, teacher-centered paradigm characterized by a one-way output of knowledge (Nogueira, 2026). In recent years, some new learning models have also been introduced into art and design education, such as project-based learning, problem-based learning, inquiry-based learning, and experiential learning. Existing research shows that in teaching practice, these learning models have their own strengths, but there are also some weaknesses and shortcomings. For example, project-based learning often lacks driving questions to drive students' inquiry into the project; problem-based learning often does not pay attention to the outcomes of learning and the outcome showcase. The author tries to combine these two learning modes with the initial letter P to make up for their respective shortcomings. We call this learning model Project-and Problem-Based Learning, or PPBL for short (Farshad and Fortin, 2026).

While the conceptual integration of project-and problem-based learning has been explored in fields like medicine or engineering, its systematic, operationalized framework within high-order cognitive art and design curricula remains under-addressed. Rather than a mere juxtaposition of the two methods, the distinct value of this study lies in constructing a contextualized, five-dimensional structural framework tailored specifically to the dual

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demands of open-ended creative inquiry and tangible outcome delivery in art and design education. The purpose of this study is to develop and empirically validate this specialized PPBL model within specific art and design majors. The research objectives are as follows:

1. To determine the basic framework and implementation steps of the PPBL model applicable to art and design courses.
2. To determine the impact of the PPBL model on enhancing the academic performance and competence of students in art and design courses.
3. To explore the attitudes and effects of the PPBL model on the changing roles of teachers in art and design courses.

2. Literature review

Project-based learning and problem-based learning derive their theoretical foundations from constructivist theory. Constructivism believes that a body of knowledge is constructed actively through the interaction between the learner and the environment, rather than passively received (Piaget, 1952). Piaget (1952) originally developed constructivism to investigate children's cognitive development, but over time, the framework has become a cornerstone of modern education. The development of constructivism and the learning sciences, which provide the doctrinal rationale for contextual, constructive, and cognitive apprenticeships for project-based learning and problem-based learning, has led to the widespread acceptance and esteem of these learning sciences in fields such as medicine, education, business, and engineering (Al-Kamzari and Alias, 2025).

Project-based learning is an approach to learning that centers on students, projects, and practical experience. Its essence is to carry out teaching and learning activities around actual projects, to discover and solve problems in the process of completing the projects, and to acquire relevant knowledge as a result. In terms of pedagogical origin, the idea of project-based learning originated from Dewey's (1986) “Learning by doing” experiential learning. The project-based learning at that time was mainly aimed at the shortcomings caused by too much emphasis on reading, and emphasized learning by “doing” through a designed project. Project-based learning, as an academic concept, originated in 1958 as a practice in American medical schools. They treated a difficult patient in a multidisciplinary consultation as a project, trying to solve a problem in a real situation. Modern project-based learning emerged in the 1970s when educators sought to incorporate more interactive and inquiry-based teaching methods. As we enter the 21st century, with the growing focus on innovation and the knowledge economy, project-based learning is recognized as an effective way to develop students' critical thinking, problem-solving, and teamwork skills. The essence of project-based learning is student-centered and focuses on authenticity and reflective learning (Blumenfeld et al., 1991). Project-based learning requires students to engage in inquiry and academic exploration, often in a collaborative group setting (Bell, 2010). In project-based learning, the role of the teacher shifts to that of a guide and facilitator, providing resources and assistance to enable students to take ownership of their learning. Successful project-based learning environments should include an ongoing review of the learning process, as well as public demonstrations of the finished product or solution (Larmer and Mergendoller, 2010). These presentations not only motivate students to learn, but also confer a sense of purpose to learning. In addition, project-based learning fosters interdisciplinary collaboration and interaction with outside experts, thus creating a more authentic professional atmosphere.

In the 1960s, medical educators at McMaster University pioneered problem-based learning. Barrows and Tamblyn (1980) argued that traditional educational approaches placed too much emphasis on rote memorization and theoretical knowledge and neglected to develop students' ability to deal with real-world problems adequately. Problem-based learning was developed to promote active learning and critical thinking by exposing students to real-world problems (Barrows, 1986). At the heart of the problem-based learning paradigm lies the use of complex and multifaceted problems as the initial foundation for learning (Savery and Duffy, 1995). Students acquire relevant knowledge and develop essential skills by engaging in group discussions and collaborative problem solving under the guidance of the instructor (Muangsean, 2025). This approach goes beyond the mere transfer of knowledge to a teaching strategy that develops students' self-directed learning skills and lifelong learning attitudes (Hmelo-Silver, 2004).

In art and design education, project-based learning and problem-based learning develop students' integrative abilities through practice and inquiry, improve their critical thinking, problem solving, teamwork, communication skills, self-management, and independent learning, and motivate them to apply their knowledge to real-world situations (Blumenfeld et al., 1991). By participating in the design and implementation of projects, students can apply theoretical knowledge to real or simulated professional scenarios, deepen their understanding of professional knowledge, and lay a solid foundation for future career development (Bell, 2010).

Although project-and problem-based learning are widely recognized and used in education, they still face many challenges. Existing literature emphasizes that implementing project-and problem-based learning presents teachers with complex operational challenges in terms of designing ongoing assessments, coordinating across disciplines, and managing students’ time (Rehman et al., 2024). For example, project-based learning presupposes project-based practice. Teachers need to design and

implement projects, including managing students and being available to answer student queries. As a result, high demands are placed on teachers, requiring them to have a high level of specialized knowledge, some of which may be beyond their skills or experience. Teachers may also face time and resource constraints that may hinder program implementation (Helle et al., 2006). Project-based learning and problem-based learning require students to be able to self-regulate and maintain a certain level of enthusiasm for learning throughout the learning process, both of which may be difficult for some students. Due to the open-ended nature of the program, it may lead to uncertainty or anxiety among students, which may affect their learning outcomes (Han et al., 2015). Project-based learning is more complex and variable than traditional teaching and assessment systems. For example, there is a lack of standardization of project outputs, which often makes it difficult for teachers to effectively assess student progress and project outcomes (Huang et al., 2026). Despite the fact that project-based learning aims to promote integrated learning across disciplines, there are still many difficulties in its implementation, making it difficult to achieve a seamless transition between different disciplines. The reasons for this are fragmentation of the school curriculum or lack of coordination between disciplines (Marx et al., 1997).

3. Methodology

The study utilized a mixed research method with a sequential interpretation strategy. The first phase began with quantitative research, and this study will conduct the second phase based on the findings of the first phase. The second phase is a qualitative study that aims to complement and explain the results of the quantitative study.

3.1. Participants

This study will be conducted at JT Vocational University in Yunnan Province, China. The institution has a three-year academic program and usually enrolls three classes of students simultaneously. The study covers three art and design majors, Visual Communication Design, Digital Media Art, and Environmental Design, with about 40 students in each session. The study population totaled approximately 1,080 students, for a total size of nearly 1,100 students. To determine the required sample size for the selected population, this study adopted the table developed by Krejcie and Morgan (1970). A sample size of 285 is required for a study population of 1,100, and the researcher expects the sample size to exceed that number if the participation rate reaches 100 percent.

During the PPBL model development and curriculum experimentation, three university faculty members were selected for this study. They had at least 5 years of teaching experience in art and design courses, at least a doctoral degree or equivalent, and a title of at least lecturer.

3.2. Quantitative research

Previous studies have shown that the PPBL model does not apply to declarative and factual knowledge (Anderson, 2005), and it is more suitable for higher-order cognitive courses. The course “Interaction Design” is one of the most advanced art and design courses in recent years, and it is a higher-order cognitive course. The “Interaction Design” course is offered in many art and design majors such as visual communication design, digital media art, environmental design, and industrial design. Therefore, this study chooses the “Interaction Design” course as a specific course to implement the PPBL model. Experiment 1: Comparison of students' performance before and after the application of the PPBL model. In order to determine the effect of the PPBL model on improving the performance of students in the art and design course, the researcher conducted an experiment in the “Interaction Design” course with 40 junior students majoring in art and design at JT Vocational University. A pre-test was administered to the students before the experiment began, followed by instruction using the PPBL model, and a post-test was administered three months later.

Experiment 2: Differences in creative and innovative skills, technical skills, communication, and expression skills among students of different majors. An “Interaction Design” course was taught at JT Vocational University to 40 students in each of the three art and design majors: visual communication design, digital media art, and environmental design. The course utilized the PPBL model. At the end of the course, the researcher examined and compared the students' design skills in three dimensions: creative and innovative skills, technical skills, and communication and expression skills. The researcher hopes to find out if the design skill enhancement of these three art and design students differs.

The course culminated in a requirement for students to create an interaction design piece based on a real project. During the creation of the work, students were required to video-record their process and appear in the video to talk about their process. At the end of the course, students are required to participate in an exhibition where they present their work and videos. The course “Interaction Design” will break the assessment and evaluation mechanism, which is mainly based on the lecturer. The researcher will invite two peer teachers, two experts from enterprises, and two experts from outside the university to evaluate the students' course results. Classroom teachers will not participate in the evaluation. The evaluation of course outcomes will be based on the following rubrics. The student's overall course grade will be determined after averaging the scores given by each grader. The assessment rubric used to evaluate students' performance is presented in Table 1.

Table 1: Rubric for assessing student performance in interaction design

Criteria	Unacceptable (E)	Needs improvement (D)	Satisfactory (C)	Good (B)	Excellent (A)
Understanding of interaction design principles	Fails to demonstrate an understanding of design principles (0–59%).	Shows a limited understanding with few examples (60–69%).	Shows a basic understanding with some appropriate examples (70–79%).	Shows a strong understanding with appropriate examples (80–89%).	Demonstrates a comprehensive understanding of design principles with insightful examples (90–100%).
Creativity and innovation	The solution lacks creativity and originality (0–59%).	The solution shows little creativity or originality (60–69%).	The solution shows some creativity but lacks originality (70–79%).	The solution is creative and shows some original thinking (80–89%).	The solution is highly creative and shows original thinking (90–100%).
Technical skills	Lacks the technical skills necessary for the project (0–59%).	Exhibits insufficient technical skills with numerous errors (60–69%).	Exhibits adequate technical skills with some errors (70–79%).	Exhibits proficiency in technical skills with minor errors (80–89%).	Exhibits mastery in using technical skills to create a polished design (90–100%).
Communication and interpretation	Unable to communicate design concepts or interpret feedback (0–59%).	Struggles to communicate design concepts and interpret feedback (60–69%).	Communicates design concepts with some clarity and interpretation (70–79%).	Communicates design concepts clearly with minor interpretation issues (80–89%).	Articulates design concepts clearly and interprets feedback effectively (90–100%).
Overall performance	The project does not meet basic expectations and is of poor quality (0–59%).	The project meets minimal expectations with some quality issues (60–69%).	The project meets expectations with satisfactory quality (70–79%).	The project meets and occasionally exceeds expectations with high quality (80–89%).	The project exceeds expectations with exceptional quality (90–100%).

3.3. Qualitative research

Three teachers in this study were selected as the interview subjects based on purposive sampling criteria: possessing at least 5 years of teaching experience in art and design, holding a doctoral degree or equivalent, and representing distinct majors (Visual Communication Design, Digital Media Arts, and Environmental Design) to capture diverse disciplinary perspectives. Through semi-structured interviews with the teachers, we gained insight into the implementation details of the PPBL model, teachers' attitudes and perceptions of their own role change, and students' learning.

To ensure a rigorous and standardized data collection process, a formal semi-structured interview protocol was developed and peer-reviewed prior to deployment. The interviews were conducted individually in a quiet, private office environment to maintain data privacy and allow participants to express their insights freely. Each interview lasted approximately 45 to 60 minutes. At the outset of each session, the interviewer introduced the research goals, explicitly guaranteed data confidentiality, and obtained written informed consent for digital audio recording. All recorded interviews were subsequently transcribed verbatim, yielding over 15,000 words of textual data for subsequent analysis.

After the interviews, the researcher executed this rigorous three-tier open coding, axial coding, and selective coding regimen to synthesize the final qualitative framework.

4. Results

4.1. Analysis of quantitative research results

Analysis of results of experiment 1: Comparison of students' performance before and after the application of the PPBL model. The final scores of the pre-test and post-test were analyzed using the paired samples t-test, and the SPSS output is as follows. The paired-samples t-test results comparing pre-test and post-test scores are presented in Table 2. The effect size analysis of the pre-test and post-test score differences are presented in Table 3.

Table 2: Paired-samples t-test results for pre-test and post-test scores

Comparison	Pre-test (M ± SD)	Post-test (M ± SD)	Mean difference*	t	p
Pre-test vs. post-test	65.04 ± 11.88	79.30 ± 7.97	14.26	8.590	0.000**

**: $p < 0.01$

Table 3: Effect size of pre-test and post-test score differences

Comparison	Mean difference	95% confidence interval	df	Standard deviation of the differences	Cohen's d
Pre-test vs. post-test	14.26	10.898–17.612	40	10.496	1.358

As can be seen from Tables 2 and 3, there was a total of 1 set of matched-pairs data, all of which showed variability ($p < 0.05$). Specific analysis shows that the difference between the pre-test and post-test is significant at the 0.01 level ($t = 8.590$, $p = 0.000$), indicating that the difference between the pre-and post-test scores is highly statistically significant. In other words, the PPBL model had a significant impact on students' performance in the Interaction Design course. The mean difference is 14.26, and the 95% confidence interval does not contain 0, which shows that the post-test scores are significantly higher than the pre-test scores, reflecting that the PPBL model effectively improves students' academic performance. Cohen's d-value was 1.358, which is a large effect size, further indicating that the PPBL model is very effective in improving students' academic performance. The

students' final grades were calculated by averaging the scores of the five dimensions of the scoring rubric: Understanding of Interaction Design Principles, Creativity and Innovation, Technical Skills, Communication and Interpretation, and Overall Performance. Therefore, a paired-samples t-test of the pre-test and post-test scores in these five areas showed that the PPBL model had a significant positive effect on the students' scores in all five areas (p-value < 0.001). The improvements in students' scores across the five competency dimensions, together with the corresponding effect sizes, are presented in Table 4.

Table 4: Student competency improvement and effect sizes

Competency dimension	Average pre-test score	Average post-test score	Score improvement	Cohen's d
Understanding of interaction design principles	65.28	76.83	+11.55	0.989
Creativity and innovation	64.40	85.95	+21.55	2.068
Technical skills	65.80	79.78	+13.98	1.284
Communication and interpretation	64.88	76.80	+11.92	1.115
Overall performance	64.85	77.13	+12.28	1.122

In terms of the increase in the mean score and Cohen's d value, the most significant increase is in "creativity and innovation," followed by "technical skills." Analysis of results of experiment 2: Comparison of design skills scores of students from different majors. The researcher used the chi-square test to analyze the performance of students from the three majors in the course of "Interaction Design," where 1.0 represents the enhancement of communication and expression skills, 2.0 represents the enhancement of creative and innovative skills, and 3.0 represents the enhancement of technical skills, and the results are as follows. The chi-square test results comparing design-skill improvement across the three majors are presented in Table 5. The distribution of students across the three design-skill improvement categories in each major is illustrated in Fig. 1.

Table 5: Chi-square analysis of design-skill improvement by major

Item	Skill category	Digital media arts, n (%)	Environmental design, n (%)	Visual communication design, n (%)	Total, n (%)	χ^2	p
Skills	1.0	7 (17.50)	5 (12.50)	14 (35.00)	26 (21.67)	10.242	0.037*
	2.0	22 (55.00)	26 (65.00)	13 (32.50)	61 (50.83)		
	3.0	11 (27.50)	9 (22.50)	13 (32.50)	33 (27.50)		
Total	—	40	40	40	120		

*: $p < 0.05$

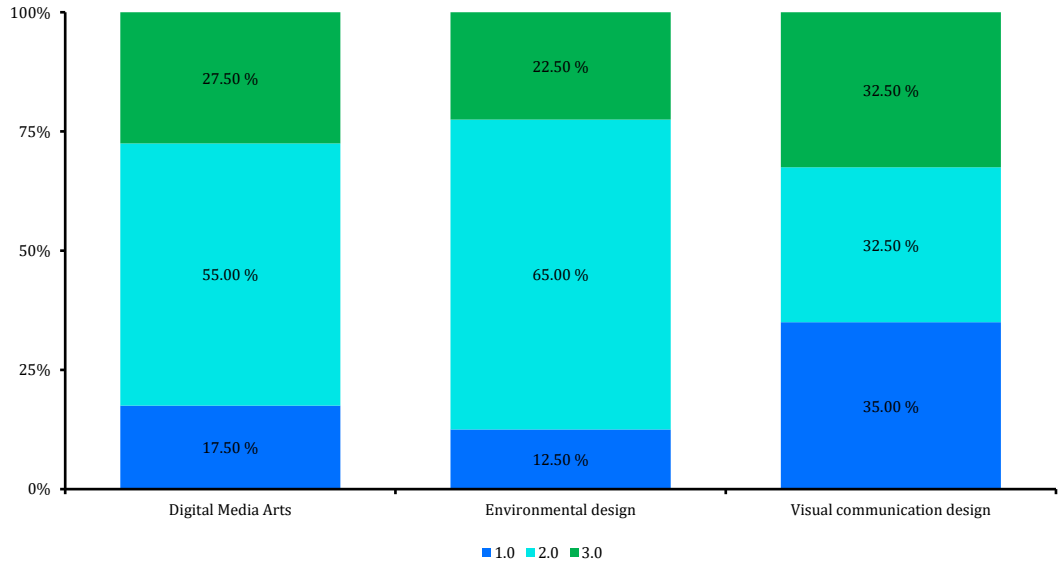


Fig. 1: Distribution of design-skill improvement categories across three academic majors

From Table 5, the p-value is 0.037, which is less than 0.05, indicating that there is a significant difference between the three majors in terms of design skill improvement.

- Communication and expression skills: students of digital media art and environmental design have a lower rate of improvement (17.5% and 12.5%, respectively). In comparison, students of visual communication design have a higher rate of improvement (35%). Visual communication design students focus more on information transfer and visual expression, and students may have already received more training in communication and expression skills in their daily studies, so there is relatively little room for them to improve their skills in this area under the PPBL model. On the other hand, students of digital media art and

environmental design may pay more attention to technical realization and creative conception, and have relatively less training in communication and expression skills. Hence, the proportion of improvement is larger.

- Creative and innovative skills: the improvement proportion of students in the three majors is relatively balanced, with Digital Media Arts (65%) having a slightly higher proportion of improvement, and Environmental Design (55%) having the lowest. Digital Media Arts encourages students to use new technologies for creative expression, so under the PPBL model, students' creative innovation skills are further stimulated and enhanced, with the highest percentage of enhancement. Visual Communication Design also focuses on creativity, but is more focused on innovation within an established framework, with the middle percentage of enhancement. Environmental design pays more attention to functionality and practicality, and has relatively low requirements for creativity and innovation, with the lowest promotion ratio.
- Technical skills: digital media art has the highest promotion ratio (32.5%), and visual communication design has the lowest promotion ratio (22.5%). Digital Media Arts involves more digital technologies and software applications, and students' technical skills are significantly enhanced through project practice in the PPBL model. Environmental Design also involves some design software and technology, with a moderate percentage of enhancement. Visual Communication Design requires relatively low technical skills and has the lowest percentage of enhancement.

4.2. Analysis of interview results: Perceptions of teachers' role change

The researcher conducted interviews with three professional teachers and coded the interviews, which were coded as follows. Open Coding: First of all, the interview content for open coding (also known as open logging), the researcher will be the statements in the order of coding, and then the original statements will be broken up into a one-by-one unit of information, endowed with the theoretical concepts, concepts attributed to the naming, and make clear its attributes and dimensions. Subsequently, the interview data was organized and segmented for open coding. Conceptual labels were assigned to data segments, and relevant concepts were derived using a constant comparative method.

By analyzing the relationships, similarities, and differences among these concepts, they were regrouped and consolidated into overarching themes. Through this iterative process of synthesis, the following 12 conceptual dimensions were identified. The frequencies of the identified open codes from the teacher interviews are summarized in Table 6.

Table 6: Teacher interview results: Open coding

Open codes	Frequency
Leader/facilitator	3
Partner	2
Coach	1
Interdisciplinary coordinator	2
Feedback provider	2
Process evaluation	1
Continuous learning	2
Flexible teaching	1
Creative skills development	1
Social responsibility	1
Practical ability cultivation	2
Closeness to social needs	1

Axial Coding: It is the second stage in the whole coding procedure. Its main purpose is to discover the connections generated between the conceptual dimensions formed during the establishment of the open coding process through the observation and collation of the clustering, and to organically integrate the correlations between the parts (Rachlitz, 2026) is the in-depth analysis of the interview materials and the directionality for the construction of the theoretical prototype and the formation of the higher-level themes. The relationships between the identified sub-dimensions and the corresponding main dimensions are presented in Table 7.

Selective Coding: Also known as core, is the third stage of rooted coding. In the process of selective coding, after organizing all the conceptual categories that have been coded and analyzed, the researcher needs to carry out a systematic analysis and comprehensively select a representative core category. It is meaningfully related to the categories in axial coding and is the core of the information (Alhassan et al., 2023). Selective coding further integrates the themes in axial coding to form core concepts. The results of selective coding, showing the integration of the main and core dimensions, are presented in Table 8.

By analyzing the coding of the teacher interviews, we can conclude that the implementation of the PPBL model resulted in a multifaceted shift and enhancement of the teacher role. Teacher roles changed from traditional knowledge transmitters to guides, facilitators, and partners in student learning. Teaching methods have also changed from a single didactic style to more flexible and diverse teaching methods, with more emphasis on cultivating students' innovative ability, practical ability, and problem-solving ability. At the same time, teachers' evaluation methods have also changed from summative evaluation focusing on results to formative evaluation focusing on the process, paying more attention to students' personalized development. In addition, teachers recognize the need to continuously learn and update their knowledge and skills under the PPBL model in order to adapt to new teaching needs and challenges. In addition, teachers of environmental design emphasize the cultivation of students' sense of social responsibility so that their design work is closer to the needs of society, reflecting the unique role of the PPBL model in enhancing students' sense of social

responsibility. In addition, schools should provide teachers with training in new learning sciences, interdisciplinary knowledge, and collaborative parenting. Encourage process assessment and feedback to reduce reliance on single test scores. Encourage teachers to collaborate across disciplines and share experiences and resources.

Table 7: Teacher interview results: Axial coding

Main dimension	Corresponding sub-dimensions	Connotation of inter-dimensional relationships
Transformation of teaching philosophy	Facilitator/Facilitator; Coach	The role of the teacher changes from the instigator of knowledge to the guide, facilitator, and supporter of students' learning, encouraging students to take the initiative to explore and discover.
Teacher–student relationship change	Partner	The relationship between teachers and students changes from traditional authority and obedience to an equal partnership in the learning process.
Change in teaching methods	Flexible teaching; Interdisciplinary coordinator	Teachers' teaching methods change from single lectures to more flexible and diverse methods, including project guidance and interdisciplinary cooperation, in order to adapt to the needs of PPBL.
Focus on competence development	Creative skills development; Practical skills development	Teachers pay more attention to cultivating students' innovative ability, practical ability, and problem-solving ability, and help students apply theoretical knowledge to practical situations.
Changes in evaluation methods	Feedbacker; Process evaluation	Teachers' evaluation methods change from summative evaluation focusing on results to formative evaluation focusing on the process, providing timely feedback, and promoting students' continuous improvement and enhancement.
Teachers' own development	Continuous learning	Teachers recognize the need to continuously learn and update their knowledge and skills in the PPBL model to adapt to new teaching needs and challenges.
Other	Social responsibility; Proximity to social needs	Teachers of environmental design emphasize the cultivation of students' sense of social responsibility so that their design works are closer to the needs of society, reflecting the role of the PPBL model in promoting students' sense of social responsibility.

Table 8: Teacher interview results: Selective coding

Relationship dimension	Core dimension	Main dimension	Corresponding sub-dimensions
Explicit factors	Role transformation and enhancement	Transformation of teaching philosophy	Facilitator/Facilitator; Coach
		Teacher–student relationship change	Partner
		Change in teaching methods	Flexible teaching; Interdisciplinary coordinator
		Focus on competence development	Creative and practical skills development
		Changes in evaluation methods	Feedbackers; Process evaluation
		Teachers' own development	Continuous learning
Other	—	Other	Social responsibility is close to social needs

5. Development of PPBL model

Based on the above findings and analysis, the researcher attempted to construct a PPBL model applicable to art and design courses. The resulting five-dimensional framework of the PPBL model is illustrated in Fig. 2.

The PPBL model is divided into a 5-dimensional design framework.

Dimension 1 (Real project): The PPBL model for art and design courses requires real projects. Design is an applied art that focuses more on commercial design or public interest design. Virtual projects find it difficult to connect with the market. Real projects need to be provided by teachers, which puts higher demands on teachers. The acquisition of real projects requires teachers to frequently contact enterprise experts or industry experts for school-enterprise cooperation and school-enterprise collaborative education. Another way to obtain real projects is from discipline competitions. Teachers encourage students to participate in design competitions and let students participate in real projects through "teaching competition."

Dimension 2 (Driving question): The driving question is the core of the five dimensions. Driving questions need to be identified by students and teachers from real projects. Driving questions should be able to stimulate students' active inquiry into the project. The 3 types of questions - factual questions, conceptual questions, and debatable questions - are more likely to be driving questions (Haluza et al., 2025).

Dimension 3 (Student practice): This approach emphasizes the integration of 'learning by doing,' enabling students to enhance their skills through hands-on experience. Concurrently, the PPBL model places a strong emphasis on collaborative teamwork. There are five main types of student practices: inquiry, social, aesthetic, technical, and regulatory. Most PPBL models will involve at least 3 types of practices.

Dimension 4 (Outcome showcase): At the end of the course, students are asked to present the work they have created. The showcase can take the form of a small art and design exhibition or an online exhibition. Students may also be asked to participate in a design discipline competition and win some awards.

Dimension 5 (Process evaluation): The evaluation of learning should cover the whole process of learning, including the stages of students' practice and presentation of results. In the specific implementation process, teacher peers, enterprise experts, or industry experts can be invited to participate in the evaluation. We should pay attention to the learning process of students and put the learning process and learning results on the

same footing. Furthermore, greater emphasis should be placed on enhancing students' diverse skill sets, with a particular focus on innovation and creativity. The PPBL model learning program can be divided into five steps.

Step 1: Question identification (Weeks 1-2): The framework will be presented to about 40 students in the Interaction Design course. These students will be divided into 10 groups of 3-5 students each. The teacher will give the students 10 real-life projects to choose from, centered on the content of the course. The teacher will guide students in identifying the driving questions for their projects.

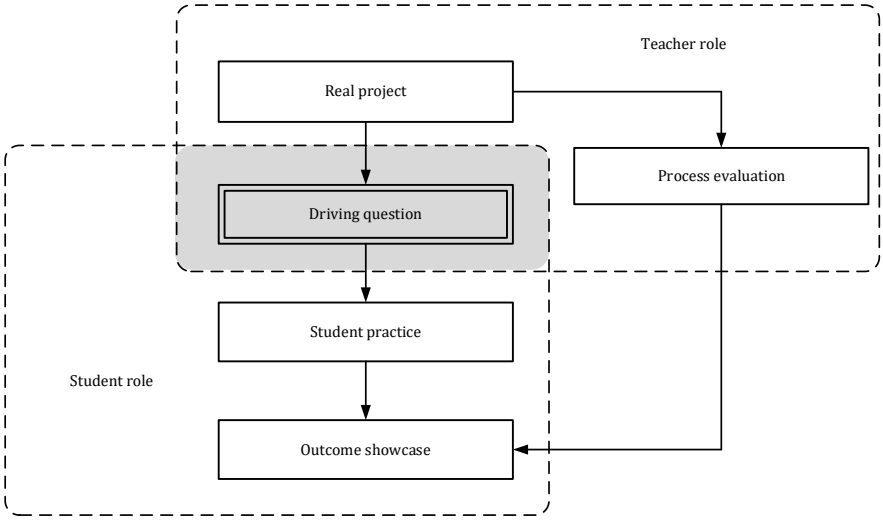


Fig. 2: Schematic representation of the five dimensions of the PPBL model

Step 2: Information gathering and research (Weeks 3-4): After identifying the project topic, students conduct information gathering and research using available resources. This includes field trip research, searching online data, searching literature for information, etc.

Step 3: Creative ideation and solution brainstorming development (Weeks 5-8): The teacher invites members of each group to brainstorm to stimulate students' creative thinking. The teacher invites the groups to brainstorm to stimulate students' creative thinking and to develop reasonable solutions for the design project. Each group will be asked to write a design plan for each project topic.

Step 4: Project implementation (Weeks 9-15): Project implementation is a relatively long process, and the teacher needs to check students' milestones regularly. The presentation of milestones can be in the form of group discussions, short presentations, online discussions through social media, etc.

Step 5: Reflection and feedback (Week 16): Each group needs to make a video or photo documentation during the implementation of the project. And give a presentation as a video at the end of the project design. The presentation will reflect the students' reflections on the project implementation process.

6. Discussion

The results of the quantitative research provide strong evidence of the effectiveness of the PPBL model in improving student performance in the “Interaction Design” course. The results show that the PPBL model has a positive impact on improving student learning outcomes. In particular, the improvement in the area of creativity and innovation was particularly significant. This is due to the fact that the PPBL model emphasizes active learning, problem solving, and practical exploration, which stimulate students' creative thinking and practical skills. From a constructivist standpoint (Piaget, 1952), this substantial creative surge indicates that confronting students with authentic, open-ended problem environments effectively disrupts passive learning tracks, forcing active cognitive restructuring. By embedding driving questions within real industrial scenarios, the framework successfully scaffolds the cognitive transition from theoretical knowledge retention to generative design synthesis. This study established the effectiveness of the PPBL model in developing practical skills and skill creation. This coincides with the study of Savery and Duffy (1995). This is consistent with recent research (Aley et al., 2024). The evolving field of the PPBL model offers unique advantages in fostering critical thinking, enhancing independent problem-solving skills, and adapting to the ever-changing needs of the industry.

The results of the quantitative research also indicate that there are differences in the PPBL model's enhancement of design skills among art and design students in different art and design programs. Such differences are related to the training objectives and courses of each major, as well as the training students receive in their daily studies. Students majoring in digital media art demonstrated the most significant progress in creative innovation and technical skills, while those in visual communication design advanced most in communication and expression. In contrast,

environmental design students showed relatively balanced progress across all three domains. This finding has rarely been addressed in previous studies. This major-specific variance can be deeply tied to the baseline cultural and technical variations inherent in creative design disciplines. Digital Media Arts students, who are routinely exposed to dynamic digital tools, naturally capitalize on the intensive technical practice of PPBL. Conversely, Visual Communication Design students focus heavily on information transfer and semiotics in their standard curriculum, leaving less room for explosive technical leaps but expanding significantly in collaborative conceptual expression. This empirical divergence provides a strong warning against 'one-size-fits-all' pedagogical models in creative disciplines. Therefore, in PPBL teaching, teachers should design teaching content and activities according to the characteristics of different majors to enhance students' skills in weak areas. Students from different majors are encouraged to cooperate across disciplines, learn from each other, complement each other's strengths, and promote all-round development. Teachers should pay attention to the individual needs and developmental characteristics of each student and provide personalized guidance to help them realize their full potential.

Through the results of the qualitative research, we found that in the PPBL model, the role of the teacher has undergone a significant transformation. Instead of being the traditional knowledge transmitter and authority, the teacher plays more of a role as a guide, facilitator, coach, feedback provider, evaluator, coordinator, and motivator. This is similar to Lave and Wenger's (1991) study. This complete operational shift repositions the art studio environment into a functional 'community of practice', where professional identity and design expertise are socially negotiated through cognitive apprenticeship. By shifting the primary pedagogical focus from result-oriented summative assessments to continuous, process-oriented formative evaluation, instructors are able to provide the flexible psychological and educational scaffolding necessary to sustain students through the initial anxiety of real-world open-ended design inquiry.

The theoretical and practical contribution of this study lies not in the baseline combination of project- and problem-based learning, but in the formulation of a highly contextualized five-dimensional framework (real projects, driving questions, student practice, outcome showcase, and process evaluation) optimized for the iterative workflow of creative design. Beyond a mere structural description of the framework, this study meaningfully advances educational theory by explicitly resolving a long-standing epistemological tension within the learning sciences: the pedagogical dichotomy between the abstract cognitive inquiry characteristic of problem-based learning and the concrete procedural execution inherent in project-based learning.

Furthermore, this study contributes to pedagogical theory by introducing and defining the 'disciplinary culture baseline' as a vital conceptual boundary condition for the efficacy of active learning interventions. While general educational literature frequently assumes that hybrid instructional models operate uniformly across creative student cohorts, our empirical evidence uncovering major-specific variations in skill enhancement proves that a model's operational efficacy is deeply moderated by the pre-existing semiotic, technical, and cognitive baselines historical to distinct sub-disciplines. This formulation shifts the discourse in design pedagogy literature from universal model replication to discipline-conditioned adaptation. Of course, this study has some limitations. For example, this study focuses on teachers and students in a vocational university in Yunnan province, China. The sample size is very limited and may not adequately represent the experiences and educational backgrounds of diverse students from other regions or countries. Breakthroughs should be made in future research in terms of expanding the sample size, exploring new model dimensions, and utilizing some emerging technologies. The PPBL model also relies on rich educational and teaching resources, including excellent faculty, solid industry-academia cooperation, and the acquisition of new technologies and skills in enterprises. It is only by supplementing these resources that the PPBL model can be better applied in the future.

7. Conclusion

PPBL model is a new teaching model in art and design courses. It places students in real projects during the learning process, and students are able to continually inquire into the projects through driving questions. The PPBL model can effectively develop students' creative and innovative skills, communication and presentation skills, and technical skills to better cope with the complex challenges they will face in their future careers.

For educational practice, this study offers three vital implications. First, design educators must abandon a one-size-fits-all instructional approach and deliberately calibrate the PPBL model parameters based on distinct disciplinary profiles—such as integrating targeted communication and expression training for digital media art students and technical skill reinforcement for visual communication majors to address their respective weak areas. Second, higher education institutions must construct stable, long-term school-enterprise collaborative mechanisms to guarantee a steady, reliable flow of real-world industrial projects and ensure timely professional feedback from industry experts. Third, schools must provide faculty with systemic administrative support and training regarding project management, cross-disciplinary design, and process-oriented formative assessment techniques to ease the workload on instructors transitioning from autocratic lecturers to facilitators. Additionally, dedicated training in student time management and collaborative team dynamics

should be structurally embedded into the early stages of the curriculum to mitigate uneven group participation.

In the future, we need to continue to research and improve the PPBL model so that education can continue to stimulate students' creativity and enable them to better adapt to the ever-changing social and professional environment. In addition, we need to keep exploring and practicing new learning models so that art and design education can keep up with the times, create greater value for students and society, and cultivate more useful talents for society. Future research should expand upon these boundaries through three concrete avenues. First, the limited sample size must be scaled up beyond a single regional vocational university to encompass diverse, multi-tier institutional types across different regions to validate the broader external validity and generalizability of the framework. Second, longitudinal tracking should be deployed to investigate the long-term impacts of the PPBL model on graduates' workplace transition, operational career readiness, and shifting professional development trajectories. Finally, future investigations must explore how emerging technologies and dynamic digital tools can be organically assimilated into the five-dimensional framework to further catalyze student-driven innovation within art and design pedagogy.

List of abbreviations

CI	Confidence interval
df	Degrees of freedom
M	Mean
p	p-value
PPBL	Project- and problem-based learning
SD	Standard deviation
SPSS	Statistical package for the social sciences
t	t-statistic
χ^2	Chi-square statistic

Compliance with ethical standards

Ethical considerations

This research was conducted in accordance with the ethical guidelines of Kunming University of Science and Technology. Because this study involves non-invasive educational research and standard classroom pedagogical evaluation utilizing anonymous data collected from adult participants, it met the criteria for exemption from formal institutional review board (IRB) review, and thus no administrative protocol approval number was required. However, all ethical protocols and international guidelines for human subject protection were strictly observed. Informed consent was obtained from all participants, who were fully briefed on the research scope and assured of the voluntary nature of their participation (including the explicit right to withdraw from the study at any point without any academic penalty) and the strict confidentiality and complete anonymization of their responses. These measures align with established ethical standards in educational and behavioral science research.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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