Project–Based learning Model Promotes Undergraduates' Innovative Thinking Take Intangible Cultural Heritage Creative Design Courses as an Example

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Abstract

Innovative thinking is considered to be an important workforce in the 21st century. Design is divorced from practice, and ideas copy each other, which leads to the lack of survival competitiveness and creative innovation ability of college students in the current complex and changeable social environment. The purpose of this paper was to investigate (1) the effectiveness of the project–based learning model in promoting college students' innovative thinking and (2) taking a course of heritage and cultural creative design as an example, this paper explored the influence of the project–based learning model on students' innovative thinking. The sample was composed of undergraduates from the heritage and cultural creative design course of a university in Yunnan, China. This study selected its participants using a random sampling technique. The tools used to collect the data were a combination of questionnaires and performance assessments related to creative thinking and problem–solving skills. The project–based learning model consisted of five steps: identification of needs or problems, generation of ideas, development of outcomes through new ideas, implementation of the new outcome, and adoption of new outcomes. In the process of implementing the model, the results of pre–test and post–test showed that students' innovative thinking has improved.

Keywords: Innovative Thinking; Project–Based Learning Model; Undergraduate Students; Intangible Cultural; Creative Design Courses

Introduction

Under the dual challenges of globalization and intensified international competition, we are facing the loss of competitiveness for survival, which requires us to have higher competence qualities to face complex problems as a means of adapting to the ever-changing social environment. To face the challenge, in the field of education, the American Association of Colleges for Teacher Education states that higher-order cognitive abilities and skills are necessary for survival in the 21st century society. Especially, innovative thinking considered essential for the 21st-century workforce and considered valuable characteristics of human cognition (Barak & Usher, 2019). Only innovative thinking can solve problems and open up new paths (Gao, 2021). Today, education is faced with the need to teach a systematic approach to innovative thinking and problem solving (Barak & Goffer, 2002). Several recent reports have called for increases in education on how to think innovatively. Universities are considering how to do this effectively while also ensuring graduates meet disciplinary content standards (Davis & Amelink, 2016). This has prompted higher education institutions to offer innovative courses to enhance students' innovative thinking (Barak & Usher, 2019).

Innovative thinking is the capital of college students based on the world, the foundation for maintaining their own creativity, and the basic quality that must be possessed in the information age. Innovative thinking is viewed as the cognitive process that leads to the application of new or significantly improved ideas (Barak et al., 2020; Cropley, 2015). In addition, Innovative thinking is the basic thinking that keeps students creative and adaptable in the information age. However, the current situation regarding innovative thinking among students in Chinese universities, especially those majoring in design-related disciplines, is not optimistic. The non-heritage cultural creative design course, chosen as the focus of this study, presents unique challenges and opportunities. This course aims to combine traditional heritage with innovative approaches to foster students' understanding of traditional culture and enhance their creative development. By studying non-heritage culture, students are exposed to rich traditional art resources but also face the challenge of integrating these resources into modern design. Therefore, this course places higher demands on students' innovative thinking abilities.

This research paper presents to develop a project-based learning model that integrates constructivist and innovation theories to enhance undergraduate students' innovative thinking in the non-heritage cultural creative design course. The project-based learning model emphasizes students' participation and practical experience in real-world projects, aiming to cultivate their

creativity, teamwork, and problem-solving skills. The significance of this model lies in its potential to enhance students' comprehensive literacy and innovative abilities, enabling them to better adapt to the complex and ever-changing social environment. Additionally, this model has the potential to bring innovation and change to the education field, exploring more effective teaching methods and strategies and contributing to the cultivation of innovative talents.

Research Objectives

Develop and implement project-based learning model and apply it in non-heritage cultural creative design courses to promote and enhance college students' innovative thinking ability.

Population: There are 1,616,600 undergraduates in all higher education in Yunnan China.

Sample: There are 25 junior undergraduates majoring in design in a university in Yunnan China.

Literature Review

Innovative Thinking

As Dewey (1933) emphasizes innovative thinking is "An active desire to listen to more sides than one, to give heed to facts from whatever source they come, to give full attention to alternative possibilities, to recognize the possibility of error even in the beliefs which are dearest to us." (Dewey, 1933). Innovative thinking has been defined by various experts from different perspectives. Dewey (1933) emphasizes that innovative thinking is "An active desire to listen to more sides than one, to give heed to facts from whatever source they come, to give full attention to alternative possibilities, to recognize the possibility of error even in the beliefs which are dearest to us." Foray and Raffo (2012) describe educational innovation as using or launching new educational tools, teachers' teaching practices, and organizational systems to increase quality and productivity in education. Hart's (1996) definition pertains specifically to the process of learning and explicitly states that innovative thinking is a way of generating new ideas.

Barak et al. (2020) and Cropley (2015) view innovative thinking as the cognitive process that leads to the application of new or significantly improved ideas. This view is supported by research identifying behaviors such as observing, exploring, questioning, and networking as key to generating novel ideas (Dyer et al., 2019). Innovative thinking is seen as a teachable competency, with educational programs designed to enhance students' innovation capabilities (Barak et al., 2020; Dyer et al., 2019).

Innovative thinking definition relates to the field of science: It is a thinking process of discovering new things, creating new methods, and solving new problems on the basis of personal experiences (Lu et al., 2013). Li (1987) innovative thinking is the thinking ability during the innovation process. For the purpose of this study, innovative thinking is defined as the cognitive competency of undergraduate students to effectively define problems, generate new or improved ideas, and obtain results of innovative value during learning activities.

Xu & Chen (2010) describe generally believe that innovative thinking is the thinking ability during the innovation process. Innovative thinking encompasses various components, as identified by different researchers. Dyer et al. (2019) highlight observing, exploring, questioning, and networking, while Raviv (2008) identifies problem–solving, big picture thinking, personal skills, and social skills as key components. In this study included five innovative thinking components. Morad, et al. (2021) indicate that innovative thinking components are: the cognitive competency to define a need or a problem, the cognitive competency to generate new or changed ideas, the cognitive competency to develop an outcome by new or changed ideas, the cognitive competency to implement a new or improved outcome for the addressee the cognitive competency to adopt a new or improved outcome with added value.

Project–Based Learning

Project–Based Learning (PBL) originated in the United States and is rooted in Dewey's (1933) concept of learning by doing. Kleijer (1918) introduced the idea of projects as a means for students to engage in practical, real–life activities that foster internal absorption, exploration, and innovation. PBL contextualizes learning by presenting learners with problems or tasks to solve or develop (Moss & Van Duzer, 1998). The Buck Institute for Education defines PBL as a systematic approach structured around complex, authentic questions and tasks, engaging students in extended inquiry processes (Markham et al., 2003). Stoller (2006) emphasizes the integration of skills, collaboration, student ownership, and tangible final products in PBL.

PBL involves students in design, problem–solving, decision–making, and investigative activities, allowing for autonomy and culminating in realistic products or presentations (Thomas, 2000). Blumenfeld et al. (1991) highlight that PBL drives activities towards addressing driving questions and producing final products. Kubiatko & Vaculová (2011) note that PBL commonly results in the creation of products like these, reports, design plans, or models.

Barak and Yuan (2021) underscore PBL's role in equipping students with observational skills, creativity, and the ability to generate new ideas. Liu & Zhao (2021) emphasize PBL's focus

on real–world problems, continuous inquiry, effective product development, and the social added value of products.

Summary of the literature review to show that the literature review delves into the definitions and components of innovative thinking and explores the principles and methodologies of Project–Based Learning (PBL). It demonstrates how these concepts have been studied, defined, and applied in educational contexts. The review identifies gaps in the literature regarding the integration of innovative thinking and PBL in enhancing the cognitive competencies of undergraduate students. This research aims to fill that gap by developing a model that combines innovative thinking and PBL to promote effective learning outcomes.

Conceptual Framework

This research is a research study aimed at exploring the relationship between Project–Based Learning (PBL) and the enhancement of innovative thinking among undergraduate students in the context of Intangible Cultural Heritage Creative Design Courses. The researcher defines the research conceptual framework based on the concept of Constructivism Learning Theory together with Innovation Theory. The details are as follows:

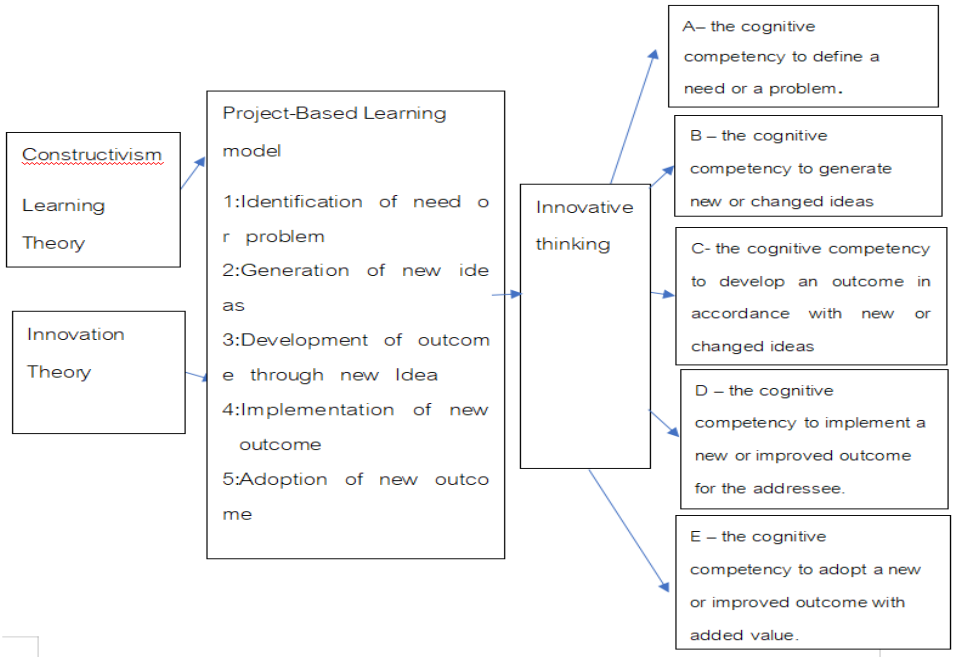

Figure 1. Conceptual Framework

Research Methodology

Step 1: Innovative thinking and learn basic information on a project basis

1. The researchers studied the level of innovative thinking of 100 undergraduate students and measured them using a 5-level rating scale. The results showed that students needed project-based learning to improve their innovative thinking ability. Cronbach's Alpha was used to test the effectiveness, and the reliability coefficient was 0.82. It can be concluded that the test questions have strong reliability standards and can be used in this research.

2. The quality of the project-based learning model, which consists of five dimensions, was tested by interviewing three education experts, and data was collected by presenting the project-based model to the experts, who then assessed it using a rating scale, respectively, strongly agreed, mostly agree, both disagree, mostly disagree, and strongly disagree. The results show that the project-based learning model is effective (consistency index = 4.50 on average. Standard = 0.50, full score = 5 points). After that, the researchers made adjustments and modifications. The model was tested on 25 students in Kunming, Yunnan Province, in December 2023. The experimental results show that the innovative thinking level of students after the implementation of the project-based learning model is significantly higher than that before the implementation.

3. The project-based learning mode includes 5 steps, and this research meets the requirements of the Human Research Ethics Committee.

The goal of project-based learning model is that students have the observation ability to identify problems according to real world problems and tasks, so as to stimulate the creativity of new ideas, the ability to choose to use innovative tools for continuous and in-depth linking, and the cognitive ability to form valuable product development and social added value of products through experiments, and the ability to design products for iteration. To some extent, achieving sustainable iterative results through a project-based learning model is an important vehicle for connecting students' creativity and innovative thinking.

The project-based learning model emphasizes the organization of learning activities around "learning by doing, thinking by learning, and thinking by doing", and finally presents a highly recognized virtual or physical product form to present the iterative results. The social environment is changing all the time, and doing learning can help students understand how the awareness of "survival of the fittest" matches the needs of society. The 5-step project-based learning model of this study, (identification of needs or problem, generate ideas, development of outcomes through new ideas, implementation of new outcome, adoption of new outcomes). It can

make students have different perspectives and new eyes, and really have the thinking ability and execution ability of "doing things". Doing blindly and doing without deep thinking is not suitable for the current environment competition. The lack of thinking in learning, thinking in the process of doing, is difficult to achieve the purpose of doing middle school. Use 5-step project-based learning to (identification of needs or problem, generate ideas, development of outcomes through new ideas, implementation of new outcome, adoption of new outcomes) model, The sustainable value problem is solved.

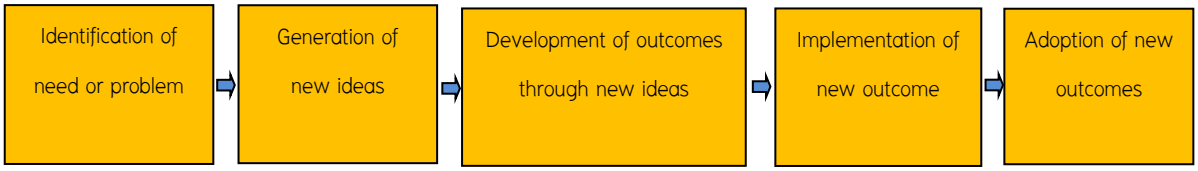

Figure 2. Project-based learning model

Step 2: Applying the project-based learning model in Intangible Cultural Heritage Creative Design Courses

For the implementation of project-based learning mode, the researchers designed the curriculum content of non-legacy creative design, which is mainly composed of 5 components, including curriculum objectives, curriculum content, curriculum activities, measurement and evaluation, and divided into 9 units. The goal of non-heritage creative design course is to learn how to design non-heritage cultural derivatives with cultural connotations. It can realize the intangible cultural heritage from intangible to tangible through design, fully combining form and culture. Through the course of intangible cultural heritage derivative design, we can cultivate high-quality cultural and creative talents with original spirit, innovative ability and innovative achievements. The course helps students to understand the general creation law of cultural and creative design, and can simultaneously use the method to create and develop the application and development of innovative national culture in the current society, and comprehensively improve the design quality and innovative thinking. According to the characteristics of design courses, this study uses a 5-step project-based learning model to design course content and course activities, as follows.

First of all: Identification of needs or problem. The inspiration comes from the observation and recognition of the real society. Teachers find problems by making students learn to observe and identify them in real social situations. The strategies of making participation with objects and

interactive research with real life scenes help students how to observe and identify problems. Students develop interest and basic background knowledge under the guidance of the teacher, while having the awareness and cognitive sensitivity to identify problems, and the awareness to explore multiple and alternative perspectives.

Second: Generate ideas. At this stage, teachers stimulate ideas by guiding students through creative thinking exercises with storytelling strategies. Helping students to be imaginative and innovative, stories inspire imagination and encourage individuals to think creatively, envisioning new possibilities, solutions and ways to tackle challenges. By engaging with different narratives, individuals can tap into their creativity and generate innovative ideas, and stories provide a platform for personal expression and self–discovery, enabling individuals to share their unique voices, experiences, and insights with others. By telling their own stories and expressing their own creativity, individuals can develop self–confidence, resilience, and a sense of agency that drives personal growth and fulfillment.

Third: Development of outcomes through new ideas. The development link of the idea. This stage is the key stage in the development of creativity to innovative thinking. In this stage mainly through the simulation practice tool strategy to achieve. Through SCAMPER, teachers stimulate students' creative thinking and innovation skills, enabling students to systematically connect insights, perspectives, ideas, perspectives, and technologies from different fields. Through the application of SCAMPER techniques (Replace, combine, adapt, modify, reuse, eliminate, reverse), students will develop creative problem solving, innovative thinking, and interdisciplinary collaboration, participate in simulation exercises and subsequent activities, and students will develop basic skills in problem solving, communication, and teamwork in a simulated real world.

Fourth, Implementation of new outcome. Test the product, teachers organize product design exhibitions in cooperation with relevant parties. Through collaboration with external stakeholders, students are able to develop the ability to demonstrate innovative products to the real world and to develop commercial appeal. Students develop actionable abilities to bridge ideas and influences and turn creative visions into practical outcomes.

Fifth, Adoption of new outcomes. Adopt iteration, teachers use Copyrights or patents of creative works as a means of iteration. Achieve sustainable value. To help students develop an awareness of innovative thinking and innovative ideas, practices, technologies or solutions in a wider context to ensure that this novelty is widely accepted and integrated into everyday life,

processes or behaviour. While clearly establishing the ownership and originality of the innovation, students have the quality and authenticity to use in different contexts.

Step 3: Procedure project-based learning model

The researchers implemented a non-legacy design course, which was taught by a qualified teacher with 5 years of teaching experience and a strong motivation. The participants in the experimental group and the control group were taught by the same teacher. According to the textbook "Design of Intangible Cultural Creative Products" designated by the school, a total of 50 students participated in the sample. The data were collected by observing the changes of project-based learning mode to improve students' innovative thinking before and after the implementation of the curriculum. After that, the researchers analyzed the data by comparing scores before and after the implementation of the course.

In the case of the same grade, to avoid bias, give each student a number and use a random number generator to assign students to different groups by random assignment. This ensures that the students in the group all have similar characteristics and backgrounds. They all come from the same college, enjoy the same school resources, and ensure that students have similar characteristics and backgrounds so that results are not influenced by these factors. The sample number involved in the implementation of project-based learning model is 25.

The results are as follows.

	Mean	Number of Cases	Standard Deviation	Standard Error of the Mean
Before learning the project-based learning model	83.4000	25	28.17801	5.63560
After learning the project-based learning model	119.4800	25	12.93290	2.58658

Data Collection	Mean	Standard Deviation	Standard Error of the Mean	Difference 95% Confidence Interval		t	Degrees of Freedom	Sig. two-tailed
				Lower Bound	Upper Bound			
Before learning the project-based learning model--- After learning the project-based learning model	-36.08000	32.53962	6.50792	-49.51169	-22.64831	-5.544	24	.000

Figure 3. The innovative thinking ability of undergraduates before and after implementing project-based learning model

These data from the table above indicate that there is a significant difference in innovative thinking ability before and after the implementation of project-based learning, T-value and Sig. All the values support this conclusion. Results after learning are generally higher than before learning.

Step 4: Evaluation validity

After implementing project-based learning model, students' innovative thinking is higher than before.

After students pass the study, their batik works can obtain the original copyright registration certificate of works supervised by the National Copyright Administration of the People's Republic of China.

It was statistically significant.000 and the National Copyright Administration of the People's Republic of China recognized certificate.

Figure 4. Effectiveness of project-based learning model

Research Results

The results of the model implementation show that the model is based on constructivism, which believes that students can identify problems through observation, generate ideas, develop links of ideas, experiment with products, and adopt iterative learning steps to achieve improvement of products. The project-based learning model has significant and impressive results in the development of innovative thinking. Teachers can carry out relevant learning activities according to the organization and combine with the surrounding real environment to find solutions. Through the introduction of project-based learning, students are not only passively accepted knowledge, but actively participate in the process of solving real world problems. This participatory nature fuels their curiosity and creativity, making them more motivated to think and come up with unique solutions.

Project-based learning provides a practical platform for students to apply the theoretical knowledge learned in the classroom to real projects. This practical nature strengthens their understanding and retention of knowledge, while developing the ability to solve problems. Secondly, the project-based learning model encourages students to collaborate and communicate in teams, which is essential for the cultivation of innovative thinking. The project-based learning model emphasizes reflection and iteration in practice, which also plays an important role in the development of innovative thinking. The project-based learning model greatly promotes the development of students' innovative thinking through the characteristics of practicality, cooperation and reflection iteration.

Discussions

The purpose of this study is to construct a project learning model combined with innovation theory to enhance the innovative thinking of college students in the non-heritage cultural creative design course. The discussion will focus on several key areas, including the implications of the research, implications for education, limitations, and recommendations for future research.

The results of this study have important implications for higher education, especially for design-related disciplines. In today's rapidly changing global environment, fostering innovative thinking among college students is critical to their success in the 21st-century workforce. This study provides a feasible way to improve students' innovative thinking ability by constructing a PBL model combined with innovation theory. The non-heritage Cultural Creative Design course provides a unique environment for exploring innovative teaching methods. By combining traditional

heritage with innovative design principles, students are challenged to think critically and creatively while preserving cultural heritage. The findings of this study contribute to the research of the literature on innovative teaching methods in design education and provide insights into effective strategies for developing students' innovative thinking skills.

The results of this study show that combining project-based learning with constructivism and innovation theory can effectively improve college students' innovative thinking abilities. The project-based learning model proposed in this study emphasizes active engagement, real-world problem-solving, and iterative design processes, all of which are important components of innovative thinking. Educators can apply the results of this study to design and implement innovative curricula that promote students' creative and critical thinking skills. By incorporating project-based learning into the curriculum, educators can create opportunities for students to engage in hands-on learning experiences that develop practical skills that are highly valued in today's job market. In addition, project-based learning enables cross-pollination of ideas and perspectives, leading to more innovative solutions to complex problems.

Although the study has its contributions, some limitations should be acknowledged. First, the sample size of this study was relatively small, and future studies could replicate the study with a larger, more diverse sample.

In addition, a pre-test/post-test design was used to assess the change in students' innovative thinking ability after implementing a project-based learning model. While this design provides valuable insights into the immediate effects of the intervention, longitudinal studies are needed to examine the long-term effects of project-based learning on students' innovative thinking skills.

In conclusion, this study contributes to the literature research on innovative teaching methods in higher education. By combining project-based learning with constructivism and innovation theory, educators can effectively improve college students' innovative thinking skills and prepare them for success in the 21st-century labor market.

Conclusion

By synthesizing all the studies, we have come to the relevant conclusion that students think it is interesting, effective and feasible to implement project-based learning mode in non-legacy creative design courses, which can improve students' innovative thinking ability.

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