



Developing the teaching model of innovation and entrepreneurship courses to enhance
the creativity for college students

Jieqi Huang

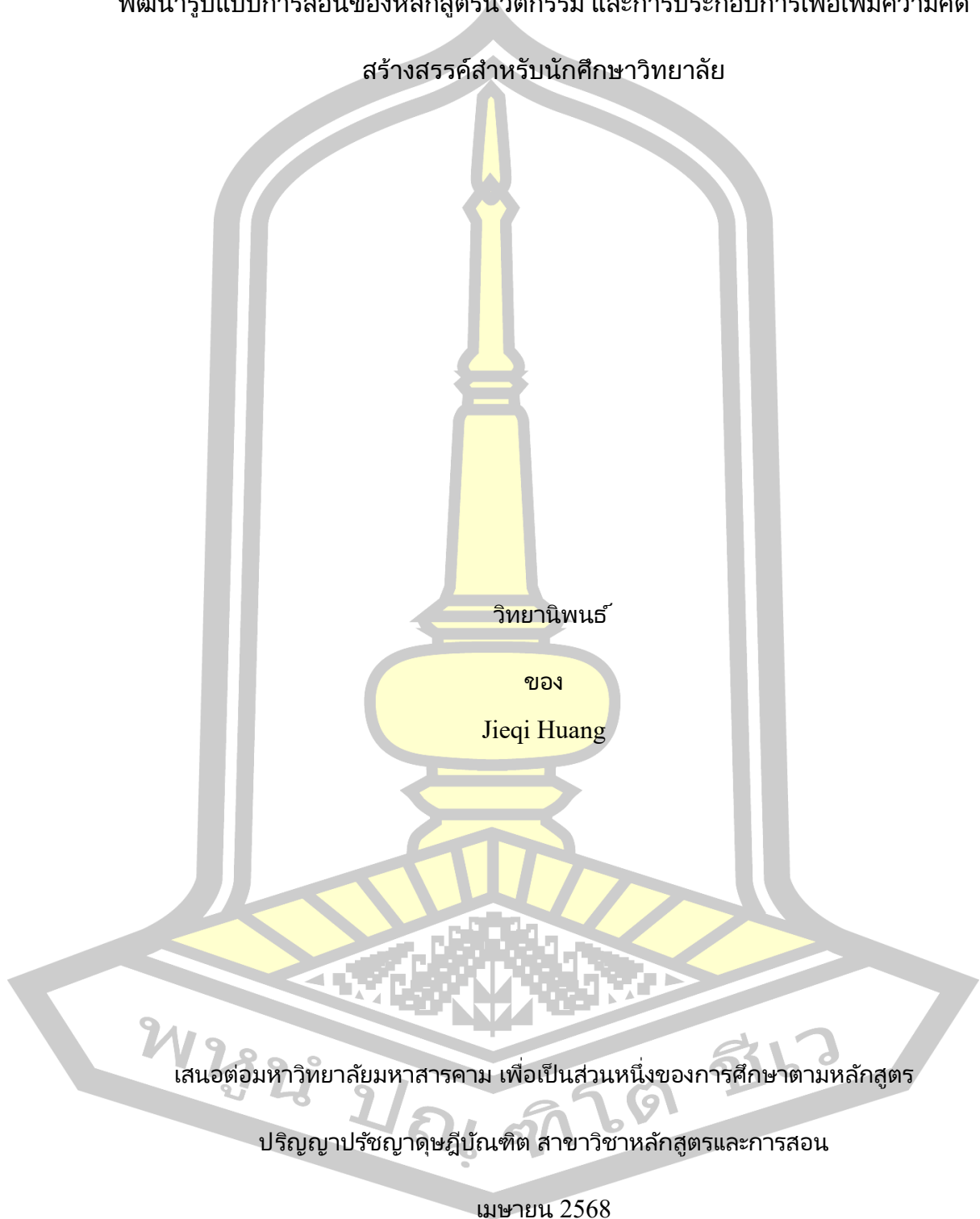
A Thesis Submitted in Partial Fulfillment of Requirements for
degree of Doctor of Philosophy in Curriculum and Instruction

April 2025

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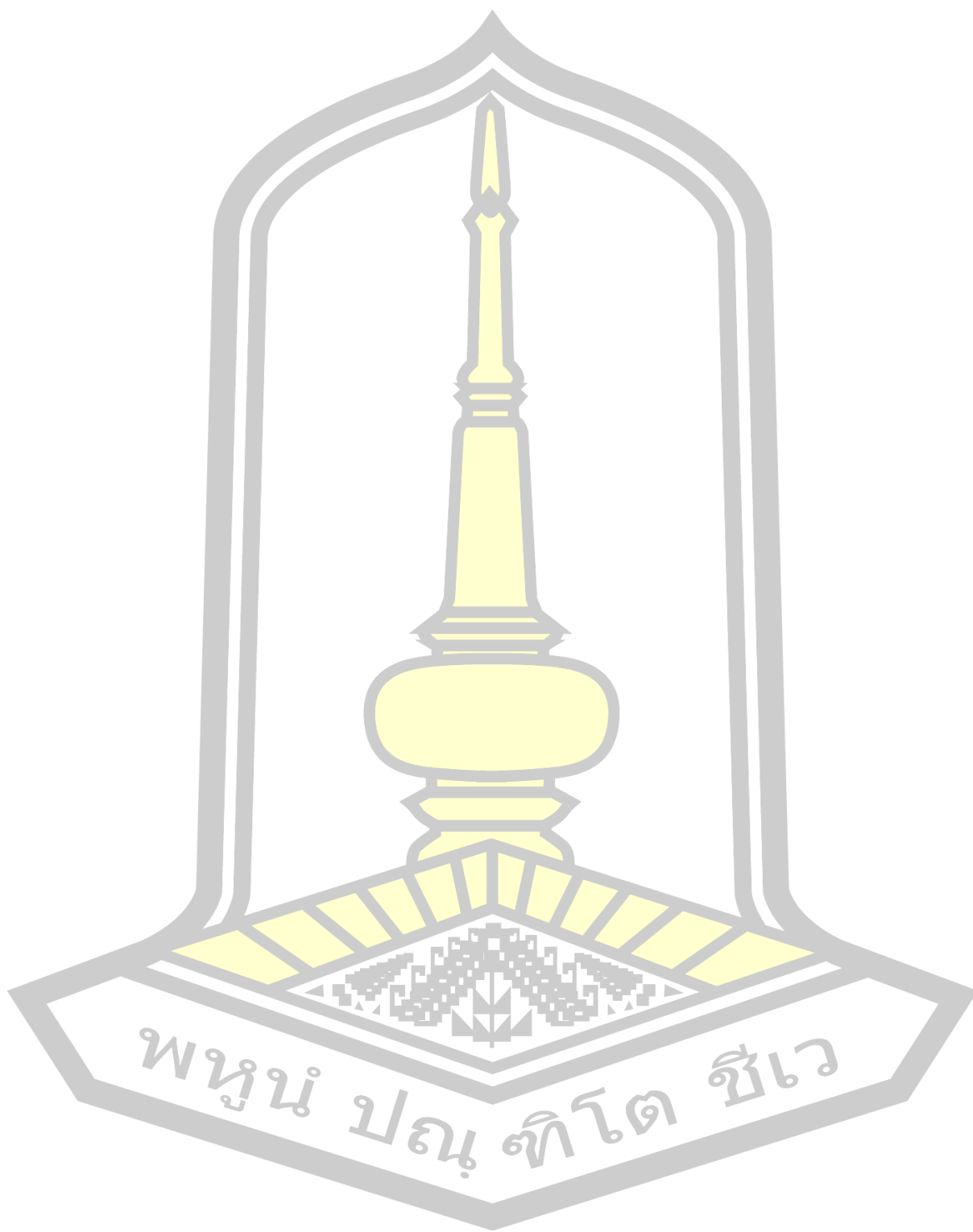


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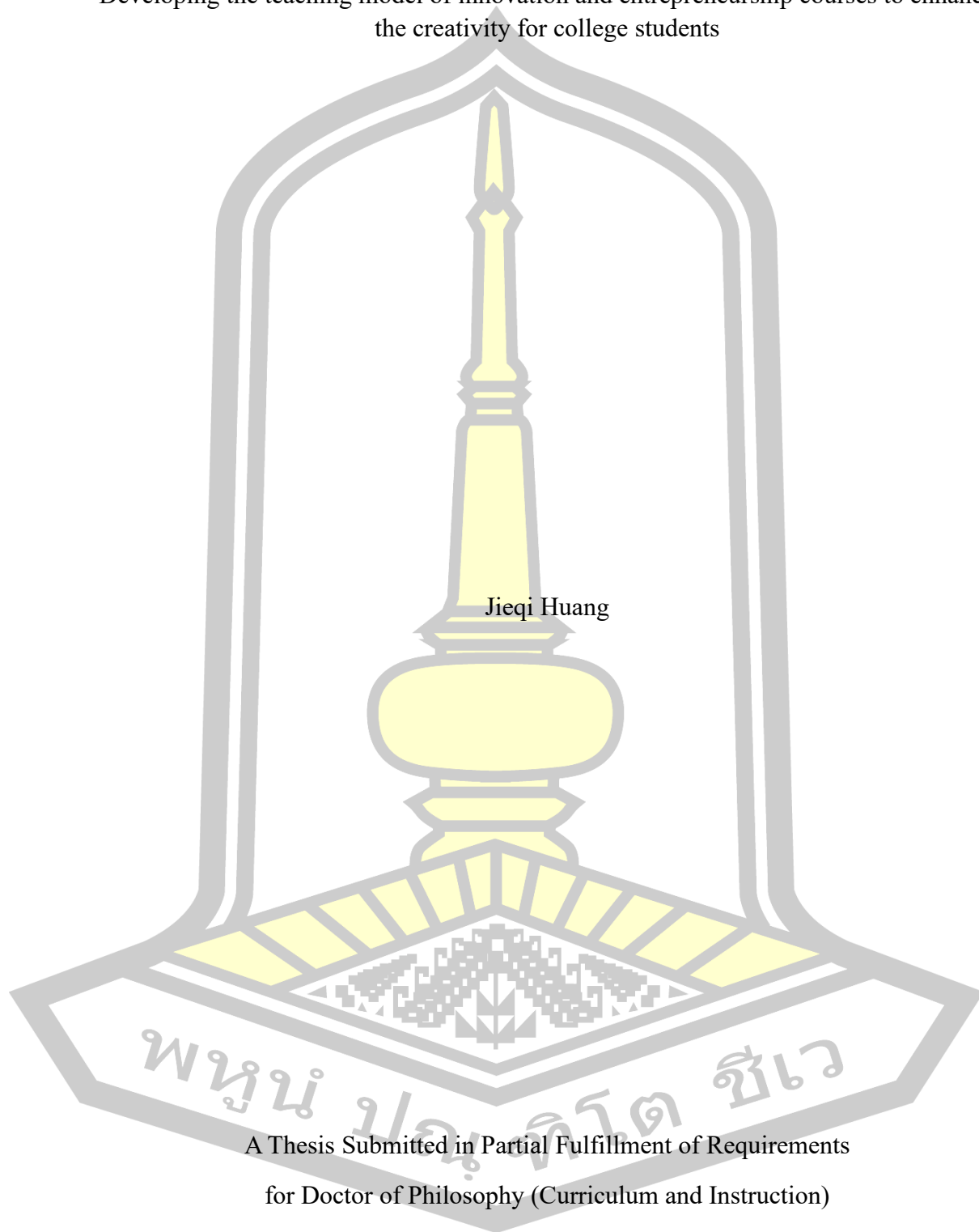
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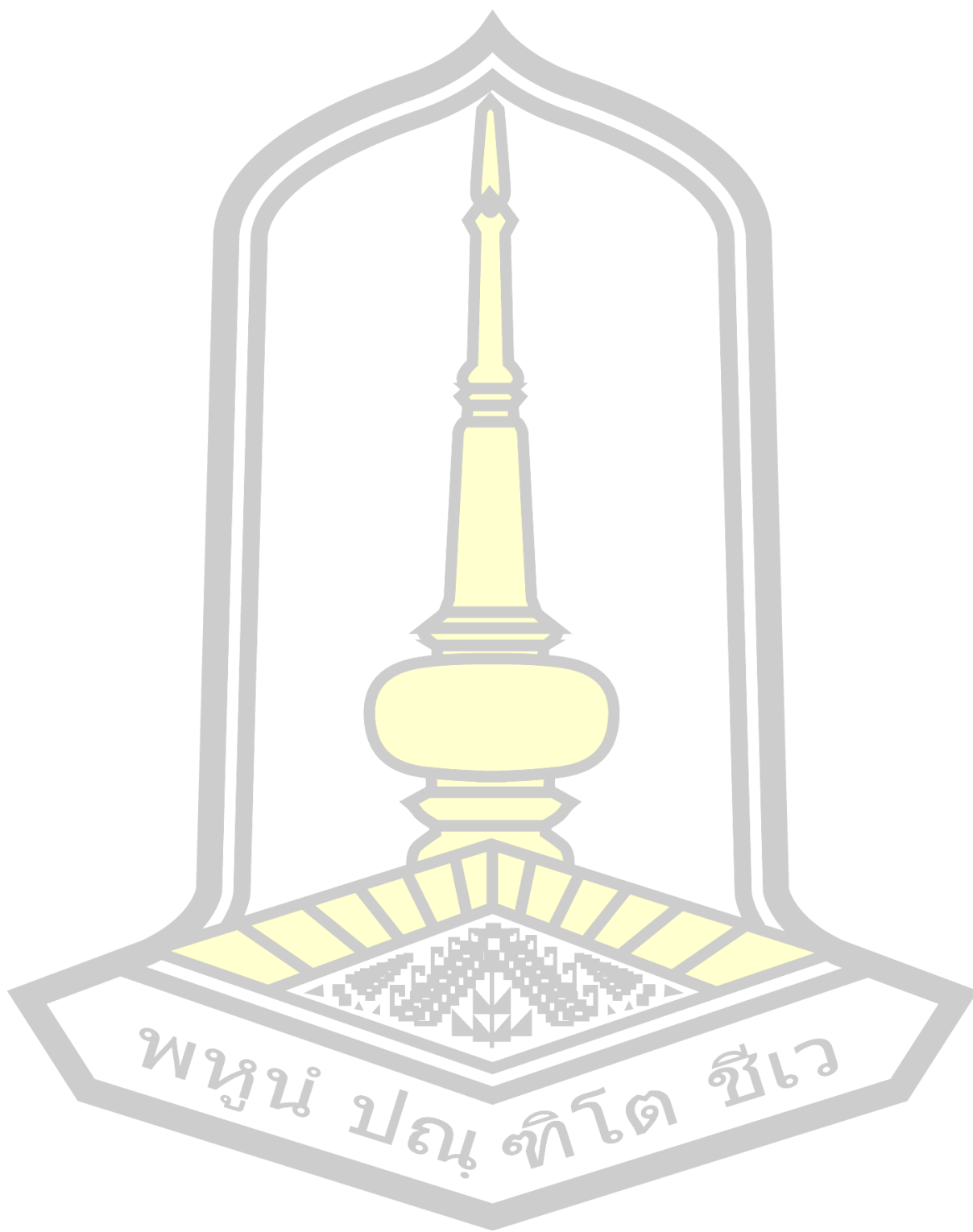


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ABSTRACT

Creativity plays a crucial role in the personal development of college students, acting as a catalyst for self-discovery, problem-solving, and the exploration of new perspectives. However, creativity levels among Chinese college students are often reported to be low, primarily due to inadequate emphasis on cultivating creativity and imagination within the education system. This research aimed to: (1) study the basic information regarding the teaching model of innovation and entrepreneurship courses based on creativity cultivation; (2) develop a teaching model to enhance college students' creativity; and (3) examine the results of using a specific teaching model to enhance college students' creativity. The sample consisted of 60 freshman students from Guangzhou Panyu Polytechnic (China) during the first semester of the academic year 2024. The students were divided into experimental and control groups for Independent t-tests and paired t-tests. Research instruments included a student questionnaire, an interview form for experts and teachers, a learning management manual, lesson plans, curriculum standards, and a creativity level test.

The results of this study are as follows: (1) the basic information study highlighted the limitations of college students' creativity as reported by the government and demonstrated that the cultivation strategies provided evidence to support the construction of a teaching model. (2) the development of the PIPT teaching model, rooted in Constructivist SOI and CPS theories, was designed to follow the process of "Problem-Ideation-Prototype-Testing." The model's 6 components—principles, objectives, syntax, social systems, reactions, and support systems—proved highly effective in achieving teaching goals, achieving an evaluation score of 4.61. (3) the implementation of the PIPT model demonstrated a

significant improvement in students' creativity. The post-test level of creativity of the experimental group was significantly higher than the pre-test, and the post-test level of the experimental group was significantly higher than that of the control group. It showed that the PIPT teaching model was more effective than traditional methods and significantly improved the creativity of college students.

Keyword : teaching model, creativity, college students, innovation and entrepreneurship course



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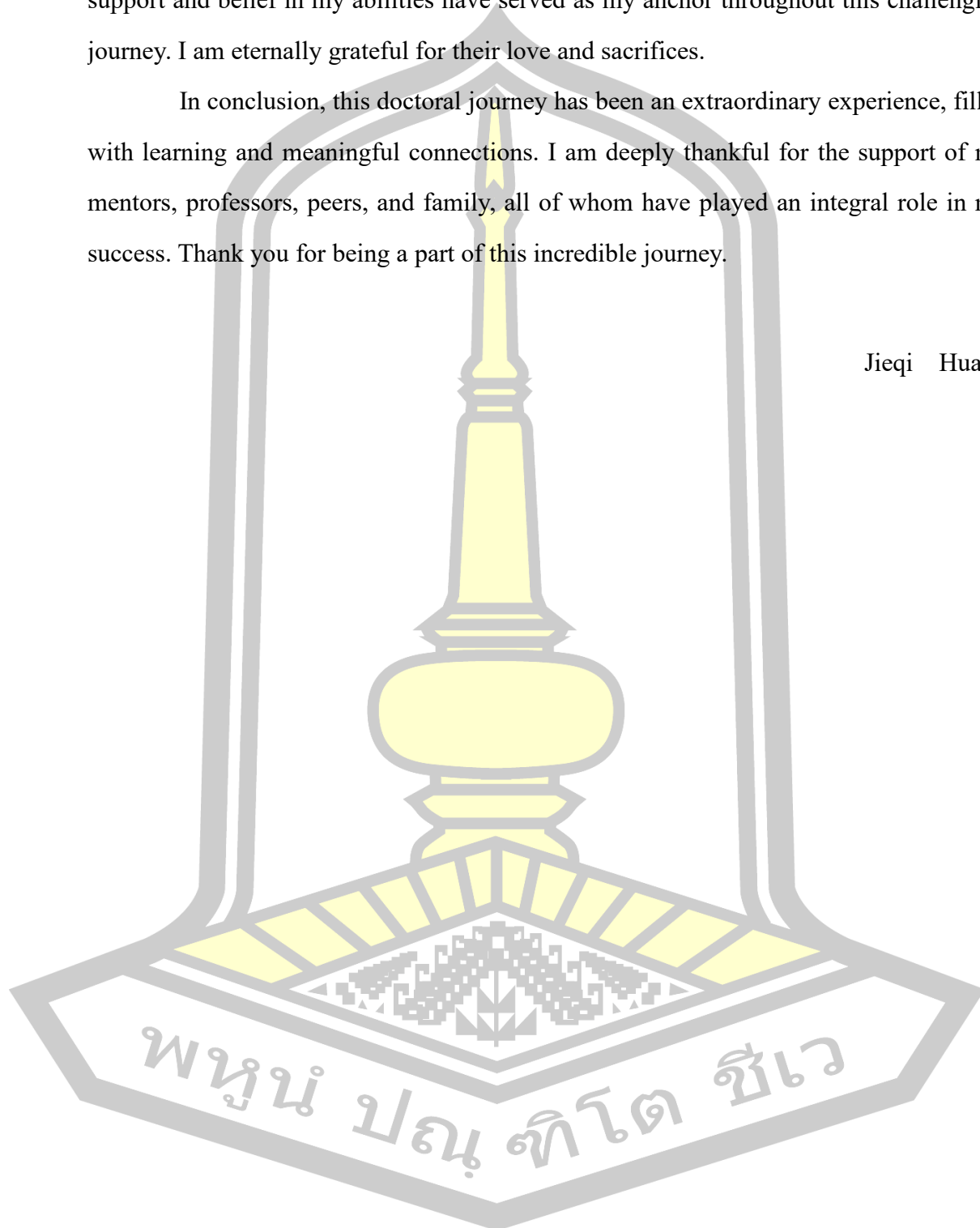


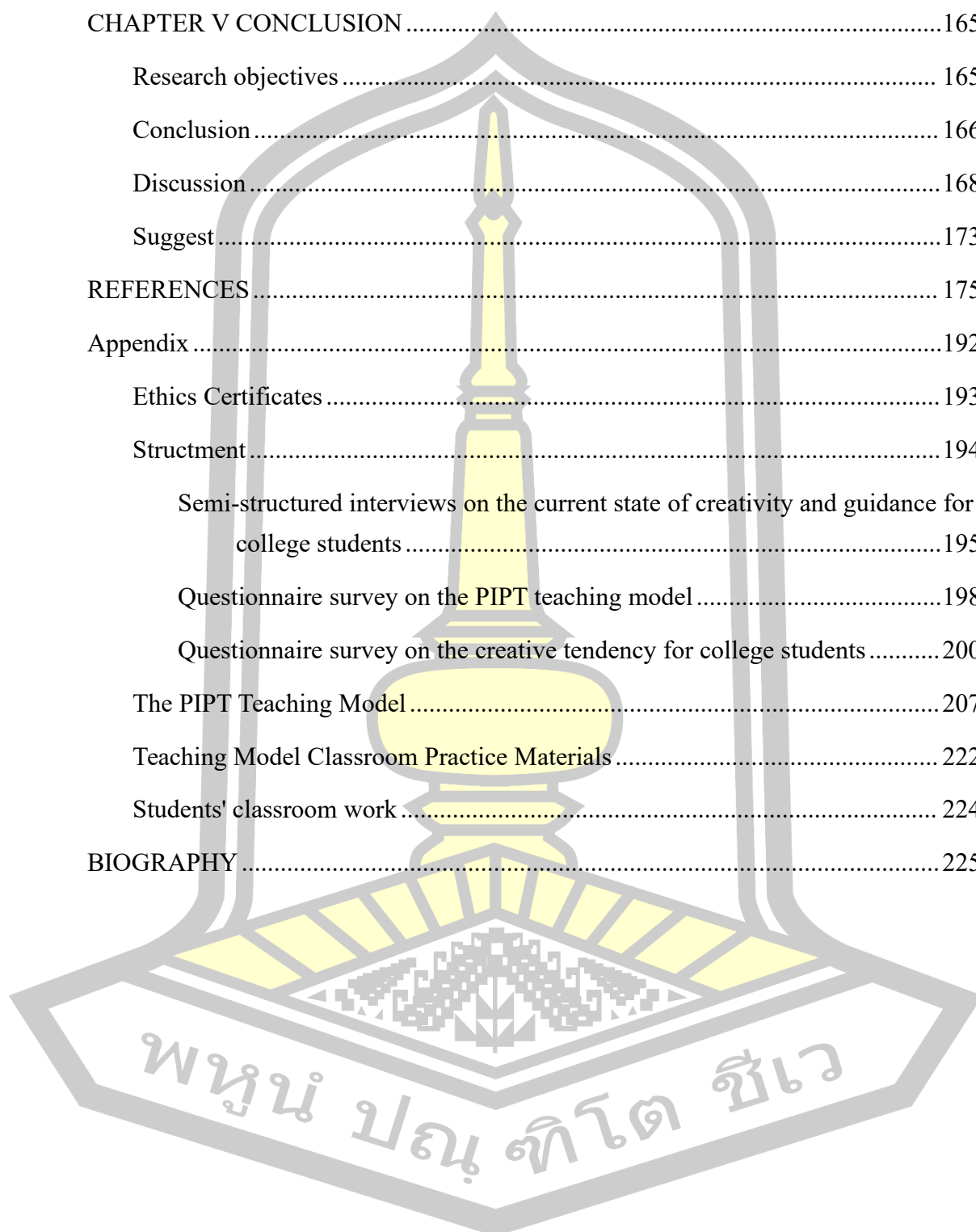
TABLE OF CONTENTS

	Page
ABSTRACT	D
ACKNOWLEDGEMENTS	F
TABLE OF CONTENTS	H
LIST OF TABLES	L
LIST OF FIGURES	M
CHAPTER I Introduction	1
Background	1
Research Questions	6
Research Objectives	7
Hypothesis of the Research	7
Importance of the Research	8
Scope of the Research	8
Definition	11
CHAPTER II LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK	12
Teaching model development theory	14
1. Meaning	14
2. Components	16
3. Type of teaching model	18
4. Teaching model design and development	21
Constructivism teaching model theory	27
1. Meaning	27
2. Types of Constructivist Teaching Models	29
3. Principles of constructivist teaching model development	34

Creativity theory	38
1. Meaning	38
2. Components	42
3. Importance	44
4. How to teach	47
5. Evaluation	50
Guilford's three-dimensional intelligence structure (SOI) theory	53
1. Guilford's Creativity Theory	53
2. Definition of SOI	53
Creative Problem Solving (CPS) Theory	56
1. Creativity can be cultivated through creative training	56
2. CPS model of creative problem solving	57
Constructivist Learning Theory	60
1. Context	61
2. Collaboration	61
3. Conversation	61
4. Meaning Construction	62
Innovation and entrepreneurial course	63
1. Meaning	63
2. Components	69
3. Importance	73
4. How to teach	76
5. Evaluation	82
Related research	86
1. Education for creativity	86
2. Study on the influence of teaching model on college students' creativity ..	89

3. Research on the impact of innovation and entrepreneurial course on college students' creativity	92
4. Research on the teaching model of innovation and entrepreneurial course based on creativity	95
Review of Existing Research	97
Conceptual Framework	98
CHAPTER III RESEARCH METHODS	103
Phase I Contextual Study	106
1. Population and Sampling	107
2. Tools for collecting data	107
3. Tool creation and quality assurance	107
Phase II Developing teaching model	108
1. Population and Sampling	108
2. Development process	109
3. Instrument	110
4. Data collection and Date analysis	111
5. IOC	113
Phase III Implementation	114
1. Population and Sampling	115
2. Research Methods	115
3. Instrument	115
4. Construction and Quality of Instrument	117
5. Measurement and Data Collection	119
6. Statistic for Data Analysis	120
CHAPTER IV DATA ANALYSIS RESULTS	122
Phase I Contextual Study	125
Phase II Developing teaching model	139

Phase III Implementation	153
CHAPTER V CONCLUSION	165
Research objectives	165
Conclusion	166
Discussion	168
Suggest	173
REFERENCES	175
Appendix	192
Ethics Certificates	193
Structment	194
Semi-structured interviews on the current state of creativity and guidance for college students	195
Questionnaire survey on the PIPT teaching model	198
Questionnaire survey on the creative tendency for college students	200
The PIPT Teaching Model	207
Teaching Model Classroom Practice Materials	222
Students' classroom work	224
BIOGRAPHY	225



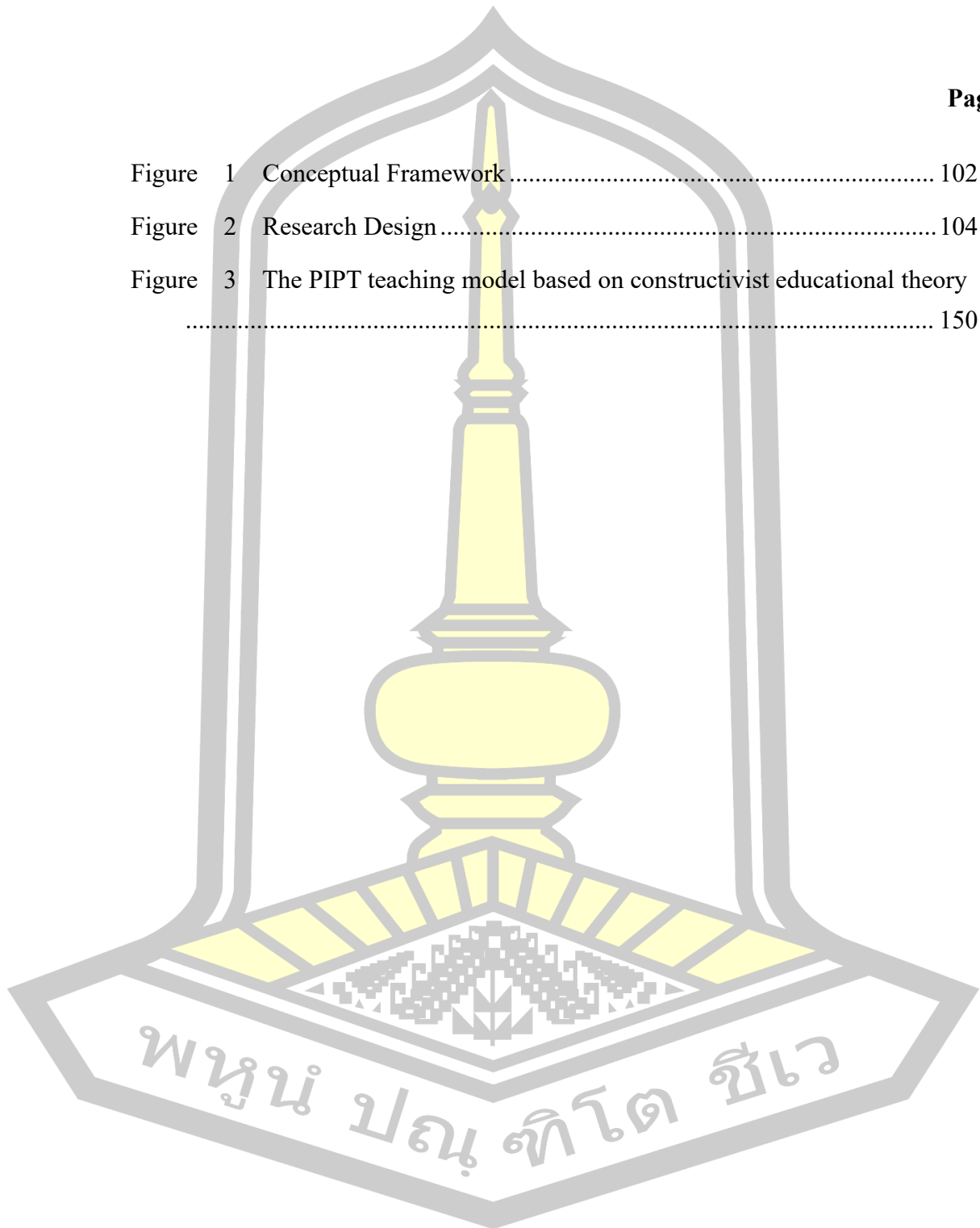
LIST OF TABLES

	Page
Table 1 Research Process	105
Table 2 Results of expert assessment of PIPT teaching models	113
Table 3 Indicators of confirmatory factor analysis	118
Table 4 Quasi-experimental	119
Table 5 Research types of papers	125
Table 6 Theoretical types of papers	125
Table 7 General information of experts	134
Table 8 Results of the necessity of teaching model development	136
Table 9 Results of the PIPT teaching model assessment	151
Table 10 Contents of the course	154
Table 11 Steps of the teaching model	157
Table 12 Evaluation index	159
Table 13 Experimental and control group pre-test data results	161
Table 14 Pre- and post-test results of the experimental group using the PIPT teaching model	161
Table 15 Pre- and post-test results of the control group using the traditional teaching model	162
Table 16 Post-test results for experimental and control groups	163

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LIST OF FIGURES

	Page
Figure 1 Conceptual Framework.....	102
Figure 2 Research Design.....	104
Figure 3 The PIPT teaching model based on constructivist educational theory	150



CHAPTER I Introduction

Background

Creativity stands out as a cornerstone for global progress and individual development. "creativity represents a vital aspect of human intelligence, as the process of having original ideas that have value" (Howard Gardner, 2011). The importance of creativity transcends mere innovation, extending its influence to economic growth, societal advancement, and a profound transformation of human thought processes. Therefore, without the creativity of human mind, there would be no creative practice and creative result (Brodin, 2004). In the realm of personal development for college students, creativity plays a crucial role. Creativity serves as a catalyst for self-discovery, problem-solving, and exploring new perspectives. Of all human activities, creativity comes closest to providing the fulfillment we all hope to get in our lives" (Mihaly Csikszentmihalyi, 1996). Therefore, possessing the ability for creative thinking has become a prerequisite skill for personal and professional success in the 21st century.

Education is a key area for fostering creativity. Creativity is not innate but a psychological state that needs to be cultivated and sparked. Education plays a crucial role in this process (Csikszentmihalyi, M. 1996). Since the 1990s, creativity education has received attention from most countries worldwide. The United States considers the cultivation of creativity and innovative ability as an integral part of "21st-century skills." The European Union emphasizes active and innovative thinking, Japan focuses on creativity and critical thinking skills, Singapore values critical and creative thinking, and the Taiwan region highlights innovative thinking, independent thinking, and proactive exploration. All of these regions regard creativity and innovative awareness as essential components of students' core competency indicators.

Creative teaching model is the foundation of creativity cultivation. Teaching should foster curiosity, imagination, and creativity rather than conformity. A flexible and personalized teaching model is key to nurturing students' creativity (Robinson, K. 2013). Empirical research shows that teachers' teaching models and methods have a strong predictive effect on the formation of students' creative thinking, which mainly guides students through teaching behaviors and enables them to enhance their creative self-efficacy in the process, thus achieving the improvement of creativity (MKaycheng Soh, 2017).

In China, the Innovation and Entrepreneurship course serves as the central vehicle for implementing creativity education among college students. In recent years, China has incorporated creativity education into the national curriculum system, implementing creativity education for all college students with the "Innovation and Entrepreneurship course" at its core. The "Basic Requirements for Entrepreneurship Education Teaching in General Undergraduate Schools (Trial)" issued by the Chinese Ministry of Education in 2012 stipulated that higher education institutions should offer foundational courses in innovation and entrepreneurship for all students, integrating them into the school curriculum. These courses should comprise no less than 32 class hours and carry no fewer than 2 credits.

Subsequently, the national education authorities issued multiple directives requiring college nationwide to implement foundational courses in innovation and entrepreneurship. The directives emphasized the need to reform teaching and assessment methods, focusing on cultivating students' critical and creative thinking. The directives also underscored the examination of students' abilities to apply knowledge for analysis and problem-solving. Therefore, the foundational course in innovation and entrepreneurship, as the primary vehicle for implementing creativity education among Chinese college students, shoulders the significant responsibility of nurturing creative talents. The effectiveness of this course directly influences students' capabilities in innovation and entrepreneurship, thereby reflecting the level of

creativity cultivated.

The creativity level of Chinese college students is generally not high. Although the Chinese government is increasing its emphasis on creative education in colleges, however, traditional educational systems and models, overly focused on standardization, often fail to ignite students' creative potentials (Ken Robinson, 2001). Many survey reports and literature show that the actual effect of Chinese colleges in cultivating creative talents is worrying. The Global Entrepreneurship Monitor (GEM) global report in recent years shows that in the scores of various projects in China's entrepreneurial ecosystem, school entrepreneurship education is lower than the average score in the Asia-Pacific region. The Quality Report of China's Higher Education issued by the Ministry of Education every year pointed out that the problem of the cultivation of creative talents in higher education is prominent, "the cultivation of innovative talents is not enough, and innovation and entrepreneurship education is still the 'soft spot' of China's higher education." The authoritative survey activity "National Youth Creative Ability Training Survey and Countermeasure Research" launched by the Chinese government shows that among Chinese college students, the proportion of teenagers with preliminary creativity characteristics is low, accounting for only 4.7% of the respondents, which is far from that of other innovative countries. Half of the college students still have personality disorder of creative thinking development, which is mainly manifested in four aspects: too rigorous, thinking set, herd psychology, information saturation. According to the survey data of 21 countries and regions in 2009 conducted by the International Assessment of World Education Progress, Chinese students ranked fifth from the bottom in creativity (Wu Xueling, Liu Ying, 2012). The results of the 2018 International Student Assessment (PISA) test released by the OECD in December 2019 show that compared with Western countries with high academic standards, Chinese students are not as efficient in learning, their ability to solve problems cooperatively is not good, and their ability to think creatively is still questioned. (Yu

Yang, 2019; Geng Chao et al., 2020).

In the teaching practice, we also found that there are serious problems in the teaching model of innovation and entrepreneurship course. In China, innovation and entrepreneurship courses aiming at creativity are still following the traditional teaching model: knowledge-oriented, teacher-oriented, and academic performance as the assessment standard. The negative effects of this creativity cultivation are obvious. Highly structured and teacher-centered classrooms, often result in lower creativity levels as they limit students' opportunities for independent thinking and exploration(Hattie, J.2009). The focus on rote memorization and standardized testing in traditional education inhibits the development of creative problem-solving skills, as students are not encouraged to think critically or innovatively"(Perkins, D. N. 1992).Teaching model should focus on developing students' diverse intelligences, catering to various learning styles, and fostering a passion for learning(Robinson, K. 1999). However, although teachers all recognize the intrinsic value of cultivating students' creativity, they find it difficult to teach the common language and methods of creativity to students in the existing teaching mode, and there is no corresponding strategy to support students' creativity cultivation, which also leads to the low performance of Chinese college students in terms of higher-order thinking skills and metacognitive skills.

Literature research reveals that there are still some gaps in the study of China's innovation and entrepreneurship education model. Foreign scholars have already delved into aspects such as course objectives, content, implementation, and evaluation of innovation and entrepreneurship education courses, with detailed and in-depth research. In comparison, Chinese scholars tend to focus on macro-level curriculum system research, lacking sufficient exploration in the areas of innovation and entrepreneurship education teaching models, course objectives, content, and evaluation. There are also some research gaps: firstly, innovation and entrepreneurship education is a relatively macro concept, including innovation and

entrepreneurship courses, practical activities, entrepreneurial competitions, among many others. If not classified, and only summarized as innovation and entrepreneurship education, the subsequent analysis and research lack a certain level of specificity. Secondly, many scholars believe that the ultimate goal of conducting innovation and entrepreneurship education and implementing courses is to enhance students' creativity. However, few researchers have evaluated through empirical studies whether innovation and entrepreneurship courses can truly enhance students' creativity. That is, does participation in innovation and entrepreneurship courses improve students' creativity? Thirdly, currently in Chinese innovation and entrepreneurship education research, scholars are more focused on the theoretical system of innovation and entrepreneurship education, or conducting research on specific antecedent factors affecting students' creativity. There are few empirical research results related to the impact of innovation and entrepreneurship course models on creativity. This article aims to use the developmental perspective prevalent in the field of education, longitudinally examining individual creativity stimulation issues, and enriching the theory of creativity cultivation. There are few empirical research results related to the impact of innovation and entrepreneurship course models on creativity. This article aims to use the developmental perspective prevalent in the field of education, longitudinally examining individual creativity stimulation issues, and enriching the theory of creativity cultivation.

Based on this, researcher believed that researching the teaching models of innovation and entrepreneurship courses in China is highly meaningful for cultivating creativity in college students. Creativity education has been part of Chinese higher education practices for nearly 20 years. However, despite this history, the aspect of education most criticized in China is the inadequate emphasis on cultivating creativity and imagination. The teaching model, viewed from the perspective of educational sociology, is a typical social interaction process. As the most direct and fundamental form influencing the quality of school education, it is a crucial avenue affecting the

cultivation of creativity in college students. The lag in research on teaching models has become a constraint on the development of creativity education in China, evident in both theoretical studies and teaching practices. Therefore, studying the cultivation of creativity in college students through teaching models holds practical significance for higher education in China. In light of this, this paper conducts research on the relationship between teaching models and student creativity development, aiming to transform the paradigm of innovation and entrepreneurship courses in Chinese higher education, with creativity as the core requirement for talent development. By exploring and establishing a teaching model underpinning the development of core student competencies, this research offers insights and strategic suggestions for promoting creativity cultivation in students through the reform of innovation and entrepreneurship courses in Chinese higher education. This holds significant theoretical and practical implications for the ongoing reform of innovation and entrepreneurship education in China.

Research Questions

1. How does the basic information about the development a teaching model to enhance the creativity of Chinese college students?
 - 1.1 What are the applicable theories and principles?
 - 1.2 What are the main problems of the creativity of college students?
 - 1.3 What are the guidelines for developing teaching model to enhance college students' creativity?
2. Based on the innovation and entrepreneurship courses in Chinese colleges, how does the components of teaching model effect on promoting creativity of college students?
 - 2.1 How to develop a teaching model based on the creativity of college students?
 - 2.2 How to assess the components and quality of the teaching model?

3. How does the results effect by implementing the teaching model to promote college students' creativity in innovation and entrepreneurial course?

3.1 How to implement the teaching model?

3.2 How is the level of creativity among college students?

Research Objectives

1.To study the basic information of the teaching model of innovation and entrepreneurship courses based on creativity cultivation

1.1 To study the theories and principles related to college students' creativity

1.2 To study the current situation of college students' creativity

1.3 To study the guidelines for developing teaching model to enhance college students' creativity

2. To develop teaching model to enhance college students' creativity

2.1 To develop a teaching model to enhance the creativity of college students

2.2 To assessing the quality of the teaching model

3. To study the results of using specific teaching model to enhance college students' creativity

3.1 To implement the teaching model

3.2 To compare the creativity level of college students before and after using the teaching model

3.3 To compare post-test of creativity in the experimental and control groups

Hypothesis of the Research

There is a significant difference before and after students' creativity on implementing the teaching model in the innovation and entrepreneurship course.

There is a significant difference in the creativity post-test between students in the experimental and control groups.

Importance of the Research

1. It is a guideline for designing a teaching model to enhance students' creativity for teachers of innovation and entrepreneurship course in China.
2. It provides teaching management tools for Chinese colleges offering creativity and entrepreneurship programs.
3. It is an example for measuring and evaluating the creativity level of Chinese college students.

Scope of the Research

The Research is a Research and Development (R&D) effort, and the research process is divided into the following stages:

Phase I Contextual Study

Research methods

In this stage, researcher studied the theories, concepts, principles and guidelines related to the cultivation of college students' creativity in order to provide guidance for the development of teaching model. Researcher used Documentary Research and Survey Research methods.

Population and sampling

5 experts with relevant qualifications, including 2 expert in curriculum and teaching, 1 expert in research and evaluation, and 2 expert in innovation and entrepreneurship education.

Variables

1. The independent variables is student characteristics, educational environment, educational policies and standards.

2.The dependent variable is the current state of creativity of college students.

Phase II Developing teaching model

Research methods

In this stage, researcher designed and developed the teaching model from the data obtained in the first stage. This includes designing and developing teaching models and assessing the quality of teaching models through expert assessments. In addition, researcher created and validated tools to collect data in the third phase.

Participant

It includes 5 experts with relevant qualifications, including 1 expert in educational technology, 1 expert in curriculum and teaching, 1 expert in educational psychology, 1 expert in research and evaluation, and 1 expert in innovation and entrepreneurship education.

Variables

The dependent variable is the opinions of the constructing teaching model.

Phase III Implementation

Research methods

This stage applies the teaching model to the research target group in order to promote creativity cultivation and study the performance of students in creativity. This stage mainly adopts the method of Experimental Research to study the teaching effect.

Population

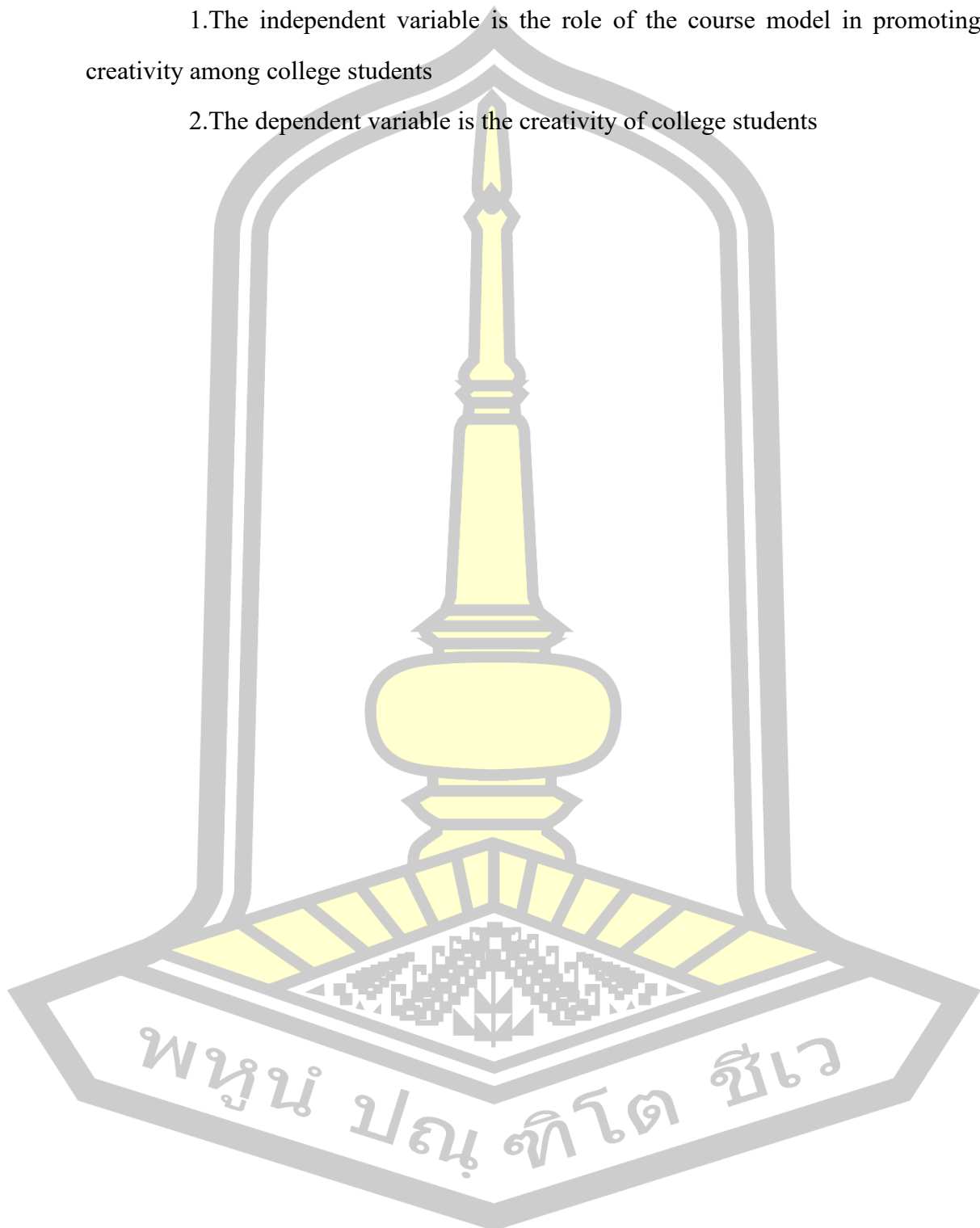
60 freshmen students from Guangzhou Panyu Polytechnic, China

Sampling

The sample for this phase is 60 college students in the academic year 2024 from Guangzhou Panyu Polytechnic, China. They come from different classes of the same major, one is an experimental class that implements a specific teaching model, and the other is a control class that implements a traditional teaching model.

Variables

- 1.The independent variable is the role of the course model in promoting creativity among college students
- 2.The dependent variable is the creativity of college students



Definition

1. Teaching model means a stable structure and operational procedure that reflects the teaching process, guided by specific ideas and theories of learning and teaching, and supported by relevant technologies, resources, and environments. This model is specially designed to achieve designated teaching goals. According to Joyce and Weil, this teaching model comprises six components: Principles of the Model, Objectives, Syntax and Sequence, Social System, Principle of Reaction, and Support System.

2. Creativity means a personality trait or individual capability that can be enhanced through cultivation. Creative individuals, according to this definition, possess the ability to generate original ideas and actively promote the implementation of these ideas, ultimately leading to creative outcomes. Drawing on Williams' Creativity Tendency Theory, researcher argued that creativity education in higher education should respect students' subjectivity. The essence of this approach is to cultivate students' subjectivity and creativity, which test by the creativity tendency scale, encompasses four dimensions of creative tendency: adventurousness, curiosity, imagination, and challenging.

3. The innovation and entrepreneurship course serves as a foundational platform for the implementation of innovation and entrepreneurship education within Chinese higher education institutions. Integrated into the standardized curriculum for all undergraduate students, this course reflects a form of general education. The educational objectives of the course aim to cultivate an innovative spirit and entrepreneurial competencies, particularly creativity, among college students through the delivery of relevant knowledge and skills related to innovation and entrepreneurship."

CHAPTER II LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

In the research, research did the literature review about the teaching model to enhance the creativity, and related research as follows:

1. Teaching model development theory

- 1.1 Meaning
- 1.2 Components
- 1.3 Type of teaching model
- 1.4 Teaching model design and development

2. Constructivism teaching model theory

- 2.1 Definition of the theory
- 2.2 Types of Constructivist Teaching Models
- 2.3 Principles of constructivist teaching model development

3. Creativity theory

- 3.1 Meaning
- 3.2 Components
- 3.3 Importance
- 3.4 How to teach
- 3.5 Evaluation

3.6 Evaluation based on the current situation of Chinese college students'

creativity

4. Guilford's three-dimensional intelligence structure (SOI) theory

- 4.1 Guilford's Creativity Theory
- 4.2 Definition of SOI

5. Creative Problem Solving (CPS) Theory

- 5.1 Creativity can be cultivated through creative training
- 5.2 CPS model of creative problem solving

6. Constructivist Learning Theory

6.1 Context

6.2 Collaboration

6.3 Conversation

6.4 Meaning Construction

7. Innovation and entrepreneurial course

7.1 Meaning

7.2 Components

7.3 Importance

7.4 How to teach

7.5 Evaluation

8. Theoretical Conceptual

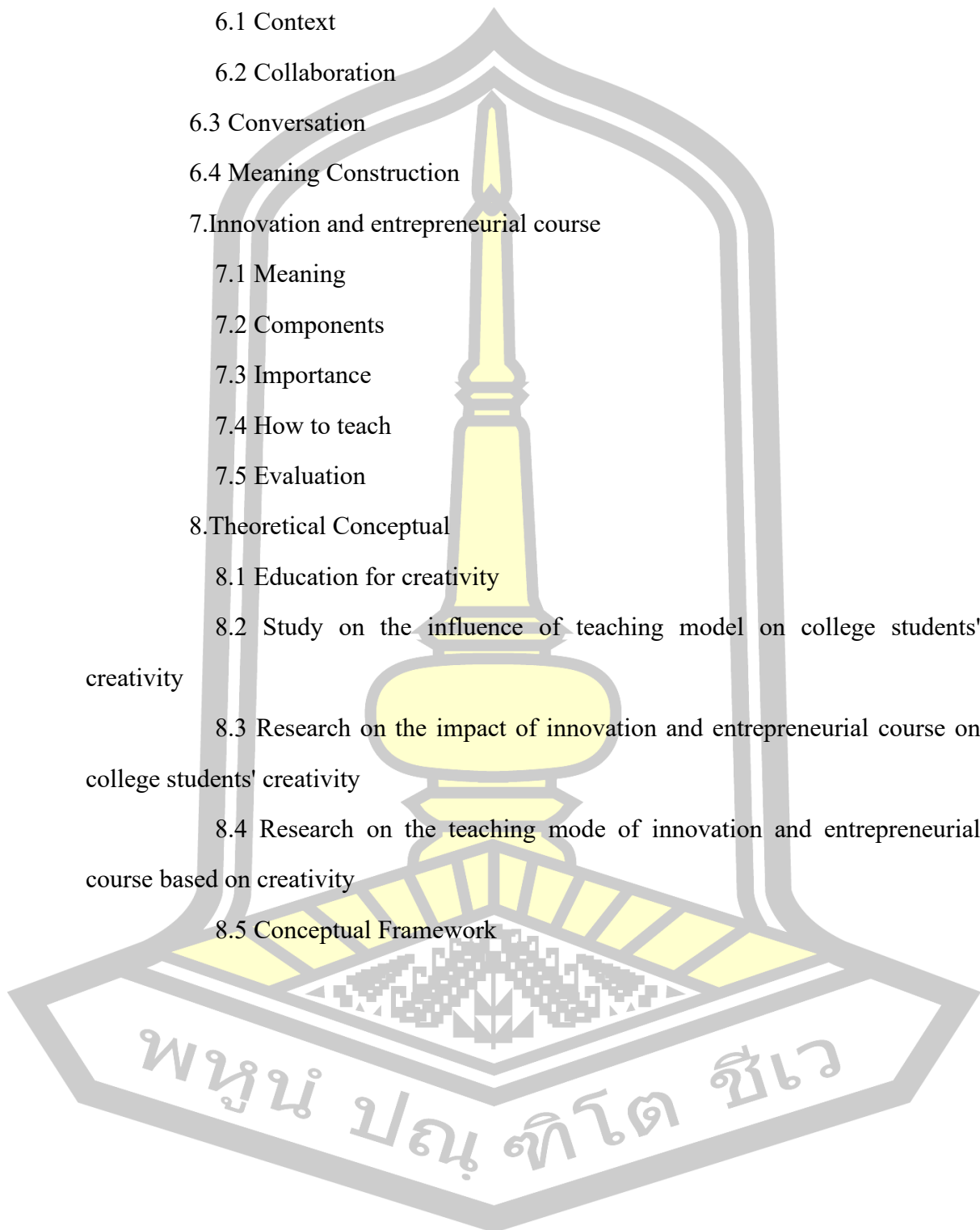
8.1 Education for creativity

8.2 Study on the influence of teaching model on college students' creativity

8.3 Research on the impact of innovation and entrepreneurial course on college students' creativity

8.4 Research on the teaching mode of innovation and entrepreneurial course based on creativity

8.5 Conceptual Framework



Teaching model development theory

1. Meaning

In the 1970s, American education experts Bruce Joyce, Marsha Weil, and Emily Calhoun introduced the term "teaching models" in their collaborative work, "Models of Teaching," marking the initiation of systematic research into this concept. Teaching models are synonymous with learning models, aiming not only to achieve specific educational objectives such as acquiring information, mastering skills, shaping thoughts, and clarifying values but also, crucially, to instruct students on how to learn. This involves enhancing students' ability and speed in acquiring knowledge and fostering autonomous learning skills. Theoretically, teaching models exhibit strong logical coherence and play a significant guiding role in instructional practices.

Joyce, Weil, and Calhoun (2014) define pedagogy as a program or guide used to assist in the management of teaching or teacher teaching, which helps students learn and understand their own learning knowledge, ideas, skills, values, ways of thinking, and expressions more easily and effectively.

In accordance with Tisana's perspective (2012), instructional models are specific arrangements designed to assist in instructional management. They possess systematicity, involving the process or steps of design and development within teaching, guided by principles, theories, concepts, or fundamental beliefs. These models encompass the steps or stages in the instructional process, as well as the principles, theories, concepts, or fundamental beliefs considered in their design and development. They cover instructional methods and approaches utilized throughout the entire teaching activity.

Boonleung and Tumthong (2016) provide a summary, defining instructional models as practical operations designed and developed to achieve specific objectives. Through systematic design and development, these models utilize methods based on

principles, theories, thoughts, or fundamental beliefs. They showcase the relationships among different components, demonstrating the instructional direction aimed at achieving the objectives.

Various conceptual perspectives on teaching models have emerged globally, broadly categorized into five distinct viewpoints. The first perspective is the Structural Paradigm, emphasizing teaching models as stable, systematic, and theoretical teaching paradigms formed around specific teaching themes. The second perspective, Activity Procedure, views teaching models as stable instructional activity structures and procedures based on instructional theories and practical experiences. The third perspective, Method Category, equates teaching models with specific means and methods employed during the teaching process. The fourth perspective, System Elements, posits that teaching models encompass four elements: teacher, student, instructional materials, and environment, forming an interconnected, interactive, and unified organic whole. The fifth perspective, Intermediate Level, considers teaching models as a transitional phase between theory and practice, comprising three levels: theoretical foundation, instructional procedures, and operational methods, reflecting both educational theory and instructional practice.

Despite diverse definitions, teaching models can be broadly classified into two categories: those pertaining to the instructional process and those associated with instructional structure. Moreover, commonalities among these definitions include the requirement for specific educational philosophies or theories as guidance, the necessity to achieve predetermined instructional goals, the presence of relatively stable structural frameworks, the inclusion of specific operational processes, and the need for support from particular resources and environments during application.

Therefore, this study posits that instructional models refer to stable structures and operational procedures specially designed, under the guidance of certain educational philosophies and theories, and incorporating the latest research findings from the learning sciences. These models reflect the teaching process and are

developed to achieve specific instructional objectives, with the support of certain technologies, resources, and environments. This research aims to investigate instructional models utilized in the context of innovation and entrepreneurship courses in Chinese universities, focusing on enhancing creativity development among college students. The study will concentrate on the components, objectives, and teaching processes of instructional models.

2. Components

Jerome Bruner emphasized the importance of an approach that demonstrates the authenticity of knowledge in teaching. According to Bruner's perspective, instructional models should be tailored based on the developmental stages of each learner. Madeline Hunter highlighted the significance of clear objectives, predetermined environment, teaching, demonstration, guided practice, checking understanding, independent practice, and summarization. These components constitute the foundation of an effective instructional model. In China, academia generally believes that the components of instructional models encompass the following aspects:

Theoretical Basis: Instructional models reflect specific teaching theories or pedagogical philosophies, serving as normative guidelines for teaching behaviors under certain theoretical guidance.

Educational Objectives: Every instructional model is directed towards and accomplishes specific educational objectives. Educational objectives hold a central position within the structure of instructional models and exert a constraining influence on other factors constituting the instructional model.

Operational Procedures: Prescribe the sequence of tasks that teachers and students should undertake during instructional activities, specifying what should be done first and what should follow.

Implementation Conditions: Refer to various conditional factors that

enable the instructional model to be effective, including teachers, students, instructional content, teaching methods, teaching environment, and instructional time.

Educational Evaluation: Refers to the unique evaluation methods and standards for completing instructional tasks and achieving educational objectives associated with various instructional models.

According to Joyce, Weil, and Calhoun's Teaching Model (2008), a well-designed teaching model should proposed six components, it reflected their comprehensive understanding of instructional design.

Principles of the model: Refers to the core intent of the model. The main objective of the model is revolved around by focal components.

Syntax and Sequence: This component underscores the organized arrangement of instructional content to ensure the logical and structural progression of the teaching process. Teachers should present information in a clear sequence, facilitating students' better understanding and absorption of knowledge.

Social System: This element focuses on the classroom's social atmosphere and interactions among students. Instructional models should create a supportive social environment that encourages collaboration, sharing, and interaction among students.

Principle of Reaction: This component emphasizes introducing interaction and student engagement to stimulate positive responses. Instructional models should be designed to provoke students' curiosity and active participation.

Support System: This component focuses on providing the necessary support and resources for students to ensure their successful learning. This may include personalized learning support, tutoring, and appropriate teaching tools.

Effect of Instructional Model: This element centers on evaluating and adjusting instructional models to ensure their positive impact on students' learning and growth. This involves periodic assessment, reflection, and continuous improvement.

This study contends that the instructional model framework developed by

Joyce and Weil not only focuses on the organization of subject matter and the design of teaching processes but also underscores the importance of the social environment, the motivating role of student participation, and the necessity for student support. Through continuous assessment and reflection, teachers can adjust instructional models to ensure their alignment with students' learning needs and achieve optimal outcomes. This comprehensive approach contributes to elevating the quality of curriculum design and fostering the holistic development of students. Therefore, based on these instructional model elements as the theoretical foundation, this study categorizes the creativity instructional model into six major components: Principles of the model, Syntax and Sequence, social system, principle of reaction, support system, and the effect of teaching Model.

3. Type of teaching model

Due to the diverse theoretical foundations and educational philosophies upon which instructional practices are based, variations in learning content, objectives, and the forms and processes of instructional activities naturally emerge, leading to the development of different instructional models. According to statistics from Joyce and Weil in 1980, there are more than 20 instructional models. Joyce and Weil (2014), based on the theory and roots of instructional models, distinguish four types of instructional models: 1. Information Processing Instructional Model, 2. Personality (Human Nature) Development Instructional Model, 3. Social Interaction Instructional Model, and 4. Behavior Modification Instructional Model. Veenar Prachakul and Prasart Nuangchalem (2020) propose seven types of instructional model categories: Personality Characteristics Mode, Behaviorist Mode, Subject Methods Mode, Teaching Skills Mode, Process-product Model, Reflective Teacher Model, and Teaching Principles Model.

In the realm of educational technology, a common classification is based on different learning theories, resulting in five main categories of instructional models:

Behavior Modification Model: Primarily grounded in behaviorist learning theory, emphasizing the impact of environmental stimuli on learners' behavioral outcomes. Examples include Skinner's operant conditioning and reinforcement theory, Bandura's observational learning, and behavior correction theory. Teaching methods associated with this model include programmed instruction, mastery learning, simulation, computer-based drills, and exercises. Particularly applicable to knowledge and skill training.

Social Interaction Model: Mainly rooted in social interaction theory, highlighting the mutual influence and social connections between teachers and students, as well as among students. Examples include Bandura's social learning theory, Vygotsky's cultural-historical development theory, etc. Teaching methods encompass cooperative learning, group discussions, role-playing, and social science investigations. Particularly suitable for fostering interpersonal communication skills.

Individual Model of Personality Development: Based on individualized instruction theory and humanistic teaching philosophy, emphasizing the subjective agency of individuals in the learning process and advocating for personalized instruction. Teaching methods include non-directive teaching, heuristic teaching, and discussion-based teaching with emphasis on both commonalities and differences. Suitable for cultivating individuality, divergent thinking, and developing independent learning and problem-solving skills.

Information Processing Model: Mainly rooted in the cognitive theory of information processing, viewing teaching as a creative information processing process. Teaching methods include inquiry methods for concept acquisition, model-based teaching, meaningful reception learning, discovery learning, and investigative methods. Used to enhance logical and critical thinking abilities.

Constructivist Model: Primarily based on constructivist learning theory, emphasizing that learners construct their understanding of things in their own way with the help of others. Teaching methods include situational methods, exploratory

discovery methods, problem-based learning, group research, and cooperative learning. Particularly suitable for advanced knowledge acquisition and cultivating a spirit of scientific inquiry.

This study contends that the teaching model based on constructivism is suitable for cultivating problem-solving abilities and creativity in college students. Grounded in the constructivist learning theory, this teaching model posits that learning occurs through the active engagement of learners in the construction of meaning and knowledge, rather than passive knowledge acceptance. Learners are considered creators of meaning and knowledge in this process. One of the primary goals of constructivist teaching is to foster learners' ability to draw upon their own learning experiences and understand how to learn. Typical constructivist classrooms involve active learner participation, a democratic learning environment, student-centered and interactive teaching activities, and teachers encouraging learners to be more proactive and responsible in the learning process.

A teaching model represents a learning environment. Any type of constructivist learning environment incorporates elements such as "questions" or "big issues," case studies, long-term projects, and problems (complex cases and complete projects at the course level). Therefore, constructivist learning environments can support question/issue-based learning, case-based learning, project-based learning, and problem-based/oriented learning. In constructivist learning environments, the urgent problems to be solved drive learning activities, and the content and theories learned by learners are aimed at addressing these problems. This contrasts with traditional, theory-driven objectivist teaching perspectives, as problems are integrated into the practice of theory.

Building upon constructivist learning theory and learning environments, several mature teaching methods have been developed, including scaffolding instruction, anchored instruction, and reciprocal peer teaching.

4. Teaching model design and development

When designing and developing teaching models, a systematic planning process is essential to achieve both effectiveness and efficiency. In academia, this process is generally considered to involve the following steps:

Needs Analysis: According to Gagné, Briggs, & Wager (1992), the first step in instructional design is to clearly define the needs and goals of the students. Only by fully understanding the students can practical and feasible instructional plans be formulated.

Objective Specification: Mager (1997) points out that instructional objectives should be specific, measurable, and aligned with the actual needs of the students. Clear objectives form the foundation of successful teaching.

Designing Instructional Strategies: "The selection of instructional strategies is closely tied to educators' profound understanding of the subject matter and students. Appropriate instructional strategies are one of the key factors for successful teaching." (Joyce & Weil, 1980)

Implementation: Gagné et al. (1992) propose, "The implementation of the instructional plan requires careful monitoring, with timely adjustments made based on student feedback. Flexibility during implementation is crucial for adapting to students' learning needs."

Teaching models are highly logical in theory and highly instructive in practice, and Joyce and Weil's development of a teaching model consists of the following key steps, each of which is designed to maximize learning outcomes and student comprehension:

Diagnosing Learner Needs: Teachers begin by gathering and analyzing information about their students in a variety of ways, including their background knowledge, learning styles, interests, and possible academic and behavioral barriers. The purpose of this step is to ensure that instruction is individualized and targeted to

better meet student needs.

Setting Objectives: After identifying student needs, teachers set specific, measurable learning objectives. These objectives should be clear to help students understand what they will learn and how they will assess their own progress.

Selecting Teaching Strategies: Based on the set learning objectives and diagnosed student needs, teachers select appropriate teaching strategies and methods. These strategies may include lectures, group discussions, experiments, problem-solving tasks, case studies, etc. to promote student engagement and understanding.

Designing and Organizing Learning Experiences: In this step, teachers design specific instructional activities and learning experiences that support students in achieving the set learning objectives. Activities should provide a meaningful and coherent learning pathway that is contextualized to the students' learning needs.

Implementing Instruction: Teachers are responsible for guiding and supporting the student learning process during the implementation phase. This may include explaining concepts, providing feedback, motivating students to participate in discussions and activities, and ensuring that students are able to understand and apply what they have learned during the learning process.

Assessing and Adjusting: At the end of the instructional process, the teacher assesses student learning outcomes and adjusts instructional strategies and methods based on the results of the assessment. Assessment can be formative (during the learning process) or summative (at the end of the learning cycle) to help teachers understand whether students have achieved the expected learning outcomes and to make improvements for future teaching.

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Currently, in the field of education, several widely utilized instructional model development frameworks include the 5E instructional method, the ADDIE teaching model, flipped classroom, BOPPPS teaching model, Outcome-Based Education (OBE) philosophy, and the CDIO educational model. Among these, the use of the ADDIE model in instructional design is a widely recognized approach, designed specifically for the design and development of instructional systems. The ADDIE model comprises the following five steps:

Analysis: This stage aims to gather, analyze, and evaluate educational issues and needs. In this step, educators need to understand the target audience, learning environment, learners' prior knowledge and skill levels, and any factors that may impact course design. The goal of analysis is to ensure that the designed instructional model or course meets the actual needs of students and organizations.

Design: In the design stage, based on the results of the analysis, educators formulate the framework for instructional strategies and materials. This includes defining learning objectives, selecting teaching methods, establishing assessment criteria, determining instructional content, and identifying resources. The design stage focuses on creating a comprehensive instructional plan, ensuring it aligns with learning objectives and effectively conveys knowledge.

Development: In the development stage, educators begin creating instructional materials and resources based on the designed framework. This may involve creating presentations, writing textbooks, developing multimedia resources, and designing interactive learning activities. The goal of the development stage is to transform the planned design into educational materials that can be practically used for teaching.

Implementation: The implementation stage is the process of putting the instructional plan into practice. This includes educators starting to use the developed materials in the teaching environment, interacting with students, and imparting knowledge. During this stage, adjustments may be necessary to adapt the teaching

process to meet the needs and feedback of students.

Evaluation: The evaluation stage aims to assess the effectiveness of the instructional plan and learning outcomes. This may include formative evaluation (conducted during the teaching process) and summative evaluation (conducted after the teaching concludes). Through evaluation, educators can identify the successes of the instructional plan, areas for improvement, and insights for future instructional design.

The five steps of the ADDIE model form a cyclical process that can be flexibly applied in each instructional project, ensuring that educational design is systematic, effective, and continually improved based on evaluation results. Therefore, this study applied the ADDIE model and the Research and Development (R&D) framework to design and develop the instructional model.

In this study, researcher grounded in constructivism and utilizing the 6 elements of Joyce and Weil's instructional model, applied the ADDIE model and the Research and Development (R&D) framework to design and develop an instructional model. The specific steps are outlined as follows:

Analysis (A): Research and analyze basic data, including information on the current situation or issues obtained from literature, research results, or observations of relevant individuals. This information guides the design and development of the instructional model. Outcomes from this stage include a curriculum needs assessment report, learner analysis, course outline, design methods, assessment strategies, and project schedule.

Design (D): This step transforms data into an instructional model, involving the execution of various activities to achieve established goals. Results from the design stage include course objectives, design documents, instructional prototypes, and course flowcharts.

Development (D): This step puts the results obtained from the design step into practice, carrying out actual development work. The data obtained is designed

and developed into an instructional model, and its effectiveness is evaluated by experts. Outcomes from the development stage include supporting materials, instructional content, and course management procedures.

Implementation (I): The fully developed instructional model is applied to the targeted student group in the research. Outcomes include class rosters, instructional implementation, and support plans.

Evaluation (E): The purpose of this step is to assess the instructional model and use the findings for improvement. Results from the evaluation step include implementation documents, course effectiveness, and course impact.

Additionally, researchers applied the developed instructional model to the targeted student group in the study. The study focused on the development of creativity in university students and the effectiveness of student use of the instructional model. The developed curriculum model mainly includes the following components:

Principle : Objectives, theories, principles, and basic concepts constituting the teaching model.

Objective: To enhance creativity for college students.

Syntax: Detailed information on instructional steps or activities. It explains the logical sequence of activities in the teaching process, outlining the complete procedure and plan of the instructional model.

Social System: Describes the characteristics of the learning environment, including the roles and relationships between teachers and students.

Principles of Reaction: Describes the teacher's response to student behavior, such as rewarding students, encouraging expression of opinions, or refraining from evaluation. Teacher reaction principles must align with the theory used to create the model.

Support System: Explains the conditions or necessary requirements for the successful application of the model, including all instructional media and technical

support used in the instructional model.

Application: Provides recommendations and observations to assess the application effectiveness of the instructional model.

Effect of Instructional Model: Describes the effects brought about by using the instructional model, encompassing both the primary instructional objectives and additional benefits obtained from using the model. This provides guidance for teachers in considering and choosing instructional models.

Constructivism teaching model theory

1. Meaning

The earliest proponent of constructivism can be traced back to J. Piaget et al. of Switzerland. On the basis of Piaget's theory, Kohlberg made further research on the nature of cognitive structure and the developmental conditions of cognitive structure; Stenberg and Katz emphasized the key role of individual initiative in the process of constructing cognitive structure and explored how to give full play to individual initiative in the cognitive process; and Vygotsky founded the "cultural-historical-developmental theory" emphasized the cognitive process in the process of cognitive development. Vygotsky's "cultural-historical theory of development" emphasizes the role of the social and cultural-historical background of the learner in the cognitive process, on the basis of which Vygotsky's Veleri school of thought studied the important roles of "activity" and "social interaction" in the development of the higher mental functions of human beings in depth. On this basis, the Veleroy school, led by Vygotsky, thoroughly studied the important role of "activity" and "social interaction" in the development of human higher mental functions. All these researches have further enriched and improved the constructivist theory and created conditions for its practical application in the teaching process.

Constructivist learning theory emphasizes student-centeredness, which not

only requires students to change from passive recipients of external stimuli and objects of knowledge inculcation to the main body of information processing and active constructors of knowledge; but also requires teachers to change from knowledge transmitters and inculcators to the helpers and facilitators of students' active construction of meaning. This means that teachers should adopt a new teaching mode, a new teaching method and a new teaching design idea in the teaching process, thus forming a new generation of learning theory - constructivist learning theory at the same time, but also gradually formed a new generation of teaching modes, teaching methods and teaching design ideas that are compatible with the constructivist learning theory. The idea of constructivist learning theory has also been gradually formed.

Teaching model refers to the stable structure of teaching activities under the guidance of certain educational ideas, teaching theories and learning theories, and carried out in a certain environment. The short form of teaching activity process is usually called "teaching process". As we all know, the traditional teaching process consists of three elements: teachers, students and teaching materials. In modern teaching, a variety of teaching media are usually used, so the element of "media" should also be added. These four elements in the teaching process is not isolated from each other, not related to each other simply combined together, but interconnected, interacting with each other to form an organic whole. Since it is an organic whole, it must have a stable structure, and the stable structure formed by the four elements of the teaching process is called "teaching mode".

Constructivist learning theory advocates teacher-guided, student-centered learning; constructivist learning environments contain four elements: context, collaboration, conversation, and meaning construction. In this way, we can generalize the teaching mode that is compatible with the constructivist learning theory and the constructivist learning environment as follows: "student-centered, with the teacher playing the role of an organizer, guide, helper and facilitator during the whole

teaching process, and giving full play to the students' initiative, motivation and spirit of initiative by utilizing the elements of the learning environment such as context, collaboration, and conversation, so as to achieve the goal of enabling the students to effectively realize their knowledge of the current learning situation, and to make them more aware of the importance of learning. The learning environment elements such as context, collaboration and conversation are utilized to give full play to students' initiative, enthusiasm and creativity, and finally achieve the purpose of enabling students to effectively realize the meaning construction of the knowledge they are currently learning.” In this model, students are the active constructors of knowledge meaning, rather than passive recipients of external stimuli; teachers are the organizers, guides, helpers and facilitators of the teaching process of meaning construction, rather than the knowledge of the transmitter, the instiller; textbooks provide knowledge is no longer the content of the teacher's teaching, but the object of the students' active construction of meaning; the media is no longer a means to help the teacher to teach knowledge, The media is no longer a means to help teachers impart knowledge, but is used to create situations, collaborative learning and conversational exchanges, i.e., as a cognitive tool for students' active learning and collaborative exploration. Obviously, in this context, the four elements of teachers, students, teaching materials and media have completely different roles and relationships with each other compared with traditional teaching. However, these roles and relationships are very clear and explicit, and thus become another form of stable structure for the process of teaching and learning activities, i.e., the model of teaching and learning in the constructivist learning environment.

2. Types of Constructivist Teaching Models

Under the constructivist teaching model mentioned above, the following teaching methods have been developed and are relatively mature.

2.1 Scaffolding Instruction

According to the relevant documents of the European Community's "Distance Education and Training Program" (DGX III), Scaffolding Instruction is defined as: "Scaffolding Instruction should provide a conceptual framework for learners to construct their understanding of knowledge. The concepts in such a framework are needed to develop the learner's further understanding of the problem by breaking down complex learning tasks in advance in order to facilitate the gradual progression of the learner's understanding." Obviously, this kind of teaching idea is derived from the famous Soviet psychologist Vygotsky's "nearest developmental zone" theory. It is from Vygotsky's idea that constructivists borrowed the "scaffolding" (Scaffolding) used in the construction industry as a figurative analogy for the conceptual framework mentioned above, which in essence is used as a scaffolding in the learning process. The concepts in this framework are needed for the development of students' further understanding of the problem, that is, the framework should be established in accordance with the "nearest developmental zone" of the students' intelligence, so that the scaffolding can be used as a support to constantly raise the students' intelligence from one level to another new higher level, so that teaching and learning can be truly realized. Go to the front of development.

Scaffolding teaching consists of the following links:

(1) Building scaffolding: build a conceptual framework around the current learning theme, according to the requirements of the "nearest developmental zone".

(2) Contextualization: Introduce students to a problem situation.

(3) Independent Exploration: Allow students to explore independently. Exploration involves identifying the attributes that are relevant to a given concept and arranging the attributes in order of importance. Exploration of the beginning of the teacher to inspire and guide, and then let the students to analyze their own; explore the process of the teacher should be prompted at the right time, to help students along the conceptual framework of the gradual climb.

(4) Collaborative learning: group consultation and discussion. The results of

the discussion may make the original determination, and the concept of the current study of the attributes related to the increase or decrease in the order of the various attributes may also be adjusted, and make the original contradictory views, and a variety of attitudes of the complex situation gradually become clear and consistent. On the basis of sharing the results of collective thinking to achieve a more comprehensive and correct understanding of the current concepts learned, that is, the final completion of the construction of the meaning of the knowledge learned.

(5)Evaluation: The evaluation of learning effects includes the self-evaluation of individual students and the evaluation of individual learning in the learning group, the evaluation includes: independent learning ability; the contribution to the group collaborative learning; whether to complete the construction of the meaning of the knowledge learned.

2.2 Anchored Instruction

This kind of teaching requirements based on the infectious real events or real problems. Determination of such real events or problems is compared to the image of “anchor”, because once such events or problems are determined, the entire teaching content and teaching process is also determined. According to constructivism, the best way for learners to complete the construction of meaning for what they have learned, i.e., to achieve a deep understanding of the nature of the things reflected in the knowledge, the laws, and the connection between the things and other things, is to let the learners go to the real world in the real environment to feel, to experience, rather than just listening to others about the experience of the introduction and explanation. Anchor-based instruction is sometimes called “example-based instruction” or “problem-based instruction” because it is based on real-life examples or problems. Anchor teaching consists of several parts.

(1) Creating a situation: Enabling learning to take place in a situation that is basically the same as or similar to the real situation.

(2) Determine the problem: In the above situation, select the real events or

problems closely related to the current learning topic as the center of learning. The selected event or problem is the “anchor”, and the function of this link is to “throw the anchor”.

(3) Independent Learning: Instead of the teacher telling the students how to solve the problem, the teacher provides the students with clues to solve the problem, and pays special attention to the development of the students' “independent learning” ability. Self-directed learning skills include: 1) the ability to define a content list; 2) the ability to obtain relevant information ; 3) the ability to utilize and evaluate relevant information.

(4) Collaborative Learning: Discussion and exchange, through the exchange of different views, to supplement, correct and deepen each student's understanding of the issue at hand.

(5) Evaluation of the effect: Because the anchor teaching requires students to solve the real problems faced, the learning process is the process of problem solving, that is, the process can be directly reflected in the learning effect of the students. Therefore, the evaluation of the effectiveness of this kind of teaching often do not need to be independent of the teaching process of the special test, just in the learning process at any time to observe and record the performance of the students can be.

2.3 Random Access Instruction

Due to the complexity of things and the multi-faceted nature of the problem, to achieve a comprehensive understanding and mastery of the inner nature of things and the interconnection between things, that is, to achieve a comprehensive and deep meaning of the knowledge learned is very difficult to construct. Often from different perspectives can lead to different understandings. In order to overcome this shortcoming, in teaching, we must pay attention to the same teaching content, in different times, different situations, for different teaching purposes, with different ways to present. In other words, the learner can enter the same teaching content

through different ways, different ways of learning, so as to obtain the same thing or the same problem of multi-faceted knowledge and understanding, which is the so-called “random access to teaching”. Obviously, the learner through a number of “into” the same content will be able to achieve a more comprehensive and in-depth mastery of the knowledge content. This multiple entry, not as in traditional teaching, just for the consolidation of general knowledge, skills and the implementation of simple repetition. Here each entry has a different learning purpose, have a different focus of the problem. Therefore, the result of multiple entries is not only a simple repetition and consolidation of the same knowledge, but also a leap in the learner's understanding of the whole picture of things.

The basic idea of random access teaching comes from a new branch of constructivist learning theory - “cognitive flexibility theory”. The purpose of this theory is to improve learners' comprehension and their ability to transfer knowledge. Randomized access teaching includes the following links:

(1) Presentation of the basic situation: students are presented with a situation that is related to the basic content of the current learning topic.

(2) Randomized access: Depending on the content chosen by the students for “randomized access” learning, contexts related to different aspects of the current learning topic are presented. In this process, teachers should pay attention to the development of students' independent learning ability, so that students gradually learn to learn on their own.

(3) Thinking development training: Because the content of randomized access learning is usually more complex, the problem often involves many aspects, so in this type of learning, teachers should also pay special attention to the development of students' thinking skills. The method is: 1) the interaction between the teacher and the students should be in the “metacognitive level”; 2) pay attention to the establishment of the student's thinking model, that is, to understand the characteristics of the student's thinking; 3) pay attention to the development of the student's divergent

thinking.

(4) Collaborative learning in small groups: group discussions are organized around the understanding gained from presenting different aspects of the situation. In the discussion, each student's point of view is examined and commented in the social negotiation environment established with other students and the teacher, and at the same time, each student also thinks about and reflects on others' views and opinions.

(5) Evaluation of learning effects: including self-evaluation and group evaluation, the evaluation content is the same as in scaffolding teaching.

As can be seen from the above introduction, although there are many different forms of constructivist teaching methods, but also has its commonality, that is, their teaching links include the creation of context, collaborative learning, and on this basis by the learners themselves to ultimately complete the construction of the meaning of the knowledge they have learned. This is determined by the learning environment of constructivism. The learning environment of constructivism contains four elements: context, collaboration, conversation and meaning construction. Since all of the above teaching methods are implemented in a constructivist learning environment, they cannot but be constrained by these elements, otherwise they will not become a teaching process under the guidance of constructivist theory.

3. Principles of constructivist teaching model development

Because the constructivist learning theory emphasizes student-centered, that students are the main cognitive body, is the active constructor of knowledge; teachers only help and promote the construction of meaning for students, and does not require teachers to teach and instill knowledge directly to students. It can be seen that in the constructivist learning environment, the status and role of teachers and students have changed greatly compared with traditional teaching. In this case, it is obviously inappropriate to use the traditional teaching mode design theory and method to guide. For this reason, based on the theory of constructivist teaching model, this study

summarizes the principles of teaching model development used in it as follows.

3.1 Emphasize student-centeredness

Clarifying “student-centeredness” is crucial to instructional design, because a “student-centered” or “teacher-centered” approach will result in two very different designs. This is a crucial guideline for instructional design, as whether it is student-centered or teacher-centered will result in two very different designs. As to how to reflect student-centeredness, constructivism suggests that efforts can be made in three ways.

- (1) To give full play to the initiative of students in the learning process, to reflect the students' pioneering spirit;
- (2) To give students multiple opportunities to apply what they have learned in different situations (to "externalize" knowledge);
- (3) Students should be able to form their understanding of objective things and solutions to practical problems according to the feedback information of their own actions.

3.2 Emphasize the important role of “context” in the construction of meaning

Constructivism believes that learning is always associated with a certain social and cultural background that is “context”, learning in the actual context can enable learners to use their own original cognitive structure of the relevant experience to assimilate and index the current learning to the new knowledge, so as to give the new knowledge some kind of meaning; if the original experience can not be assimilated to the new knowledge, then to cause the “conformity” process, that is, the original cognitive structure for transformation and restructuring. If the original experience can not assimilate the new knowledge, it will cause the “conformity” process, that is, the original cognitive structure for the transformation and reorganization. In short, it is only through “assimilation” and “adaptation” that the meaning of new knowledge can be constructed. In traditional classroom teaching,

because of the failure to provide the vividness and richness of the actual situation, the process of assimilation and adaptation is more difficult to occur, which will make it difficult for learners to construct the meaning of knowledge.

3.3 Emphasize the key role of “collaborative learning” in the construction of meaning

According to constructivism, the interaction between learners and the surrounding environment plays a key role in the understanding of learning content. This is one of the core concepts of constructivism. Students are organized and guided by the teacher to discuss and interact with each other, and to form and be part of a learning community. In such communities, theories, ideas, beliefs and hypotheses are critically examined; they are negotiated and debated, first internally and then with each other. Through such a collaborative learning environment, the thinking and wisdom of a group of learners can be shared by the whole group, i.e., the whole group of learners can work together to complete the meaning construction of what they have learned, rather than one or several students completing the meaning construction.

3.4 Emphasize the design of learning environment

According to constructivism, the learning environment is a place where learners can explore freely and learn independently. In this environment, students can utilize various tools and information resources to achieve their learning goals. In this process, students not only receive help and support from teachers, but also collaborate and support each other. According to this concept, learning should be facilitated and supported rather than strictly controlled and dominated; the learning environment is a place that supports and facilitates learning. Instructional design guided by constructivist learning theory should be designed for the learning environment rather than the teaching environment. This is because teaching implies more control and domination, while learning implies more initiative and freedom.

3.5 Emphasize the use of various information resources to support “learning”.

In order to support learners' active exploration and complete the construction of meaning, a variety of information resources should be provided for learners in the learning process. However, it must be clear that the use of these media and materials is not to assist the teacher's explanations and demonstrations, but to support students' independent learning and collaborative exploration. Therefore, the section on "Selection and Design of Instructional Media" in traditional instructional design will be handled in a completely new way. For example, in traditional instructional design, the presentation of media is carefully designed according to the cognitive psychology and age characteristics of students. Now that the power to select, use and control media has been given to students, such design is no longer necessary. On the contrary, the questions of how and where to obtain information resources and how to effectively utilize them have become the urgent need for teachers to provide assistance in the process of active exploration. Obviously, these problems are not encountered in the traditional instructional design or rarely encountered, but in the constructivist learning environment, it becomes an urgent need to solve the general problem.

3.6 Emphasize that the ultimate goal of the learning process is to complete the construction of meaning

In traditional instructional design, teaching objectives are above all else, they are both the starting point and the destination of the teaching process. Through the analysis of teaching objectives, we can determine the required teaching content and the order of the teaching content; teaching objectives are also the basis for checking the final teaching effect and evaluating the teaching. However, in the constructivist learning environment, since it is emphasized that students are the cognitive subjects and active constructors of meaning, the students' construction of meaning of knowledge is taken as the ultimate goal of the whole learning process. In such a learning environment, the teaching design usually does not start from analyzing the teaching objectives, but from how to create a situation conducive to the

construction of students' meaning, the whole teaching design process is tightly focused on the “construction of meaning” as the center of the development, whether it is the independent exploration of the students, collaborative learning or teacher counseling, in short, all the activities of the learning process should be subordinate to the learning process, and the learning process should be based on this concept. In short, all activities in the learning process should be subordinate to this center, and should be conducive to the completion and deepening of the meaning of the knowledge constructed.

Creativity theory

1. Meaning

The research on creativity has a long history and has accumulated a wealth of theoretical and empirical research results. The study of creativity can be traced back to the mid-20th century by psychologist Joy. P. Guilford proposes that divergent thinking is at the heart of creativity. With the deepening of related research, the definition of creativity has gradually shifted from the traditional and single structural perspective to the multiple and systematic perspective, so as to reveal the connotation of creativity more comprehensively.

Creative interpretation of a single structure. In the early studies of creativity, researchers interpreted creativity mainly from four aspects: personality, process, product and environment. To be specific, the interpretation of creativity from the perspective of personality traits starts from the level of individual differences and believes that creative people have more unique personality traits than ordinary people. Guilford points out that whether people can achieve creative results may not be determined by intelligence, but may be related to their sensitivity to problems, divergence of thinking, motivation and other qualities. In terms of the interpretation of creativity from the perspective of process, relevant studies include the exploration of

the stages and types of the creative process, among which the famous one is the four-stage theory of the creative process proposed by Wallas, who believes that the creative process involves the preparation period, the gestation period, the clarity period and the verification period. Slavich and Svejenova summarize the relevant definitions of the creative process and find that researchers also define the creative process in terms of cognition, participation, interaction, and result formation. From the perspective of interpreting creativity from the perspective of products, many researchers have sought after creativity because of its operability. According to the "standard definition" proposed by Runco and Jaeger, the creativity of a product should consider two factors: Newness or Originality and Usefulness. Instead of emphasizing the innate traits of individuals, some researchers believe that sufficient attention should also be paid to the important role of the acquired environment in supporting the expression of creativity. In other words, creativity can be regarded as the product stimulated by external environment or pressure. For example, Davies, Jindal-Snape and Collier reviewed the relevant literature and found that the availability of resource materials, flexibility of time and space, outdoor environment and other factors play an important role in the development of children's creative skills.

Creative interpretation of multiple structures. Defining creativity from a variety of single-level perspectives has shown that creativity is a complex and multifaceted concept, so it is obvious that it is incomplete and insufficient to characterize creativity from only one aspect. As a result, it has become a new trend to define creativity by including multiple factors. Plucker, Beghetto, and Dow, based on a literature review, define creativity as "the interplay between capabilities, processes, and environments through which an individual or group can produce products that are both novel and useful in a social context." In addition, researchers such as Amabile, Csikszentmihalyi, Glveanu and others selected different components to construct complex creativity models based on an integrated view, in order to represent creativity more carefully and comprehensively.

An interpretation of creativity from a systematic perspective. The multi-component creativity model has caused researchers to think about the generality and particularity of creativity. On the one hand, some researchers believe that creativity has domain generality, and they regard creativity as a kind of universal characteristics and abilities across fields, that is, highly creative individuals in different fields have similar personality traits, and the creative performance of individuals in different fields shows strong correlation. On the other hand, researchers who argue that creativity is domain specific point out that creativity is supported by certain knowledge and skills, which vary from domain to domain. For example, the definition of creativity in education and business is more focused on problem solving, while the definition of creativity in psychology is more from the perspective of psychometrics. The amusement park theoretical model of creativity (APT) holds that creativity contains both domain generality and domain specificity, and points out that even in the same domain, there are also great differences in creativity in different task situations. In particular, with the elaboration and deepening of the research of creativity in different fields, the particularity of the field of creativity becomes more and more distinct.

To examine creativity from different fields is to explore creativity from a horizontal and transferable perspective, while to look at creativity from a vertical and developable perspective needs to consider the level of creativity. Cropley believes that outstanding experts who have made extraordinary achievements in their field and are widely acclaimed are representatives of people with high creativity, which is referred to as Big-C. In contrast, the creative output of ordinary individuals in a task in a specific domain is called Small-C, also known as Everyday creativity. In other words, individuals can also show creativity in their daily lives. Kaufman and Beghetto further divided the level of creativity in more detail and designed a 4C creativity model, which specifically covers: Mini-C (a creative experience that is personally meaningful), Little-C (everyday creativity), Pro-C (a new achievement that brings

important progress to a field), and Big-C (a major creative breakthrough that is recognized throughout history). The definition of creativity levels based on these different levels shows that everyone is creative and that different people have different levels of creativity. This affirms the creative excellence of experienced creators in the field, recognizes the creative potential of even young children, and implies a path for creative development.

It can be seen that the conceptual definition of creativity is complex and diverse, including various expressions of personality traits, processes, products, and environments. Although different scholars have different definitions of the concept of creativity, the recognized characteristics of creativity revolve around four aspects: usefulness, appropriateness, originality and novelty. After reviewing the literature in more than 90 journals, Plucker et al. proposed the following definition: Creativity is the interaction of capabilities, processes, and environments that enable individuals or groups to produce not only novel but useful products in a social context. Creativity is generally defined as the process of exploration, imagination, and creative thinking based on personal knowledge, motivation, emotion, and experience that leads to the creation of new, useful, and valuable products (ideas, solutions, or specific things) in which curious people explore to discover problems. Observe and ask questions to understand how others create new things. Curiosity, imagination and creative thinking are considered to be the core processes of creativity. Although creativity has proven to be a complex concept in the field of education, there is general agreement among researchers that the definition of creativity requires two core criteria: originality (i.e., novelty, uniqueness, etc.) and value (i.e., meaningfulness, meeting task constraints, or effectiveness). The Qualification and Curriculum Authority understands creativity as boosting self-esteem, motivation and achievement, preparing students for life and enriching their life experiences. According to the literature review, based on the cultural background of creativity, this paper defines creativity as a personality trait or personal ability that can be improved through cultivation. Creative students can

generate original ideas and actively promote the implementation of ideas, and finally get creative results.

2. Components

Based on the multi-angle, three-dimensional and systematic definition of creativity, exploring the core components of creativity can provide feasible ideas for cultivating creativity. In many researches on creativity theory, some researchers believe that creativity is a complex system involving multiple factors and interactions, and based on this view, they integrate various components and propose a broader and comprehensive creativity theoretical model. These components can be roughly divided into internal factors and external factors two aspects. Internal factors mainly refer to individual cognitive components and non-cognitive components, the former such as divergent thinking, convergent thinking, knowledge and skills, the latter such as motivation, attitude, personality traits, etc., while external factors point to the external physical environment, humanistic background, overall atmosphere and so on.

Nijstad, Dreu and Rietzschel believe that creativity depends on the quality of flexible thinking and the spirit of perseverance and deep exploration, which can produce a rich variety of new and unique ideas. A Dual pathway to creativity model is constructed from the two dimensions of Flexibility and persistence. On the basis of intellectual factors and non-intellectual factors, Lin Chongde holds that individuals with both creative thinking and creative personality can be called creative talents. Sternberg's triad theory of creativity points out that "the creation of creativity is the result of the interaction of three levels, namely Intelligence, Cognitive intellectual types and Personality/Motivation." Feldhusen believes that knowledge base, metacognitive skills and personality traits are the main causes of the formation of creative products. The Creativity component model proposed by Amabile includes Task motivation and Domain-relevant skills skills and creativity-relevant skills. The higher the degree of integration of these three elements, the higher the level of

Creativity an individual will display. Among them, task motivation refers to the willingness and attitude of an individual to participate in a certain task, domain-related skills are the knowledge skills and relevant experience that an individual has mastered, and creation-related skills refer to the personality traits, divergent thinking ability and cognitive style related to an individual's creation.

Although internal factors play an important role in creativity, individual creativity needs to be carried out in a certain external environment. Therefore, relevant studies on the influence of external environment on creativity from the perspective of social psychology have gradually attracted the attention of researchers. In fact, Amabile's creative component model also includes an external component, that is, the social environment. She believes that the environment can affect every internal component of an individual. For example, the conditional restrictions of the external environment may transform the internal motivation into the external motivation, thus destroying the creative behavior. On the basis of the tripartite theory of creativity, Sternberg further considered the importance of environmental context, and added two elements, such as knowledge and thinking form, to form an expanded theory of the essence of creativity with six elements. The Innovative engine theory proposed by Seelig also includes the external factors of resources, environment and culture, and the internal factors of knowledge, imagination and attitude. In addition, Glăveanu also pointed out that the value of creativity is given in the Social dialogue, and creativity is not only restricted by social factors, but also cannot exist in isolation from cultural resources. Instead of constructing a more complete theoretical model to present the multiple components that affect creativity, some Chinese researchers prefer to study the impact of a certain component on individual creativity from more specific elements, such as knowledge renewal, character elements, innovation atmosphere, parenting style, class environment, etc.

The academic community has basically reached a consensus that creativity is composed of static structure and dynamic structure, that is, the static structure of

creativity mainly includes: general creativity, namely creative thinking and creative style, knowledge factors, non-intellectual factors, namely motivation and creative personality, and special creativity, namely creative ability and skills. These factors interact and influence each other, and jointly determine the level of creativity. The dynamic structure of creativity is mainly the sum of intelligence and non-intelligence used by creativity in the process of producing valuable information, which mainly includes: the ability to find problems, the ability to clarify problems, the ability to elaborate problems, the ability to organize problems and the ability to output solutions to problems. To sum up, this study believes that the cultivation of creativity includes two aspects, namely creative affective behavior and creative cognitive behavior. Creative emotional behavior refers to a person's positive psychological tendency towards specific creative activities, that is, the so-called creative tendency, which mainly includes four aspects of character, such as adventure, curiosity, imagination and challenge.

3. Importance

In the face of emerging new challenges in the 21st century, increasing global competition and increasing uncertainty in the international environment, the effective use of information technology and being good at innovation and creation are of great importance to students, and the domestic and foreign education circles have also reached a consensus on this. In the era of knowledge economy, creativity is one of the important abilities to judge the level of individual and national competitiveness. Creativity is the key to the innovation process and is often referred to as the "first step of innovation". College students' creative learning plays an important role in their personal development. Today's colleges and universities are striving to become a learning university, providing the best quality learning environment for students' personal development and deep integration of learning. The extension of creativity of college students is slightly different from that of others. Compared with others, the

creativity of college students is not only reflected in creative thinking ability (fluency, uniqueness, flexibility) and creative personality tendency (adventure, curiosity, imagination, challenge), but also reflected in creative behavior ability. That is, the ability to explore and discover problems, the ability to solve practical problems and the ability to produce creative results.

The psychological basis of creativity cultivation. The psychological basis of college students' creativity can be cultivated means that creativity is a kind of advanced psychological activity and psychological quality, and people's creative thinking activities are accompanied by people's psychological activities, and the formation and development of creative thinking cannot be separated from its psychological activity basis, which involves people's feeling, perception, memory and other thinking styles, as well as attitude, motivation, emotion, will and other personalities Trait related. It can be seen that the psychological basis of creativity can be cultivated mainly in two dimensions: thinking style and personality trait.

The first is the plasticity of thinking style. Thinking style refers to how people use or harness their intelligence and knowledge. The existing research results show that the style of thinking can be shaped by thinking training. As early as this year, Osborne proposed the brainstorming method to train the way of thinking, in addition, Williams's "creative thinking and personality model", Guilford's "problem solving teaching model", Osborn-Panes's "creative problem solving teaching model", and Taylor's "creativity to develop multiple talents" Thinking teaching mode and other studies show that thinking style can be shaped.

The second is the plasticity of personality traits in psychology, personality refers to the individual has a relatively stable and with a certain tendency to win the synthesis of various psychological qualities, including personality psychological characteristics and personality tendencies, personality psychological characteristics refer to temperament, character and ability, personality tendencies refer to motivation, emotion, interest, hobby, belief, ideal, will and attitude. The plasticity of personality

refers to that the social environment exerts a subtle influence and shape on the individual when he or she is in a certain environment. The social role, family environment and social class of the individual all have direct or indirect influence on the personality. Research by Kuhn and his colleagues shows that middle-class parents in the United States and Italy place more emphasis on purpose, values, and self-orientation than lower-class parents do on deference to external authority. There are various indications that social culture directly or indirectly affects the formation of personality. The above shows that it is the plasticity of people's thinking style and personality traits that provides the psychological basis for the cultivation of creativity.

The pedagogical basis of creativity cultivation. As we all know, education is a social practice to train people, through education can change students' mental model, way of thinking, so that people's physical and mental change. Through teaching content can increase students' basic knowledge and skills, through certain teaching means, methods, can shape the way of thinking of students, such as inquiry teaching, discussion teaching, can effectively cultivate students' thinking style, and these are the necessary conditions for the formation of creativity. Take the dimensions of the influence of knowledge structure on several characteristics of creativity as an example: First, the influence on fluency. When people encounter a problem, they must first form the idea of solving the problem in their mind. The wider the scope of knowledge, the more solid the grasp, the more information can be provided, and many thinking results can be quickly dispersed in a short time. Second, the impact on flexibility. In order to transform the thinking from one dimension to another and realize the leap from one field to another, it is necessary to have a rich professional basic knowledge as a prerequisite. Third, the impact on novelty. Lack of basic knowledge causes people's creativity to dry up, lack of philosophical knowledge may cause people to lose the direction of creation, and lack of knowledge of creative techniques is easy to cause people's thinking to be imprisoned. It can be seen that the necessary knowledge reserve is a prerequisite for creation, and education can increase people's knowledge

reserve. Therefore, education is a necessary condition for people to accept creation. Most college students are in the stage of youth development, and their knowledge structure, cognitive level and thinking mode are not perfect. We can cultivate them through education to make necessary knowledge and skills reserve for the formation of creativity.

4. How to teach

After 50 years of development, a lot of research results have been accumulated on the theory of creativity cultivation, which are more typical as follows:

Guilford's model of three-dimensional intelligence structure. Guilford proposed a three-dimensional Structure of Intelligence (SOI) model. By morphological synthesis, he studies the composition of intelligence and believes that intelligence is composed of operation (thinking method, including five components: cognition, memory, divergent thinking, concentrated thinking, and evaluation), content (object of thinking, object of thinking, object of thinking, object of thinking, object of thinking, and object of thinking). Including graphics, symbols, semantics, action four components) and the result (that is, the application of a certain operation to a certain content of the product, including unit, type, relationship, system, transformation, meaning of six components) composed of three-dimensional spatial structure. As can be seen from Guilford's SOI theoretical model, human intelligence includes 120 different factors, which can be constructed from the interaction of the three dimensions of operation, content, and outcome in the model. According to his intellectual structure model, Guilford designed a thinking cultivation teaching model that focuses on solving problems. It emphasizes that memory storage (knowledge and experience) is the basis of problem solving. The process of problem solving begins with the input of environment and individual data into the system, and filters and selects the data based on personal knowledge and experience through the process of attention, and then causes cognitive operations to understand the existence and nature

of the problem. Then divergent thinking, brewing a variety of ways to solve the problem, through concentrated thinking to choose the solution to the problem.

Taylor's 3D curriculum model. Taylor proposed a three-dimensional curriculum model for cultivating students' creativity. The first dimension is the knowledge dimension, that is, the subject knowledge that students learn, including biology, physics, art, mathematics, language, history, music, various skills, etc. The second dimension is the psychological process dimension, that is, the psychological ability developed by students in the process of learning subject knowledge and the required psychological process, including intellectual factors such as cognition, memory, divergent thinking, aggregated thinking, assessment, learning strategy and non-intellectual factors such as intuition, sensitivity, emotion, emotion and need. The third dimension is the dimension of teacher behavior, which includes teachers' teaching methods, teaching media, teachers, students and environmental factors that affect thinking and learning process. This model emphasizes the cultivation of students' creativity through subject teaching.

Williams' cognitive-affective interaction theory. Williams proposed a Theory of creative thinking cultivation called Cognitive-Affective Interaction Theory (CAI theory). Under the guidance of this theory, he designed the thinking cultivation program. The whole program consists of the following parts: First, instruction manual (including identifying and measuring creative potential, stimulating creative potential, teacher's book, teaching materials, classroom teaching strategies to stimulate thinking and emotion); Second, the Posting part (thought - emotion process, teaching strategy); Third, tapes (teacher training tapes, demonstration tapes). Williams' theory of creative thinking cultivation is a teaching mode that emphasizes teachers' use of strategies to inspire creative thinking to improve students' creative thinking through classroom teaching, and emphasizes teachers' penetration in classroom teaching and extracurricular activities. Games and activities should be adopted in teaching, so that students can make bold guesses and diverges in many directions in a loose and free

atmosphere to maximize their imagination, so as to effectively cultivate students' creative thinking ability.

Treffinger's creative learning model. Treffinger proposed the Creative Learning Model (MCL). The model includes three levels of creative learning, and both cognitive and emotional dimensions are considered at each level. The first level includes a class of cognitive and emotional factors with divergent functions, emphasizing openness - the discovery or perception of many different possibilities. Because this level includes a class of divergent thinking and emotional processes that are fundamental and important to creative learning, it therefore forms the basis of creative learning. The second level includes higher or more complex thinking processes such as application, analysis, synthesis, evaluation, methodology and research skills, transfer, metaphor and analogy, as well as higher or more complex emotional processes such as cognitive conflict and imagination. The third level is for learners to truly engage with real problems and challenges, with cognitive aspects including independent inquiry, self-directed learning, resource management and product development, and emotional aspects including internalization of values, commitment to effective living, and self-actualization.

Renzulli's theory of creativity cultivation. Renzulli proposed a general theory of promoting adolescent development through the pursuit of ideal learning activities. According to this theory, an ideal learning behavior should deal with the interaction and relationship between teachers, students and courses. At the same time, it is necessary to deal with the interaction and relationship between various factors within the teacher (including the teacher's subject knowledge, teaching skills and love for the subject), the student (including ability, learning style and interest), and the curriculum (including the subject structure, subject content and method, and the stimulation of imagination).

From the above analysis, it can be seen that the perspective of creativity research has gradually changed from a single orientation to an integrated orientation,

indicating that the connotation of creativity has gradually moved toward diversification. However, in the past research orientation, more emphasis was placed on how to develop creative strategies, teaching and evaluation, and how to develop creative process models from the research of outstanding creative talents. In recent years, researchers have gradually adopted integration orientation theory to find out the relevant influence variables. Creativity, like wisdom, is something everyone has, and many people with creative potential never know they have this ability, thinking they can't be creative. In fact, creativity is not static and can be developed to a certain extent.

5. Evaluation

Along with a more comprehensive definition of creativity, there is a general consensus among researchers that creativity is a complex, multi-component structure. In the assessment of creativity, scholars have developed a variety of creativity measurement methods. The current research on creativity measurement basically covers the elements of Rhodes' 4P framework (people, products, processes and environment).

In the evaluation research of creative personality traits, the focus is on the personality attributes, cognitive style, motivation and other aspects of creative individuals. In addition, a number of studies evaluate creativity by investigating individuals' creative achievements and past behaviors in various fields. The relevant assessment tools mainly used self-report scale, but also other forms of assessment, such as "Five elements of personality scale", "Adaptive-Creative Cognitive Style", "Biographical Checklist of Creative behavior", etc. Although there have been quite a number of studies on personality trait evaluation based on the scale, and the operation form is relatively simple and convenient, some core evaluation indicators such as openness, persistence, independence, risk-taking, tolerance for ambiguity and other traits have also been confirmed to be closely related to creativity. However, this kind

of evaluation is more to evaluate the creative potential of individuals, and it may be a subjective evaluation, which is easy to have a certain deviation from the real situation.

In the research of creativity evaluation, product-based evaluation has always been regarded as the most direct and appropriate way to evaluate creativity. On the one hand, creative products are often produced in a specific environment, and under the same conditions, products can be compared with each other, with a certain comparability, and the score is more objective and reliable. On the other hand, tasks that require the production of specific categories of products can be seen, to some extent, as genuine expressions of individual creativity. Because, in this process, individuals need to fully demonstrate their motivation, cognitive skills and other elements, and in the interaction with the environment to integrate a lot of information to achieve a product with original and appropriate characteristics. At present, there are mainly two kinds of evaluation methods for creative products. One is the evaluation of creative products based on scale, such as creative product scoring matrix and student works evaluation table. One is to use the consensus evaluation technique proposed by Amabile to evaluate creative products. This evaluation method should be based on a unified understanding. She believes that when the relevant experts in the field think that a product is creative, then the product is creative.

In the evaluation research of creative process, the main concern is to evaluate the specific cognitive factors and cognitive processes that are conducive to creativity, and most of the research focuses on the evaluation of individual divergent thinking. Among the relevant assessment tools for measuring divergent thinking, the Torrance test of creative thinking (TTCT) is a kind of test widely used, in addition, there are also alternative uses test (Alternateuses test). AUT), etc. These tests of divergent thinking measure fluency (number of ideas), originality (how unique an idea is), flexibility (variety of ideas), and refinement (how detailed an idea is). Instead of using tests to evaluate individuals' divergent thinking in the creative process, some researchers adopted qualitative research methods. For example, Rubenstein, Callan

and Neumeister used SRL micro analysis interview to study students' use of cognitive strategies in the process of creative problem solving. The results showed that, Students adopted different strategies in the problem identification stage. Although divergent thinking plays an important role in creativity, creative thinking includes not only divergent thinking, but also convergent thinking and other thinking modes. Therefore, there are also some assessment tools for evaluating individuals' convergent thinking, such as the Remote association test (RAT). Richardson and Mishra designed a scale of learning tasks, classroom practice, teacher-student interaction, and physical environment and resource availability to guide participants in designing learning environments that support students' creative performance. Chan and Yuan's research found that factors such as passion for learning, co-creation and collaboration, valuing ideas, and seeing mistakes as a necessary part of the learning process all contribute to individual creativity.

In addition, some researchers have further explored the domain generality and domain specificity of creativity by focusing on the evaluation of creativity in different fields. By comparing self-reported (quantitative) and product (qualitative) scores of creativity in seven domains, including writing, music, and science, Runco found that self-reported scores reflected the domain generality of creativity, while product scores reflected the domain specificity of creativity. Glăveanu defined three typical paradigms of creativity from the perspectives of art, scientific invention and technology.

In this study, the Creativity Tendency Scale was utilized to measure the creative tendencies of college students. This scale was developed by Williams, an American psychologist. Williams identified four key characteristics of individuals with high innovative ability: vivid imagination, sufficient curiosity, a strong sense of challenge, and a propensity for risk-taking. Based on these characteristics, he defined creative tendencies across four dimensions: (1) adventurousness, (2) curiosity, (3) imagination, and (4) challenge. The Williams Creativity Tendency Scale

systematically measures these four dimensions. Comprising 50 items, the scale employs a five-point Likert scoring system, allowing for assessment across the dimensions of adventurousness, curiosity, imagination, and challenge, as well as a total score. Consequently, the scale is recognized as a mature and authoritative tool within the international community, demonstrating high reliability and validity.

Guilford's three-dimensional intelligence structure (SOI) theory

1. Guilford's Creativity Theory

Guilford (1950) defines creativity as the ability to produce ideas that are both original and appropriate. This understanding positions creativity as a cognitive process involving divergence from conventional thought patterns. Guilford identified four main components of creativity:

·Fluency: The ability to generate a multitude of ideas in response to a prompt. This refers to the quantity of ideas produced, signifying a broad thinking ability.

·Flexibility: The capacity to shift perspectives and approach a problem from different angles. This allows individuals to adapt their thinking to various contexts and solutions.

·Originality: The ability to create unique and innovative ideas not commonly thought of. It emphasizes the importance of innovative thinking in creative tasks.

·Elaboration: The skill to develop and expand ideas into more detailed and concrete forms. This involves taking an original idea and building upon it extensively.

2. Definition of SOI

Guilford proposed a three-dimensional Structure of Intelligence (SOI) model. By morphological synthesis, he studies the composition of intelligence and

believes that intelligence is composed of operation, content and the result composed of three-dimensional spatial structure.

Operations: Refers to cognitive processes such as cognition, memory, evaluation, and production. These represent the mental activities involved in gaining knowledge and solving problems.

Content: This dimension addresses the forms in which intelligence is applied, including symbolic, semantic, behavioral, and figural content. It discusses how different types of knowledge influence problem-solving and creativity.

Result: This aspect categorizes the different outcomes of intellectual activity, such as units, classes, relations, systems, and transformations. Each product type can require different combinations of operations and content.

As can be seen from Guilford's SOI theoretical model, human intelligence includes 120 different factors, which can be constructed from the interaction of the three dimensions of operation, content, and outcome in the model. This model encourages educators to recognize the diversity of intellectual abilities among students. It suggests that intelligence is not a single measurable trait but a combination of varied cognitive abilities. It emphasizes that creative thinking involves both intelligence and creativity working synergistically, affecting how students approach learning and problem-solving.

According to his intellectual structure model, Guilford designed a thinking cultivation teaching model that focuses on solving problems. It emphasizes that memory storage (knowledge and experience) is the basis of problem solving. The process of problem solving begins with the input of environment and individual data into the system, and filters and selects the data based on personal knowledge and experience through the process of attention, and then causes cognitive operations to understand the existence and nature of the problem. Then divergent thinking, brewing a variety of ways to solve the problem, through concentrated thinking to choose the solution to the problem.

In conclusion, integrating Guilford's concepts fosters an educational environment that values creativity as an integral component of intelligence. The application of Guilford's theories has significant implications for the cultivation of creativity among college students.

Promoting Divergent Thinking: The emphasis on fluency, flexibility, originality, and elaboration encourages students to practice divergent thinking, which is crucial for innovation. This can lead to more original ideas and solutions in projects and assignments.

Enhanced Problem-Solving Skills: By focusing on problem-solving processes that integrate different types of intelligence and creativity components, college students become proficient at approaching challenges from multiple angles, fostering a mindset suited for real-world complexities.

Personalized Learning: Understanding the Structure of Intellect allows educators to create tailored educational experiences that cater to individual students' strengths, helping them excel in areas where they may have innate talent.

Collaborative Learning: Incorporating group projects and discussions promotes creativity through collaboration, where students can share diverse viewpoints and ideas, leading to richer creative outcomes.

Assessment Evolution: Fostering an accurate evaluation of creativity will encourage students to explore innovative strategies without fear of traditional grading constraints, leading to a more profound engagement in learning.

By integrating Guilford's "Structure of Intellect" model into teaching practices, educators can create a robust framework for cultivating creativity in college students. This approach not only enriches students' educational experiences but also prepares them to face dynamic challenges in their academic and professional pursuits with innovative solutions. The synergy between operations, contents, and products provides a comprehensive foundation for fostering an environment where creativity can thrive.

Creative Problem Solving (CPS) Theory

1. Creativity can be cultivated through creative training

Research indicates that creativity can be cultivated through creative training. Guilford was among the first to directly associate creativity with problem-solving, proposing a four-stage process: 1) awareness of the problem's existence; 2) generation of numerous relevant ideas; 3) evaluation of possibilities; 4) description of suitable methods to solve the problem. Dillon suggested that some problems only arise when existing information is reorganized, and creativity is the result of applying new strategies and principles during the problem-solving process. From a cognitive psychology perspective, the creative process is seen as a problem-solving process (Basadur).

Viewed from the perspective of cognitive psychology, problem-solving is inherently a high-level cognitive activity. Dewey, in his book "How We Think," analyzed the psychological process of problem-solving in five steps:

- (1) Encountering difficulty;
- (2) Defining where the difficulty lies;
- (3) Proposing a solution to the problem—putting forward hypotheses;
- (4) Deducing conclusions from the proposed solution;
- (5) Verifying hypotheses.

Clearly, problem-solving is a mental process of thinking, and Dewey's five-step method provides a systematic approach to problem-solving. Wallace, a British psychologist, introduced the "four-stage" model, suggesting that creative thinking goes through the following four stages:

- (1) Preparation, which includes discovering problems, collecting data, and gaining knowledge and inspiration from previous experiences;
- (2) Incubation, a stage of contemplation, including the use of existing

knowledge and methods to explore tentative solutions to problems;

(3) Illumination, emerging from the matured incubation stage with sudden inspiration or enlightenment;

(4) Verification, checking and confirming the initially outlined new ideas when inspiration strikes.

2. CPS model of creative problem solving

In 1966, Parnes, an American scholar, first proposed the CPS model based on Osborn's brainstorming theory, Gordon's organization theory, Guilford's intellectual structure theory and Malsow's "needs and perception training strategies". At first, he divided problem solving into five steps: finding facts, finding problems, seeking ideas, seeking solutions, and seeking acceptance.

The CPS model is based on the process of problem solving, emphasizing that a problem solver should use divergent thinking to generate as many different solutions as possible before selecting or implementing a solution, thereby improving creativity and problem solving. According to Parnes, providing stimulation during the incubation phase of the creative thought process can stimulate individuals to generate various ideas, ideas, or inspirations through associations or connections with previous experiences, thereby increasing the chances of generating new ideas or ideas and enhancing creativity.

In 1985, Treffinger and Isaksen proposed a linear creative problem solving model on this basis. In 2000, Dorval et al (Creative Approaches to Problem Solving) further modified it as a "four-component eight-stage model" : 1. Understanding challenges: (1) Finding opportunities; (2) Search for information; (3) Generate problems → 2. Generate ideas: (4) Generate ideas → 3. Prepare for action: (5) Seek solutions; (6) Seek acceptance → 4. Implement the plan: (7) Evaluate the subject; (8) Design process. The revised model adds new steps to implement the plan in order to develop learners' ability to translate the plan into concrete action. In the process of

implementing the plan, learners review and think about the strategies used and the combination of various stages, so as to form a thinking model that can be reused when dealing with similar problems.

In 2014, Sitthichai Laisema of Thailand developed U-CCPS collaborative learning model with creative problem solving process. The model consists of Ubiquitous Learning environment, Collaborative Learning, and Creative Problem-Solving Process and Creative thinking skill of the learner are four components. The experimental results show that this model effectively improves students' creative thinking skills. In 2017, ESNA at the University of Maribor, Slovenia, clarified the necessity and possibility of teaching creative problem solving skills to students of economics and business sciences and mentioned that the development of the syllabus can include the stages of the CPS process. In 2022, Nasehudin from Indonesia studied the influence of creative problem-solving learning methods on mathematics learning results through quantitative experiments, and the results showed that experimental classes applying creative problem-solving models obtained more positive results.

Creative problem-solving, as an advanced, complex, and comprehensive creative activity, refers to the process of seeking creative solutions to problems using innovative, flexible, and original methods. Since the introduction of creative problem-solving, researchers have continuously sought a universal set of steps for creative problem-solving. From Parnes' five-stage model to Treffinger and Isaksen's six-stage model divided into three components with six stages, and then to Dorval's revised four-component, eight-stage model, the CPS model has undergone continuous refinement. Currently, among the various methods used to promote creative thinking and problem-solving in curriculum design, the most commonly used is the CPS model, as revised by Treffinger and Issaken, which posits three components and six stages in the problem-solving process:

- (1) Understanding the problem: discovering challenges, discovering facts,

understanding the problem;

(2) Inspiring ideation: discovering ideas;

(3) Action planning: discovering solutions, seeking acceptance.

The CPS model has significant implications for the teaching model developed in this study. First, it emphasizes contextualized problem setting. Problems must be connected to learners' daily lives to evoke their desire to solve problems. In addition to designing challenging and developmental problem scenarios in the classroom to stimulate learners' desire to solve problems, attention should be given to designing open-ended problems to provide learners with greater creative thinking space. Sternberg proposed that open-ended problems, which are ill-defined and lack a unique correct answer, require more creative thinking and critical thinking, making them suitable for CPS training of learners. Second, there is a need to emphasize the combination and alternating use of divergent thinking and convergent thinking. In instructional design, divergent thinking can be used to generate new ideas or thoughts, and then evaluation based on conditions that match the problem and environmental requirements can converge to find a solution. In other words, the combination of divergent thinking and convergent thinking is the creative thinking process that generates new problem-solving methods. Third, the CPS model emphasizes collaborative learning in groups. In the instructional model, setting up group cooperation can concentrate all individual creativity, allowing it to have a holistic effect when creative thinking is cooperatively generated in groups, encouraging limited individual creativity and creative ideas or thoughts from other group members to interact with each other, producing a greater creative effect.

Therefore, based on this, in teaching activities, teachers should use a problem-based learning and creative problem-solving instructional model based on the problem-solving process. This involves providing appropriate problems, inspiring students' sensitivity to problems, stimulating the flexibility of students' thinking, assisting students in holistic problem thinking, and encouraging students to solve

difficult problems, acquire knowledge, and develop creativity through exploration, discovery, deep thinking, reflection, and discussion in the learning process.

Constructivist Learning Theory

Constructivist learning theory is based on the academic research of scholars such as Dewey, Piaget, Vygotsky, Bruner, Ausubel, Ernest, Honebein, and Jonassen. Its main viewpoint asserts that "learners, by reconciling information from the external world, actively construct knowledge to determine what knowledge they are going to acquire." Learning is seen as an active mental effort, rather than passive reception of teaching. Constructivist learning theory effectively explains how the learning process occurs, how meaning is constructed, how concepts are formed, and what major factors should be included in an ideal learning environment. Therefore, compared to the traditional teacher-centered teaching philosophy, constructivist learning theory holds revolutionary significance.

Constructivism advocates student-centered teaching, viewing teachers as facilitators, promoters, and guides of learning. It suggests that students should transition from a passive state of receiving knowledge to an active state of constructing meaning, promoting students to engage in active thinking and learning. According to constructivism, knowledge does not exist externally but resides in the learner's mind. Learning occurs when individuals actively construct knowledge based on their existing experiences and cognitive structures, interacting with the external world. On the aspect of learning views, constructivism posits that learning involves learners actively accepting new knowledge and constructing it to gain meaning. Moreover, learners' knowledge is built upon their existing experiences and cognitive structures, resulting in diverse knowledge constructions. From a teaching perspective, constructivism emphasizes the learner's autonomy, social interaction, and situational context. It encourages the stimulation of learners' autonomy, provides opportunities for independent thinking, creates contexts aligned with instructional content, and

facilitates learners' ease in acquiring knowledge and constructing meaning. Additionally, it enhances cooperation and interaction among students and between students and teachers, fostering collaborative exchanges. Constructivism identifies context, conversation, collaboration, and meaning construction as the four essential elements in the learning environment.

1. Context

Constructivism asserts that knowledge cannot exist independently of context. The problem-based contextual teaching studied in this paper promotes the integration of life and teaching, creating learning situations similar to the real world. This approach helps students learn, apply knowledge, engage in independent thinking, and promotes the internalization and reconstruction of knowledge.

2. Collaboration

Constructivism argues that knowledge is generated through collaborative activities. The teaching model developed in this study, focusing on student-centered, group-based instruction, supports activities such as resource sharing, interactive communication, and collaborative learning. It facilitates interaction among students, fostering the construction and application of knowledge.

3. Conversation

Constructivism holds that learners construct knowledge through highly engaged, socially negotiated conversations. The blended teaching approach in this study, through human-computer interaction, facilitates convenient and efficient dialogues between teachers and students, as well as among students. Online and offline conversations complement each other, enhancing the quality and efficiency of dialogue.

4. Meaning Construction

Constructivism posits that learners should actively construct meaning by utilizing existing knowledge, methods, and skills through active exploration and social interaction. The teaching model in this study provides students with diverse resources such as images, videos, cases, and presentations, offering systematic knowledge and vivid learning experiences. Students can engage in personalized learning, participate in collaborative activities, and shift from a traditional passive state to an active learning state, making it easier for them to understand and master new knowledge and promoting meaningful construction.

The instructional model developed in this study relies on constructivist educational theory, utilizing scaffolding and contextual creation in teaching. Classroom instruction often involves teacher-student interactions, group collaboration, project completion, case analysis, and other activities to help students develop and strengthen independent thinking, discussion and negotiation, expression of personal opinions, and continuous questioning of creative thinking abilities and attitudes. Under the guidance of constructivist theory, the new model emphasizes a support system for interactive knowledge, putting learners at the center as active constructors of knowledge. It highlights the role of teachers as guides, organizers, and helpers in meaning construction. Furthermore, it underscores the creation of a learning environment and support system emphasizing real situations, interactive, and collaborative learning methods.

The new teaching model is designed with a problem-oriented approach, guiding students to understand and solve problems throughout the process of classroom activities. The generation of these problems is mainly due to the inability of students' existing knowledge to connect with new knowledge. Constructivist learning theory emphasizes that learning is essentially a process where, guided by teachers and supported by technology, students actively participate and cooperate, helping them

establish connections between new information and existing experiences. In the teaching activities, teachers guide students to explore continuously based on their existing knowledge, helping them find connections between old and new knowledge. This process propels students' existing knowledge towards the transformation into new knowledge, ultimately enabling students to solve problems and achieve the learning goals. Throughout the teaching process, learning occurs as students construct new knowledge and concepts through interaction with the environment, employing cognitive strategies such as thinking, discovery, and exploration during contextualized cooperative learning.

Innovation and entrepreneurial course

1. Meaning

In the era of knowledge economy, there is a wider market demand for talents with professional skills, risk-taking and innovation. The ability of innovation and entrepreneurship has become an important resource in international competition and individual competition, and has been valued and encouraged by various countries. In 1989, the United Nations Educational, Scientific and Cultural Organization (UNESCO) issued the World Declaration on Higher Education in the 21st Century: Vision and Action, which proposed for the first time that "the development of students' entrepreneurial skills should be the main concern of higher education", and graduates should not only become "job seekers", but also gradually become "job providers". The concept of "Enterprise Education" was first proposed and became the "third education passport" after higher education and vocational education. In 1991, UNESCO broadly defined "entrepreneurship education" as: To develop the most pioneering personalities, including initiative, risk-taking, entrepreneurship, the ability to work independently, and the development of technical, social and managerial skills. UNESCO's definition of entrepreneurship education has fully absorbed the

connotation of innovative education, in fact, it has integrated innovative education into entrepreneurial education, and realized the integration of innovative education and entrepreneurial education. Some scholars pointed out that the three UNESCO International Seminars on Entrepreneurship Education marked the birth and rise of innovation and entrepreneurship education as an independent academic field in the world, and also marked the emergence of a new field of educational theory and practice.

The United States is the first country to develop entrepreneurship education. In 1947, Harvard Business School offered the world's first entrepreneurship education course, "Start-up Management." This is also regarded as the beginning of innovation and entrepreneurship education in universities. Up to now, innovation and entrepreneurship education has been very common in American colleges. Many colleges not only set up undergraduate education and entrepreneurship majors, but also set up graduate education and entrepreneurship majors. In 1987, the British government launched the "Higher Education Entrepreneurship" program, which officially opened the era of entrepreneurship education in British universities. With the development of innovation and entrepreneurship education in universities in the United States and the United Kingdom, Finland, the Netherlands, France, Germany, Australia, Canada and other countries have joined the camp. In Asia, in the early 1980s, South Korean universities implemented entrepreneurship education earlier. So far, 164 universities in South Korea offer formal courses on innovation and entrepreneurship education. Japan began to promote entrepreneurship education in universities in the 1980s. By 2020, 247 universities of various types have implemented innovation and entrepreneurship education, accounting for about 3.7% of the 756 four-year universities in Japan. Singapore is also an active explorer of innovation and entrepreneurship education in universities. In 2002, Nanyang Technological University in Singapore developed the "Science and Technology Entrepreneurship and Innovation Course", referred to as "TIP course", which has

achieved good results. With the main push of developed countries, entrepreneurship education began to rise in colleges and universities, and developed into a trend and trend of higher education in the world.

Different from the internationally accepted "entrepreneurship education", innovation and entrepreneurship education is a localized concept in the Chinese context and a comprehensive concept developed on the basis of innovation education and entrepreneurship education. In a broad sense, its theoretical core and essential meaning are basically consistent with the internationally accepted concept of entrepreneurship education. Based on the practice of innovation education and entrepreneurship education, it evolved by absorbing its essential core, and experienced a dynamic extension and expansion process from the single concept to the integrated concept. Innovation and entrepreneurship education in Chinese universities started in the late 1990s. In May 2010, the Ministry of Education of China officially put forward the concept of "innovation and entrepreneurship Education" in its Opinions on Vigorously Promoting Innovation and Entrepreneurship Education in Colleges and Universities and College Students' Self-employment, emphasizing that innovation and entrepreneurship education is a teaching concept and model that ADAPTS to the needs of economic society and national development strategies. This is the first time that "innovation and entrepreneurship education" has been mentioned in an official government policy document. "Opinions" pointed out that "innovation and entrepreneurship education should be oriented to all students and integrated into the whole process of talent training." This is a major progress in removing the utilitarian value orientation of innovation and entrepreneurship education in Chinese universities, and provides a concept guidance for the in-depth development of innovation and entrepreneurship education in China. After that, the Basic Requirements for Entrepreneurship Education in ordinary undergraduate Schools (Trial) issued by the Ministry of Education in 2012 and the Implementation Opinions on Deepening the reform of Innovation and Entrepreneurship Education in colleges

and Universities issued in 2015 were inherited and developed, and the document clearly stated that innovation and entrepreneurship education should be "for all college students, combined with professional education, It runs through the whole process of talent training, closely links the talent training of colleges and universities with the social service work, and strives to improve students' innovative spirit, entrepreneurial consciousness and entrepreneurial ability through the teaching of certain knowledge of innovation and entrepreneurship, so that college students can become high-quality innovative talents." This has also become a consensus in the field of higher education in China.

It can be seen that "Enterprise" and "Entrepreneurship Education" have a long history of development and different cultural boundaries in the field of higher education at home and abroad. Unlike most foreign universities that advocate Entrepreneurship education or maker education, Chinese universities currently emphasize Innovation and Entrepreneurship Education. The goal is to cultivate students' innovative, application-oriented and skill-based talents with knowledge, consciousness, spirit and ability of innovation and entrepreneurship. The innovation and entrepreneurship education referred to in this paper is: A variety of educational and practical activities organized with the training of innovative and entrepreneurial talents as the starting point and end point, innovation, creativity and practicality as the basic connotation, and various theoretical course teaching and practical course activities of innovation and entrepreneurship as the key elements, in order to improve the cognitive and non-cognitive quality and ability required for innovation and entrepreneurship of college students. The core goal is to cultivate and improve the creativity of college students.

With the development and research of innovation and entrepreneurship education, various types have been continuously divided. O'Connor believes that entrepreneurship education includes three types. Firstly, teaching "about" entrepreneurship, which focuses on content and theoretical methods, aims to gain a

general understanding of entrepreneurial activities and is the most commonly used type in universities; Secondly, teaching "for" entrepreneurship aims to provide entrepreneurs in the early stages of entrepreneurship with relevant entrepreneurial knowledge and skills; Thirdly, teaching 'through' entrepreneurship refers to a process and experimental approach that helps students experience the actual entrepreneurial learning process. According to Bandura's theory of observational learning, Zhu Hong and Zhang Haohao divide it into four types: basic education, simulated education, practical education, and observational learning education. In 2002, DebabH. Streeter et al found that entrepreneurship education models in universities in each country can be divided into two categories: One kind of "Focused ", which takes the development of entrepreneurship as the path, limits students to business schools and aims to cultivate professional entrepreneurial talents; A kind of University-wide aims to cultivate the entrepreneurial ability and literacy of the whole school students, for the whole school students. In addition, some scholars have studied the organizational model of innovation and entrepreneurship education in 38 universities in the United States and found that about 75% of innovation and entrepreneurship education adopts the University-wide innovation and entrepreneurship education model. The University-wide is becoming more and more common. In China, education departments and university innovation and entrepreneurship education program documents emphasize the " University-wide " innovation and entrepreneurship education value orientation. In May 2010, the Ministry of Education issued the Opinions on Promoting Innovation and Entrepreneurship Education in Colleges and Universities, which clearly requires that innovation and entrepreneurship education in colleges and universities should be open to all students and integrated into the whole process of talent training. In August 2012, the Ministry of Education issued the "Basic Requirements for Entrepreneurship Education and Teaching in ordinary undergraduate Schools (Trial)", requiring colleges and universities to set up compulsory courses of "Entrepreneurship Foundation" for all students. It should be no less than 32 class

hours and no less than 2 credits. In May 2015, The State Council issued the Opinions on Deepening the Reform of Innovation and Entrepreneurship Education in Colleges and Universities, emphasizing once again that innovation and entrepreneurship education in colleges and universities should focus on the universality and popularity of innovation and entrepreneurship education for all students.

The curriculum of innovation and entrepreneurship education is the premise and basis of the teaching activities of innovation and entrepreneurship education in colleges and universities, and occupies a central position in all innovation and entrepreneurship education work. Compared with scattered innovation and entrepreneurship activities, specialized and systematic course teaching has more significant advantages in cultivating innovative and entrepreneurial talents and improving students' comprehensive quality of innovation and entrepreneurship. Corresponding to the mode of innovation and entrepreneurship education in colleges and universities, the course model of innovation and entrepreneurship is also divided into two types: Business school-based type and University-wide type. The "basic course of innovation and entrepreneurship" studied in this paper is a University-wide course model of innovation and entrepreneurship, which is a general education model. It is the core course of innovation and entrepreneurship education for all students in Chinese colleges and universities, and is included in the unified teaching plan of schools, and is the core link of China's implementation of innovation and entrepreneurship education. The core of the basic course of innovation and entrepreneurship is to cultivate college students' innovative spirit and entrepreneurial ability, that is, creativity. It also has the following characteristics: First, it takes all students as the teaching object. Innovation and entrepreneurship courses are not "exclusive" to business school students; they are relevant to any individual. Secondly, the creation of vocational education can not be separated from the foundation of vocational education. The high school has the tradition of professional education, and the innovation industry education is fully "embedded" in the vocational education of

high school, that is, it can deepen the vocational education, and realize the innovation industry education has been carried out in the whole process of talent training. Finally, the course of innovation and entrepreneurship is not the training of innovation and entrepreneurship skills, but the focus of education is to cultivate students' innovation concepts, entrepreneurial spirit, innovation thinking and innovation ability, that is, creativity cultivation.

2. Components

Both academia community and colleges have realized that the training of creative talents cannot be separated from the corresponding curriculum, and the curriculum is the basic condition to achieve the goal of talent training. Many scholars put forward that the basic curriculum of innovation and entrepreneurship is centered on cultivating creative talents, so it is necessary to strengthen the curriculum reform and construct the curriculum model of cultivating creative talents, and explore and study how to reform and construct it. Hao Deyong of Nanjing Normal University in China put forward the concept of "creative curriculum" and compared it with the corresponding "identity curriculum". They believe that the main difference between "creative curriculum" and "identity curriculum" lies in the difference of the starting point of the curriculum and the psychological level of learning. The core purpose of the "identity" course is to copy and accumulate knowledge, students' learning stays at the level of perception and memory, and its teaching mode is cramming teaching and accepting learning. Although the "creative" curriculum does not deny the necessity of knowledge mastery, it is more than identification mastery. On the basis of helping students grasp the achievements of human cognition, it cultivates students' innovative spirit and raises their learning level from perception and memory to imagination and thinking. Its teaching mode is shown as heuristic teaching and inquisitive learning.

From the perspective of educational philosophy, some scholars put forward that in order to develop the creativity of the subject, we must change the

possessive-individual subject curriculum view of positivism and science paradigm, and point to a humanistic paradigm of creative curriculum view. This new view of curriculum should create a living "life world" and "meaning world" for students, in which students interact with the outside world through their own free and conscious activities, so that their own meaning is constantly enhanced and their experience is constantly expanded. Here, there are no compulsory elements and external shackles, and everywhere is filled with subjectivity that students can directly experience. The relationship between teacher and student is not a possessive relationship of "master and guest", but a communicative relationship of interactive subject. Therefore, the curriculum view of innovation and entrepreneurship should be aimed at human freedom, and it is a subjective curriculum view dedicated to giving full play to human freedom and creativity. Professor Xue Tianfu believes that the mission of innovative talent training ultimately depends on the practice of "curriculum system innovation", and the implementation of "curriculum system innovation" is the ultimate return to achieve innovative talent training. Based on the reality of China's higher education, curriculum system innovation can not be placed on a single factor, but should be a system innovation including curriculum concept, curriculum content, curriculum system and curriculum technology, multi-pronged to promote the process of innovative talent training in an all-round way. To be specific, it is to lay down the ideas and concepts suitable for the training of innovative talents, construct the material content suitable for the training of innovative talents, improve the rules and regulations matching the training of innovative talents, and create the methods and technologies suitable for the training of innovative talents.

To sum up, curriculum reform should be the forerunner of educational reform, and its direction should be aimed at cultivating students' innovative consciousness and creative ability. The nature, structure, form and method of curriculum must be fundamentally reformed. This paper agrees that the cultivation of creative talents needs the corresponding creative curriculum. The basic course of

innovation and entrepreneurship, which takes creativity as the first objective, should meet the requirements of creative course in terms of course objectives, content, teaching mode and evaluation. Because the "identity" course based on the copy and grasp of established knowledge will lose the realistic basis, and the "creativity" course aiming at cultivating students' innovative consciousness and creative ability will become the direction of school curriculum reform to meet the challenge of knowledge economy. The improvement of knowledge production efficiency depends on the improvement of individual awareness and ability of knowledge innovation. It is difficult to improve the productivity of knowledge even if you have more knowledge, if you only recognize but not seek differences, only accept but not innovate, and only be satisfied with the status quo without thinking about progress.

Of course, "creativity" course does not completely point to the latest field of human cognition development, nor does it require students to "produce" the latest knowledge that human beings have not yet obtained in the process of learning. Its most basic feature lies in its creative character and basis in terms of its goal, value, function and so on. It refers to the cultivation of students' innovative consciousness, attitude, creative mastery and creative problem-solving ability in the course of learning. To create such an innovation and entrepreneurship curriculum, the following three elements must be present:

First, **constructivism**. Innovation and entrepreneurship curriculum is not only a construction process of internal elements interacting with each other, but also a construction process of external elements interacting with each other. From the internal point of view, it needs the full collaboration of faculty and staff, but also needs the active participation of students, and needs various support and guarantee conditions. At the same time, it advocates the active construction of students' learning, social interaction and situational. From the external point of view, innovation and entrepreneurship education is essentially the interactive relationship between science, technology and society, and the process of interaction and restriction between relevant

actors such as schools, governments, enterprises, capital and parents. Innovation and entrepreneurship education is an open and interactive education, rather than a closed education model. Whether innovation and entrepreneurship education can be carried out effectively also depends on the openness of schools to enterprises, capital and society and the effectiveness of their interaction. Open teaching mode is the due meaning of innovation and entrepreneurship education. At the same time, both internal construction and external construction need to build a seamless network of actors.

Second, subjectivity. Innovation and entrepreneurship education is people-oriented education, which emphasizes student-centered, fully respects students' main body status, independent personality and individual differences, pays attention to tapping students' potential, encourages students' personality development, cultivates students' originality and pioneering, and cultivates students' critical thinking, innovative thinking and divergent thinking. Improve students' innovative spirit and entrepreneurial ability, and this kind of subjective education is not for a small number of students, but for all students, and is all-inclusive. Innovation and entrepreneurship education is also a kind of humanized and personalized education, which advocates the full play of the subjectivity of the educators, the full release of learning initiative and creativity, and requires deep communication, exchange and cooperation between teachers and students, students and the society. It advocates students to actively participate in the discussion, debate and even debate in the teaching process. In this interactive teaching, enhance the ability of innovation and entrepreneurship. In addition, innovation and entrepreneurship education also focuses on the lifelong development of the subject.

Third, practicality. Innovation and entrepreneurship course is a very practical course type, the cultivation of students' practical ability and practical ability can not be separated from personal experience and practice. For a long time, the traditional education attaches too much importance to the transfer of knowledge, and

the students cultivated by such education are often "giants of knowledge" and "dwarfs of action". As a new educational concept and model, innovation and entrepreneurship education should lead and promote the comprehensive reform of education, and always carry out the cultivation of innovative and entrepreneurial talents as the fundamental meaning to all fields and the whole process of the curriculum. Different from the traditional teaching of knowledge, the course of innovation and entrepreneurship has a strong practical orientation. Because students' creativity, innovation ability and entrepreneurial ability can not be formed in the teaching and listening, but a process that is gradually generated in the "doing" and "thousand". Students' learning is knowledge learning based on problem solving, scientific inquiry and scientific discovery learning. Innovation and entrepreneurship education advocates problem teaching and activity teaching, and advocates that students learn by "doing" and "doing".

3. Importance

For the value of innovation and entrepreneurship education and curriculum, domestic and foreign scholars have shown a relatively consistent recognition, and conducted research from different angles. Since the emergence of entrepreneurship education is closely related to economic development, the economic value of innovation and entrepreneurship education has received the first attention of scholars. Countries around the world often support and promote entrepreneurship education after experiencing severe economic recession and economic malaise, and regard entrepreneurship education as a good medicine that can cure their own economic problems. Some focus on the value of economic and social development. For example, when the Department of Innovation, Universities and Skills of England submitted Innovation Nation to Parliament, it explained the role of entrepreneurial ability and entrepreneurial spirit in economic and social development. On this basis, he proposed that universities should cooperate closely with enterprises. Make full use of the

abundant practical resources owned by enterprises to carry out relevant entrepreneurial training, and then effectively improve the entrepreneurial ability of college students; Some scholars regard innovation and entrepreneurship education as the guide for economic growth in the 21st century, the driving force for strong economic growth and the thermometer of economic development. Gorman et al. believe that entrepreneurial ability can be learned, and more people with entrepreneurial ideas should be encouraged and helped through entrepreneurship education. Peterman and Kennedy argue that expanding entrepreneurship education has a positive impact on the likelihood of entrepreneurial ideas being generated and implemented, and that if education is more targeted, more successful entrepreneurs will emerge. Timmons agrees that entrepreneurship education is an important component of national strength. Over the past 30 years, the United States has produced a new generation of entrepreneurs and set the "entrepreneurial genetic code" for future generations that will propel the United States to continue to be a leading force in the next century.

Some studies focus on the impact on students' self-development. For example, Richard Lambert believes that entrepreneurship education can cultivate students' entrepreneurial skills and innovation ability, and help ensure graduates' strong employability. With the further development of entrepreneurship education research, people's understanding of its value is constantly deepening and comprehensive, from the level of economic value to all aspects of society and individual level. In a comparative study of entrepreneurship education in the United States, the United Kingdom and Finland, Kristina Erkile expounded the arguments in support of entrepreneurship education in each country, pointing out that entrepreneurship education contributes to social development (including international social, national and local development), as well as to the development of individuals themselves. Innovation and entrepreneurship education can promote the establishment of new enterprises (Gartner, 1985) and improve students' knowledge and

understanding of the process of enterprise innovation and management (Hills, 1988); Help students learn creative skills (Kuratko, 2005); To help students prepare for future life, increase students' sustainable learning ability, help students achieve personal responsibility, and enhance students' sense of social responsibility (Sexton Kasarda, 1992)

Intention is the precursor of action. It takes a student's willingness to start a new business. It is found that entrepreneurship education can influence students' desire to become entrepreneurs or entrepreneurs. Innovation education has a cumulative and significant influence on students' choice of entrepreneurship (Kakkonen, 2010). Students who receive entrepreneurship education have stronger entrepreneurial intention and career commitment, higher achievement scores on standardized tests, lower dropout rates, and higher personal success (Ajzen. 2001). Creating a business is not the heart of the creator, self-efficative sense. Innovation and entrepreneurship education can enhance students' belief in entrepreneurship and sense of self-efficacy, thus improving their entrepreneurial ability (Dyer 1995). It helps to strengthen a person's sense of safety, belonging, self-efficacy, self-ownership, self-awareness and sense of accomplishment, and helps to develop a person's creative and creative thinking. Enhance one's creativity, knowledge and skills (Leeetal. 2005).

On the whole, most research literature affirm the educational value, social value and economic value of innovation and entrepreneurship education. This paper holds that the fundamental task of innovation and entrepreneurship education and curriculum is to cultivate innovative and entrepreneurial talents. The main content of education not only focuses on the development of students' creativity, the cultivation of innovative spirit and ability, and the cultivation of entrepreneurial consciousness, entrepreneurial spirit and entrepreneurial ability, but also focuses on students' basic literacy of science and technology, that is, understanding the interaction between science, technology and engineering, industry and society. Establish a sense of responsibility to others, to society and to nature. Therefore, it can be said that

innovation and entrepreneurship education and courses focus on the all-round development of students.

4. How to teach

"Innovation and entrepreneurship can be taught." Whether it's an early Canadian experimental study (Kantor, 1988), a related study of the founders of Silicon Valley's iconic 3Com company (Robert Metcalfe, 2013), or a study by renowned entrepreneurship professor Timmons (2003), and a lot of practical experience, Both have clearly confirmed that entrepreneurship can be taught, which has reached a high degree of consensus both in the business community and academia at home and abroad.

Curriculum plays an important role in the education of innovation and innovation in high schools, and its importance and urgency are concerned by many countries. Entrepreneurship education courses in different regions are included in the differences. In 1967, Jeffrey Timmons set up a typical entrepreneurship course in the famous Biessen Business School. Subsequently, under the guidance of Biessen Business School, Massachusetts Institute of Technology proposed an education of innovative spirit to cultivate students' professional fields based on the characteristics of students' majors. The entrepreneurship curriculum system set up not only covers the comprehensive quality improvement content under general education, but also covers the education of general education. It also includes pioneering and innovative content for students' personality characteristics, following the entrepreneurial education curriculum system of "entrepreneurial concept generation", "entrepreneurial commercial design", "product manufacturing", "capital integration and new company establishment". Dutch universities take entrepreneurship education as a part of talent training, integrate "business management" and "entrepreneurship", adopt case analysis method to carry out teaching, guide students' entrepreneurial education practice with real entrepreneurial cases, learn lessons, and guide students how to find and use

business opportunities. Although Japan started late in entrepreneurship education, it has developed rapidly. It has made bold attempts in education mode and curriculum setting, forming a curriculum system of entrepreneurship education with local cultural flavor. For example, Japanese universities offer courses of technological innovation management aimed at social cognition, exploring the connection between natural science and social science. To cultivate entrepreneurs' acumen and insight to high-tech and market, the course focuses on practical training, and penetrates entrepreneurial practical training into the course to cultivate students' entrepreneurial awareness and decision-making ability. In terms of entrepreneurship education, British universities mainly adopt systematic and hierarchical courses, pay attention to practical operation, and guide students to increase their knowledge and enrich their skills around their future career and career needs. British colleges and universities adopt a teaching model integrating professional education and entrepreneurship education. While cultivating entrepreneurial spirit and awareness, students can know why and how to start a business, and rely on sustainable entrepreneurial talent training methods to enhance students' entrepreneurial ability. Innovation and entrepreneurship courses in European countries take the characteristics of entrepreneurs as an important part of the curriculum (Colin,Jack, 2004). However, the curriculum of entrepreneurship education should be targeted in order to produce more successful entrepreneurs (Peterman Kennedy, 2003). The implementation of innovation and entrepreneurship education curriculum should be carried out in different categories, including the innovation and entrepreneurship education of disintegrating innovation and entrepreneurship, the innovation and entrepreneurship education of preparing innovation and entrepreneurship, and the innovation and entrepreneurship education of carrying out innovation and entrepreneurship. Universities should offer different courses (Jamieson,1984).

In academic circles, scholars have conducted research from different angles on the content and objectives of innovation and entrepreneurship courses. Innovation

education courses can train students to correct the motivation and attitude of innovation, cultivate the ability and skills required for innovation, know who to interact with and collaborate with in innovation, and have a keen insight into the time and situation; Knowledge is necessary to create a career (Johannisson,1991); Solve the entrepreneur characteristic; Ability to identify business opportunities; Have the basic skills and knowledge to develop effective plans; Can identify various business strategies; The skills and skills needed to collect market information are analyzed (Roach, 1999). Curriculum content is the key to achieve the goal of innovation education. Innovation and innovation education in the university campus shows a widespread spread, far beyond the traditional curriculum content and curriculum structure (Winkler, 2015). Due to the complex nature of the innovation and innovation activities, the innovation and innovation education curriculum will cover multiple aspects, subjects and topics. The curriculum should involve three aspects: opportunity identification, resource integration, organizational management and operation (Kourlshy, 1995); Should include business management, business law, business financial accounting and business business related market marketing, etc. (Solomon, 2002); Should include a number of topics, such as the definition of entrepreneurship, self-assessment, entrepreneurship, business planning, business, environment, governance and international questions (Brown, 2000); Students should be provided with relevant laws applicable to each stage of entrepreneurship (Sekhar, 2017). Because entrepreneurs meet with various questions in the field of entrepreneurship, the curriculum for entrepreneurship education can be organized according to the questions posed by entrepreneurs (Murray, Gillin, 1990).

In China, how to promote the construction of innovation and entrepreneurship education curriculum has become a concern of scholars. It is of great significance to define the price and target of the curriculum for the establishment of the curriculum for innovation and innovation. The value orientation of innovation and entrepreneurship courses in colleges and universities is diversity and integration, and

the goal of innovation and entrepreneurship courses in colleges and universities is upward quality, industry literacy and communication ability (Du Jianqun, Du Shangrong, 2018) The concept of core nutrition has a guiding meaning for the concept of curriculum, content structure and other aspects. High schools should design a stratified and classified curriculum system based on the concept of core nutrition, and integrate the content of the curriculum according to the existing academic courses. We will promote the construction of education courses for innovation and innovation. Innovation ability can be divided into two dimensions: innovation ability and innovation ability. According to the maturity level, the innovation ability can be divided into five levels: no order level, initial level, promotion level, optimization level and practice level. The curriculum system of innovation and entrepreneurship can be constructed based on the maturity model of college students' innovation and entrepreneurship ability (Jia Jianfeng, 2018). Colleges and universities should take the requirements of college students' creativity and quality as the starting point, and surround the ideological training of creativity and innovation, the basic knowledge training of creativity and innovation, the practical training of entrepreneurship and the tested interaction, etc. Establish and improve the curriculum system of innovation and entrepreneurship for college students (He Yanhong et al., 2016). Colleges and universities should adjust the subject curriculum system, set up general courses of innovation and entrepreneurship education, strengthen the construction of mentor teams in innovation and entrepreneurship education, strengthen the construction of students' innovation and entrepreneurship teams through multiple channels, and promote school-local collaborative innovation (Zhang Qiao, 2016).

Teaching and learning is the main channel for the implementation of the curriculum for the creation of new careers. Teaching and learning model and method are the basic formula and method for the implementation of the curriculum of Chuang Chuang Ye education. According to the research, the implementation of innovation education should be based on the real time innovation activities

(Vesper, McMullan, 1988); Practical applications based on surface creativity, multidisciplinary and process orientation methods and theories (Plaschka, Welsch, 1990); To conduct a variety of activities, let students experience themselves, in order to hone students' will, cultivate students' creativity and creativity skills (Bechard, 2005), it is necessary to adopt the teaching and learning method based on practice. To help students develop and practice the skills and techniques needed for productive entrepreneurship (Neck, Greene, 2011); Based on the research, eight kinds of teaching methods are proposed: narration, examination and writing; Business simulation; Workshop; Consultants or practitioners; Visit the real world; The establishment and management of a company in the course of study; Games and competitions; Practical training (Hytti, Gorman, 2004). Some studies have divided the implementation method of innovation and innovation education curriculum into: direct teaching method; Interactive teaching method; Questions guide learning (Esmi, Marzoughi, Torkzadeh, 2015). The teacher is the key element in the implementation of the curriculum. The key is to find the most effective way to manage and teach skills, to determine the best match between student needs and teaching methods (Henderson, Robertson, 1999). Business schools have always been the core institutions for the implementation of innovation and entrepreneurship education courses. Business school training courses should include the actual case, curriculum structure should be a dynamic state, to provide all students with basic skills, and to provide opportunities for entrepreneurs support (Garazi Azanza, 2017).

In China, the academic circles generally agree that the implementation of innovation and entrepreneurship education needs to follow certain principles and adopt appropriate teaching models. Innovation education is born out of management education, but the two exist in essence. "Creative education should not only be separated from traditional management education, but also have a breakthrough in teaching and learning methods." The classroom teaching method can not achieve the results of creative education. Innovation and entrepreneurship education calls for

simulation teaching and experiential courses (Cao Shengli, 2009); Innovation and entrepreneurship should be implemented in all aspects of education and teaching, such as classroom teaching, experimental teaching, practice and ability cultivation, guided by innovation and entrepreneurship education, and comprehensively deepen education and teaching reform (Xie Heping, 2017) Innovation and entrepreneurship education should be fully integrated into college classroom teaching system (Chen Wenjuan et al., 2012). Universities should shift the focus of innovation and entrepreneurship education from the first class to the second class (Huang Xinghai, 2015). Innovation education is a process. Colleges and universities should consider what elements and domain knowledge should be integrated for students to learn a complete entrepreneurial plan (Wen Zhaodong, 2003), which is the best way for students to experience the entrepreneurial process (Huang Hong Diju, 2015).

To sum up, there are not many special contributions of students studying the curriculum of innovation and entrepreneurship education. The research of foreign students on the curriculum of innovation and entrepreneurship education has involved the curriculum objectives, curriculum contents, curriculum implementation, curriculum evaluation, and the research is relatively detailed and in-depth. Comparatively speaking, the research of scholars in mainland China tends to study the macro curriculum system, and the research on the curriculum objectives, contents and evaluation of innovation and entrepreneurship education is insufficient. The method of teaching and learning is the most widely used teaching practice in the education of creation and innovation. Classroom teaching, case studies, writing business plans, and guest talks with entrepreneurs are the main tools of entrepreneurship education (Sollomonetal. , 2002). The traditional teaching method has its limitation in the education of innovation and innovation. The traditional classroom teaching method is not effective in developing actionable results in the creation learning (Higgins, Elliott, 2011), Students clamour for innovative methods of teaching and learning (Kuratko, 205). Because of the strong activity of the new innovation industry, "doing learning"

and learning in the practice of the new innovation industry is the way of thinking. Many studies have shown the effectiveness of dynamic learning in innovation education (Hoetal. 2018), Entrepreneurial skills and behaviors can be developed effectively through reflective and activity-based learning. Thus, it can be seen that the teaching and learning method is still the basic channel of creative education, but both scholars and teachers do not care about the effectiveness of the teaching and learning method, and tend to pursue effective teaching methods and explore innovative teaching and learning methods.

5. Evaluation

Innovation and entrepreneurship curriculum evaluation plays an important role in improving the quality of innovation and entrepreneurship education in colleges and universities. At present, there are few studies on the evaluation of innovation and entrepreneurship courses, which is basically equivalent to or follows the evaluation model of innovation and entrepreneurship education. The evaluation model of innovation and entrepreneurship education includes process element evaluation and impact evaluation. Process evaluation refers to the evaluation of the number of innovation and entrepreneurship courses, innovation and entrepreneurship environment, innovation and entrepreneurship investment, and students' satisfaction with innovation and entrepreneurship courses. Impact assessment refers to the changes that innovation and entrepreneurship education brings to the educators, including emotional and cognitive changes as well as behavioral changes.

First, evaluation and monitoring of process elements of innovation and entrepreneurship education system in universities. Vesper and Gartner interviewed business school professors around the world and advocated a "seven-factor assessment" of innovation and entrepreneurship education in universities. It includes the courses offered by high innovation and entrepreneurship education, entrepreneurship textbooks and works published by teachers, the school's social

influence, alumni's participation in innovation and entrepreneurship education, alumni's self-employment, the innovation level of alumni entrepreneurship projects, and the entrepreneurial activities of scholars and professors. Scholar Xu Xiaozhou analyzed the content of the interview data with the method of grounded theory, and proposed the theoretical structure model of VPR three-dimensional three-level innovation and entrepreneurship education evaluation. Li Yadong and Zhu Weiwen took the "what", "what to evaluate" and "how to evaluate" of innovation and entrepreneurship education evaluation and monitoring as the main clues, conducted literature review and comparative review of relevant domestic and foreign research, combined with China's actual situation and drawing on useful experience, and put forward suggestions for the path and focus of future evaluation and monitoring research.

Second, the impact of innovation and entrepreneurship education on the development of college students. With the continuous development of innovation and entrepreneurship education, college students, as the main participants in innovation and entrepreneurship education, will inevitably be affected to some extent. Existing studies have discussed the impact evaluation of innovation and entrepreneurship education on the development of college students from many perspectives, which is summarized into the following two aspects: First, the enhancement of knowledge and ability. Andreas pointed out that entrepreneurship education should cultivate college students' negotiation and sales ability, leadership and management ability, creativity, and the ability to transform such creativity into new innovative products or services. Hahn et al research shows that college students who participate in innovation and entrepreneurship education, especially those who participate in the elective courses of innovation and entrepreneurship education, can improve their entrepreneurial skills (such as: Identify new business opportunities, create new products and services, manage innovation within the company, become a leader and communicator, etc.). The opportunity identification ability of students participating in innovation and

entrepreneurship education is also stronger than that of students not participating in entrepreneurship education. Li Yayuan conducted a survey of college entrepreneurs and found that the best form of entrepreneurship education is practical education such as enterprise internship, entrepreneurial park training and KAB teaching or ERP sandtable teaching. Jiang Ying and Ou Jinmei also pointed out that the key to improving entrepreneurial skills and entrepreneurial willingness is entrepreneurial education. However, Oosterbeek et al. 's empirical study of the Junior Achievement Young Enterprise student mini-company (SMC) program involving high school and college students in the United States and Europe found that SMC program has no significant impact on college students' self-rated entrepreneurial skills. SMC program makes students' expectations of entrepreneurship more realistic. Students with low entrepreneurial ability are less enthusiastic about entrepreneurship, while students with high entrepreneurial ability are more enthusiastic.

The other is a change in attitude and emotion. Some research results show that through participation in innovation and entrepreneurship education, college students' self-efficacy, entrepreneurial interest, attitude towards entrepreneurship and entrepreneurial intention are improved and enhanced. Students who choose entrepreneurship courses have higher entrepreneurial intention than those who do not choose entrepreneurship courses, and students who have undergone entrepreneurship education are more likely to start businesses. Gu Jingjing's research shows that innovation and entrepreneurship education has a significant positive impact on the employment satisfaction of college students, and attaching importance to innovation and entrepreneurship education is conducive to improving the employment satisfaction of college graduates. Participation in innovation and entrepreneurship courses has shaped college students' interest in entrepreneurship career. Jhon et.al studied students of The University of Cenderawasih (Uncen) and found that this course caused great changes in students' thinking patterns. At the same time, research shows that innovation and entrepreneurship education is not conducive to the

improvement of college students' entrepreneurial intention. After receiving entrepreneurship education, some college students will realize that they are not suitable for entrepreneurship and choose other occupations. In general, innovation and entrepreneurship education not only helps college students to be more clear about their career choices and affect their employment satisfaction, but also helps them to build self-confidence, cultivate entrepreneurial knowledge and skills, improve problem-solving ability, and build social networks.

In addition, scholars from various countries also analyzed the influential factors of entrepreneurship education from the perspective of psychology, combined with psychological scales and questionnaires to carry out psychological measurements on the test subjects, and analyzed the influential factors of entrepreneurship education. Liliana and Cismariu (2014) conducted a psychological test on 300 students, which was conducted from the perspective of the impact of personality and values on entrepreneurial intention and success rate. Biriey and Westhead (1994) conducted a psychological questionnaire test on more than 400 social entrepreneurs in the UK, and concluded that social recognition, individual needs, entrepreneurial means, role playing and welfare support are all influential factors for entrepreneurial success.

To sum up, there are relatively few researches on the evaluation price of entrepreneurship education at present (Charney, Libecp, 2000), and the evaluation of entrepreneurship education courses should consider two aspects. That is to say, the rigorous and practical nature of the teaching and training curriculum of the new creative industry. It is necessary to use multiple methods in the evaluation of innovation education curriculum. However, this kind of "true" and "use" spear shield is to choose between the course opening and delivery and course evaluation is a competition (Solomon, George, 2007). In 2009, the World Organization for Economic Cooperation and Development (OECD) pointed out in the "Evaluation of Entrepreneurship education Programs" that there is no single model for the evaluation of entrepreneurship education programs, and a combination of qualitative and

quantitative methods can be used. Whether the innovation and entrepreneurship education curriculum can be really used by students, studies have found that business and engineering professional courses will show different levels of innovation ability (Leeetal, 2018). Students who have been exposed to entrepreneurship education courses will understand the information in the professional field more accurately and quickly (Helfat, Peteraf, 2015).

Related research

1. Education for creativity

Can creativity be nurtured by training in appropriate ways? The book *Learning to Live* clearly points out the value of education for human creativity: "Education has the power both to foster the creative spirit and to repress it." (UNESCO International Commission on the Development of Education, 1996) The U.S. House of Representatives Democrats even more starkly emphasized their belief that education has a non-negligible value for national innovation in a 2005 report, *The Innovation Agenda: a Commitment to Maintaining Competitiveness in America's First Place* (House, Democrates, 2005). Lex Cheng, a neuroscientist at the University of New Mexico, concluded that those who are diligent in creative activities are better at controlling their brains. Speakers, comedians, athletes, etc. excel at improvisational games from their regular training in switching between two modes of thinking. Kim Kyung-hee, a scholar at the College of William and Mary, says that creativity theorist Donald Triffinger's "Creative Problem Solving Method" is the most successful method to date for improving children's creativity. The General Electric Company in the United States has opened a course on "Creative Engineering" among its employees, and the results show that those employees who have passed the training course have three times higher achievements in inventions and the speed of obtaining patents than other employees. American psychologists, Mr. and Mrs. Torrance, have

investigated and analyzed 142 studies on creativity training and divided the training variables into nine categories. In the 142 studies, they found that creativity was improved by 72% through education and training. Prof. Lin Chongde, a famous Chinese psychologist, put forward the idea that "creative talents = creative thinking + creative personality". Among the many ways to cultivate creativity, character education will show breakthrough progress and great significance in the cultivation of creative ability of contemporary college students due to its relative absence in the early stage.

The assumption that creativity can be influenced has been confirmed with the deepening of academic research into the factors that influence creativity since the 1950s. Researchers have begun to show strong concern for creativity, which should be prioritized in education. Overseas research on "education for creativity" started earlier, mainly focusing on Europe and the United States, the former Soviet Union and Japan. In the West, creativity research is generally referred to as creation science. The practical application of creativity education as a specialized field began in the early 20th century in the U.S.A. In the 1930s and 1940s, research on the creativity of scientific and technological personnel reached a climax, and researchers represented by Alex F. Osborn developed a set of special methods of creativity cultivation - the Intellectual Stimulation Method (Brain Storm Method). Osborn (Alex.F.Osborn) as the representative researcher developed a special method to cultivate creativity - Intellectual Stimulation (Brain Storming), which is also translated as Brain Storming. 1954, Osborn founded the "Creative Education Foundation", which is committed to the training and application of this method throughout the United States to promote. According to Osborne, the development of creativity education should be based on the development of creative curricula and the application of creative principles and methods in teaching, so as to cultivate creativity in human beings. After Osborne, the Swiss astronomer Zwicky put forward the "Morphological Analysis Method" in 1942, which centered on the analysis and combination of forms or elements; in 1944, the

American professor Gordon put forward the famous "Metaphorical Method", which centered on analogy. Afterwards, hundreds of creation techniques have been derived from these three techniques. From this point of view, Western creative education emerged in the field of technical invention, focusing on the training and specific application of creative techniques.

In the Soviet Union, research on "education for creativity" started at an early stage. In terms of theoretical research, Zankov systematized creative education through 20 years of experimental research in education, while Sukhomlinsky, through his own long-term practical research, put forward the basic approach and core of creative education. Vygotsky, Leontsev and other representatives of the "Veliru" school put forward the "double stimulation method", pointing out that the decisive role of teaching is not only manifested in the content and level of intellectual development and the characteristics of intellectual activity, but also in the speed of intellectual development, as a method of judging the creativity of the mind. as a method of judging the creativity of the mind.

Japan is the first country in East Asia to conduct research on "education for creativity". The Japanese educational philosopher Inamo Kuzukaze firstly devoted himself to the research and advocacy of creativity education, and systematically elaborated the theory of creativity education in his masterpiece "Theory of Creativity Education" in 1923, and began to devote himself to the research of creativity development in the 1960s, which was increasingly emphasized, and from the end of the 1950s to the beginning of the 1980s, Japan implemented the reform of the curricula of primary and middle schools three times successively. Invention classrooms, patent universities, and Sunday invention schools all over Japan implemented creativity education in their teaching practices to varying degrees, and at the end of the 1970s, the Japan Institute for Creativity and the Institute for Creativity Development were established. These researches and practices have enriched the form and content of creativity education from different perspectives, and significant

achievements have been made in the development of teaching materials, curricula and teaching methods for creativity education.

Throughout the practice of education and academic research in many countries, the basic value connotation of "education for creativity" is to cultivate people's innovative spirit and creative ability as the basic value orientation and purpose of educational activities. It is emphasized that innovative education is education for human beings, and it is affirmed that creative ability can be cultivated. It is advocated that innovative education should be carried out throughout the whole process of talent cultivation to promote the spirit of human subjects, cultivate the independent personality of students, and develop students' critical thinking and ability. Among them, creative thinking is the key, and it is made clear at the level of specific education and learning that innovative education is the process of guiding students to engage in creative learning, especially the development of their creative thinking and the cultivation of creative qualities. Starting from the law of human physical and mental development, creativity has unprecedented important value in today's era, human creativity not only contains rational and irrational factors in the inner psychology, but also subject to the influence and constraints of the external social conditions, modern education to successfully cultivate creative talents needs to be based on the age-specific characteristics of the creative development of human beings to carry out education in stages.

2. Study on the influence of teaching model on college students' creativity

Given that creativity has different levels and is regarded as an ability that everyone possesses, and that creativity is regarded as a higher cognitive level for students to learn in Rum's taxonomy of teaching objectives, these views have led researchers to explore the cultivation of creativity. Many studies have shown that, to a certain extent, it is reasonable and effective to cultivate creativity by means of proper

creative teaching practice and creative thinking training.

In the relevant studies, some researchers start from the teaching mode that helps to cultivate students' creativity, and most of the studies choose problem-driven, project-driven and other similar teaching strategies as the main line of teaching practice. In particular, the method of designing teaching process based on Creative problem-solving (CPS) has been widely practiced in the teaching of multiple classes and disciplines, and it is considered that the model can effectively promote the development of students' creative thinking. The CPS model was originally developed by Osborn and has been iterated and refined by other researchers to form a four-component eight-stage model that includes understanding challenges, generating ideas, preparing actions, and implementing solutions. Some Chinese researchers have also created other types of teaching models. Based on the concept of design learning, Rao Min carries out design teaching practice to promote the cultivation of students' creativity through seven aspects, including determining the theme, proposing challenges, exploring and solving doubts, developing and creating, sharing works and extending after class. Based on TRIZ theory, Yan Ni and Zhong Bochang put forward an inventive teaching model. Zhou applied the 5E (Participation, Exploration, Interpretation, Refinement and Evaluation) model to the cultivation practice of scientific creativity of rural teachers, and verified the effectiveness of this teaching model.

There are also abundant research results on the introduction of creative thinking techniques to cultivate creativity. Sun, Wang and Wegerif designed a set of divergent thinking training (association, decomposition, combination adjustment) and applied it to task situations related to scientific creativity, and the results showed that students' scientific creativity performance was improved. Kao combined four analogies and metaphorical analogies to design learning projects, and found that participants' originality scores on Torrens creativity test increased with the increase in the level of visualization of these projects, indicating that such methods can be better

applied to teaching to promote creativity. Wu and Wu designed project-based learning activities and introduced SCAMPER teaching strategies, and found that the creative thinking of highly creative learners was improved, and the habitual thinking of low-creative learners was also improved. Based on his many years of teaching experience, Shang Hua summarized the relevant methods of cultivating and training creativity, including sudden association method, brainstorming method, three-dimensional thinking method and drawing inferential three methods.

The researchers also found that the independent support from teachers had a significant effect on the creativity of college students. Deci et al. found that students who feel independent support from teachers are more curious and confident, and thus have stronger intrinsic motivation and learning autonomy, and are more challenging. Angela proposed that improving teachers' behaviors, guidance strategies and students' learning atmosphere could effectively stimulate students' creative motivation and promote the development of college students' creativity. Beghetto found that the way teachers gave feedback to students and the evaluation atmosphere they created significantly affected students' creative motivation and ability of creative expression. Ren Yang divided tutor support into emotional support, learning support, information support and scientific research support, and verified that tutor's learning support has a positive impact on students' adventure and challenge, and emotion, information and scientific research support have a positive impact on their adventure, curiosity, imagination and challenge. Zeng Hui et al. found that the creativity tendency of college students is intrinsically linked to EPQ personality traits, neurotic high scores can maintain independent behavior and thinking, extroverts have a wide range of hobbies, are full of interest and curiosity to the outside world, and are eager for stimulation and adventure; People with high mental quality can transcend and release all kinds of external values that hinder creation.

3. Research on the impact of innovation and entrepreneurial course on college students' creativity

As the core force of creativity education, innovation and entrepreneurship education has become the focus of attention of countries all over the world. The United States has incorporated entrepreneurship education into the national education system, Germany proposes that universities should become melting pots for entrepreneurs, and Japan regards entrepreneurship education as an urgent task for social development, etc. Innovation and entrepreneurship education has become an international trend, and it is the basic consensus of education reform and development of all countries in the world. Reflected in the scope of education, the attention to the creativity of education and the cultivation of innovative talents in the field of education theory and practice has never been as extensive and strong as at present. The research results of the academic circles around the relevant themes show that the important value of creativity in education is not only reflected in the cultivation of innovative talents, but also in the enhancement of social creative vitality and innovation ability, leading the reform of curricula and education and teaching, and promoting the progress of science and technology and cultural prosperity.

The core of innovation and entrepreneurship education is to cultivate the spirit of innovation and entrepreneurship, i.e. creativity, among university students. Creativity is the ability to propose or produce work products that are novel (i.e., original, new and different, etc.) and relevant (i.e., useful and suitable for specific needs). Traditionally, creativity has been regarded as a genetically determined individual difference that is difficult to develop later in life. However, as research continues, scholars are beginning to believe that creativity can be developed and nurtured, and Csikszentmihalyi argues that creativity is the result of a combination of an individual's innate traits and acquired learning, and that it can be cultivated and improved based on a series of systematic activities. Only when an individual puts into

the environment and interacts with the environment can creativity be emphasized. Innovation and entrepreneurship education provides college students with a kind of interactive environment for teachers, students and peers, giving them the opportunity to express their unique views and learn from each other, and helping them to better improve their creativity. Chinese scholars Li Tao and Xiao Yunlong start from the concept of innovation and entrepreneurship education adapted to the creativity economy, emphasize the importance of creativity, and explain that innovation and entrepreneurship education is the foundation and means of creativity. Innovation and entrepreneurship education in colleges and universities has many forms of expression, including lectures by excellent innovation and entrepreneurship talents, as well as continuous and systematic curriculum teaching by teachers, which contains many brainstorming and mind-expanding sessions, which are very favorable to the cultivation and improvement of college students' creativity. Therefore, innovation and entrepreneurship education plays an irreplaceable role in college students' creativity.

In the education system, the curriculum is always in the center, and the goal and direction of education must be implemented in the specific curriculum and realized through the curriculum. Scholars have generally agreed on the status and value of curriculum construction in innovation and entrepreneurship education, affirmed the irreplaceability of the curriculum in innovation and entrepreneurship talent cultivation, and basically formed a consensual judgment: innovation and entrepreneurship education curriculum is the basic carrier of innovation and entrepreneurship education, the link between innovation and entrepreneurship theory and practice, and directly related to the improvement of the core quality of innovation and entrepreneurship talents and the guarantee of cultivation quality. Basically, a consensus judgment has been formed: innovation and entrepreneurship education curriculum is the basic carrier of innovation and entrepreneurship education in colleges and universities, it is the link between innovation and entrepreneurship theory and practice, and it is directly related to the enhancement of core quality of

innovation and entrepreneurship talents and the guarantee of cultivation quality.

The most direct effect of innovation and entrepreneurship courses on creativity is reflected in talent cultivation, through the teaching of innovation and entrepreneurship theory and practice courses can further solidify students' innovation and entrepreneurship knowledge foundation, develop students' innovation and entrepreneurship thinking and potential, and enhance students' innovation and entrepreneurship comprehensive ability. Chen Jing and Wang Zhanren assert that the curriculum is the main place for students to master innovation and entrepreneurship knowledge and ability, and that classroom teaching and extracurricular practice constitute the "two wings" of the practice system of innovation and entrepreneurship education ecological development in colleges and universities, which can help to synchronize and improve the professional skills and entrepreneurial knowledge of students. Qiu Cunjin also believes that the construction of innovation and entrepreneurship curriculum system is beneficial in promoting students to establish the concept of innovation and entrepreneurship, shaping students' positive innovation and entrepreneurial awareness, and improving students' innovation and entrepreneurship methods and abilities. Wang Yuhong and Yan Guangfen further deduced through the empirical research findings of malefactors that the innovative and entrepreneurial curriculum lands on the cultivation of students' creative way of thinking, the development of their innovative ability and pioneering spirit, the stimulation of their initiative and entrepreneurial enthusiasm, and the enhancement of their comprehensive quality. Obviously, whether it is for improving the development level and quality level of basic education of innovation and entrepreneurship course itself, or for students' innovation and entrepreneurship knowledge reserve, practical application, quality cultivation and comprehensive ability development, perfecting the construction of innovation and entrepreneurship education course undoubtedly has its intrinsic rationality, and the systematic, structured and modularized course is more effective than the spontaneous, fragmented and single innovation and

entrepreneurship activity experience in innovation and entrepreneurship training. The systematized, structured and modular curriculum is more effective than spontaneous, fragmented and single innovation and entrepreneurship activities.

4. Research on the teaching model of innovation and entrepreneurial course based on creativity

Innovation and entrepreneurship education is different from traditional education in that the forms and methods of teaching and learning in the curriculum are different from the usual curriculum teaching and learning activities. As the results of Winsiow's national survey show, the old methods represented by exams are being replaced by new methods, with students preferring forms and methods such as designing business plans and entrepreneurial cases, with a greater focus on students' entrepreneurial understanding and practical skills. Dzisi's use of a mixed-methods approach to collecting and analyzing randomized data found that the traditional passive and incremental methods of entrepreneurship teaching and learning affect students' ability to apply the knowledge and skills acquired through education and training. He emphasized that in order to strengthen the educational system for educating and learning entrepreneurship, continuous innovation and innovative teaching methods should be encouraged, suggesting that attention should be paid to globalized entrepreneurship teaching and learning sciences, which in turn will produce qualified graduates with employable skills. Sinkovic et al. pointed out that many researchers claim that the use of web-based learning tools and ICTs will revolutionize the traditional methods of learning in the university, and fundamentally change the process of knowledge collection and dissemination, but there are conflicting views about the benefits and actual learning outcomes of these technologies. They believe that through the use of ICT, especially the Web as a dynamic and integrated learning tool, it is possible to deploy Wakachi strategic competencies to fundamentally improve the international knowledge, skills and

abilities of entrepreneurial students, and propose the use of the Web as an integrated teaching tool. It can be found that foreign scholars basically agree that the teaching methods of innovation and entrepreneurship education courses should move from traditional to modern, and tend to be diversified, practiced, informatized, networked and internationalized.

Chinese scholars' research on innovation and entrepreneurship education mode also focuses on several aspects, such as experiential teaching mode, project participatory teaching mode, collaborative innovation teaching mode, and studio mode. Zhang Yuguang and Diao Yanbin (2017) in "Exploration of Experiential Innovation and Entrepreneurship Education Mode in Colleges and Universities" believe that entrepreneurship education adopts the experiential teaching mode to integrate the field experience into the teaching link, so that students are placed in the interactive field of knowledge construction, ability expansion, and experience of application, which stimulates the entrepreneurial potential of the students, enhances the initiative for conscious participation, and realizes the effect of entrepreneurship education in thinking, inquiry, and inspection. Additive. Wang Shuanghong (2015) proposed in "Exploration of Project Participatory Entrepreneurship Education Mode for College Students" to realize the resource integration of project teaching and entrepreneurship education, and under the guidance of senior mentors in enterprises, students participate in the operation of the project, relying on the means of "learning by doing" to realize the enhancement of entrepreneurial awareness, entrepreneurial thinking, entrepreneurial ability, and to achieve entrepreneurship education through cooperation, participation and interaction. In this way, the teaching of entrepreneurship courses can be completed in a cooperative, participatory and interactive project-based mode, which can tap the entrepreneurial potential of students and enhance the effectiveness of entrepreneurship education. Chen Bochong, Liu Qing (2017) in the article "Studio Entrepreneurship Education Mode: Connotation, Advantages and Prospects" proposed that the studio, which is a teacher-guided,

student-led, semi-market operation equivalent to a small company in the society, be the focus of entrepreneurship education, and that it is carried out through the teachers' undertaking of the social projects and the students' participation in completing them, and that it implements the semi-commercial operation in terms of the project negotiation, negotiation and cooperation, following up on the completion of the project, and following up the service, and so on. This kind of studio teaching mode with the concept of both theory and practice constitutes a complete entrepreneurship education chain through modularization, standardization, evaluability and semi-market operation, which organically integrates daily entrepreneurial practice with entrepreneurship education and meets the development demand of society for entrepreneurial talents.

Review of Existing Research

Numerous scholars have launched qualitative and empirical studies on creativity, innovation and entrepreneurship education, which have promoted the continuous deepening and development of innovation and entrepreneurship education and creativity researchers. Innovation and entrepreneurship education always goes hand in hand with creativity, and scholars seem to have tacitly recognized that innovation and entrepreneurship education inevitably promotes the development of creativity regarding the relationship between innovation and entrepreneurship education and creativity. Yet there are few empirical studies to verify this. Through the literature review, foreign academic research on innovation and entrepreneurship education focuses on empirical research, which is more microscopic and specific, such as researching the characteristics of entrepreneurs, the qualities they should have, entrepreneurial opportunity identification, the operation mechanism of start-ups, growth management of start-ups, and entrepreneurship education from multiple perspectives. Domestic research on innovation and entrepreneurship education, on the other hand, mostly focuses on theoretical research, which is more macroscopic. This

paper finds that there are still some research gaps in the existing research: first, innovation and entrepreneurship education is a macro concept, including innovation and entrepreneurship courses, innovation and entrepreneurship practice, innovation and entrepreneurship competitions and many other aspects, if it is not categorized and only generalized as innovation and entrepreneurship education, then the analysis and even the proposed policy recommendations lack a certain degree of relevance. At present, only a few scholars have categorized innovation and entrepreneurship education and conducted specific research. Second, while many scholars believe that the ultimate goal of entrepreneurship programs is to enhance the creativity of college students, few researchers have conducted empirical studies to assess whether entrepreneurship programs can really enhance the creativity of college students. That is, does participation in innovation and entrepreneurship courses enhance the creativity of college students? Thirdly, in the few empirical studies, most of the studies on the research on influencing factors are stuck on descriptive and regression analyses, ignoring the fact that college students' participation in innovation and entrepreneurship education is not randomly existed, and there is the problem of sample selectivity bias. Fourth, the mode of innovation and entrepreneurship courses should be different from the traditional teaching mode, which has reached a consensus in theory and teaching practice, but few studies have verified the impact of different teaching modes on students' creativity, especially empirical studies.

Conceptual Framework

From the perspective of educational sociology, the instructional model is a typical social interaction process. It serves as the most direct and fundamental form influencing the quality of school education and is a crucial avenue affecting the cultivation of creativity in college students. In terms of educational practices, the content of instruction can enhance students' foundational knowledge and skills. Through various teaching methods and approaches, such as inquiry-based teaching

and discussion-based teaching, it is possible to shape students' thinking styles effectively. These are essential conditions for the formation of creativity. In China, most college students are in the stage of youth development, typically between the ages of 18 and 22. During this period, their knowledge structures, cognitive levels, and thinking patterns are not yet fully developed. Through the reform of educational models, we can provide the necessary knowledge and skill foundation for the formation of creativity. Based on this, the primary guiding principles for establishing the instructional model in this study are as follows:

First of all, the creativity of college students is slightly different from that of other people in terms of extension. Compared with others, the creativity of college students is not only embodied in creative thinking ability (fluency, uniqueness, adaptability) and creative personality tendency (adventurousness, curiosity, imagination, challenging), but also has an important embodiment of creative behavioral ability, that is, the ability to investigate and discover problems, the ability to solve practical problems and the ability to produce creative results. In teaching practice, we find that problem solving is very closely related to creativity. According to the problem solving criteria proposed by Ausubel and Robinson, creativity is the highest expression of problem solving, which is solving problems in a novel and unique way. Therefore, we can reveal the nature and laws of creativity by studying the process of problem solving, adopt the principle of "problem-centered" in the teaching mode, and cultivate students' creativity by training their problem-solving ability.

Secondly, the inherent characteristics of innovation and entrepreneurship education, such as subjectivity and practicability, determine the uniqueness of its curriculum implementation, i.e., it cannot follow the knowledge-based and indoctrination curriculum implementation of the traditional professional education model, but emphasizes more on experiential and participatory teaching, focusing on the unity of knowledge and practice, and the unity of theory and practice. As the core link of innovation and entrepreneurship talent cultivation, the implementation of

entrepreneurship education courses must organize and carry out teaching activities with the basic logic of student-centered and practice-oriented. Practicality is a very important feature of innovation and entrepreneurship education, and in the process of implementation it is necessary to ensure that students have a way to obtain practical experience. In the European Union, four types of pedagogical approaches are advocated: active learning, project-based learning, experiential learning, and student-connected communities. The EU defines a practical entrepreneurial experience as "an educational experience that provides students with the opportunity to generate, recognize and transform ideas into action. Currently, European countries provide students with hands-on entrepreneurial experiences by completing projects, taking practical challenges, participating in community challenges, creating mini-companies and experiencing microfinance. Since the project-based approach is more popular in Europe, of the five approaches, project completion is the most prevalent practice in practical entrepreneurial experiences and is commonly used in about one third of European countries. In addition, student participation is another important feature of the innovative entrepreneurship teaching model. The classroom should build a democratic and harmonious teacher-student relationship and different forms of interactive small groups based on the "master-master" relationship by creating a democratic and harmonious teacher-student interaction situation. In the continuous interaction between teachers and students, students' enthusiasm for creativity is stimulated, innovative thinking and creative personality are formed. In the course of interactive teaching in the classroom, students accumulate knowledge and are socialized, thus developing the creativity needed for the development of society.

Finally, the study *Fostering Students' Creativity and Critical Thinking*, developed by the OECD Centre for Educational Research and Innovation, points to creativity as a higher-order thinking skill that emphasizes the construction of new and appropriate ideas and products. *Creativity and Critical Thinking*", developed by the

OECD Centre for Educational Research and Innovation, points out that creativity, as a higher-order thinking skill, emphasizes the construction of new and appropriate ideas and products. Creativity is based on prior knowledge and uses the sub-thinking skills of Inquiring, Imaging, Doing and Reflecting, which summarizes the process of innovation or creativity. Based on the conceptual framework of creativity developed by the OECD Educational Research and Development Institute (ERI), the Innovation and Entrepreneurship Teaching Model (IETM) breaks down the process of creativity into a series of human skills: Inquiring, Imaging, Doing, and Reflecting. The IETM is designed as a set of instructional activities that are closely linked to the daily teaching and learning activities of the teacher and the students in order to improve the effectiveness of the classroom and the development of creativity in the students.

To sum up, based on constructivism education theory and creative problem solving theory, this study develops a teaching model with the core goal of cultivating students' creativity. In this study, the six components presented by Joyce et al. (2011) were adapted in developing the teaching model namely (1) principles of the model, (2) objectives, (3) syntax, (4) social system, (5) principle of reaction, and (6) Support system. The improvement of students' creativity level is used as evaluation indicators.

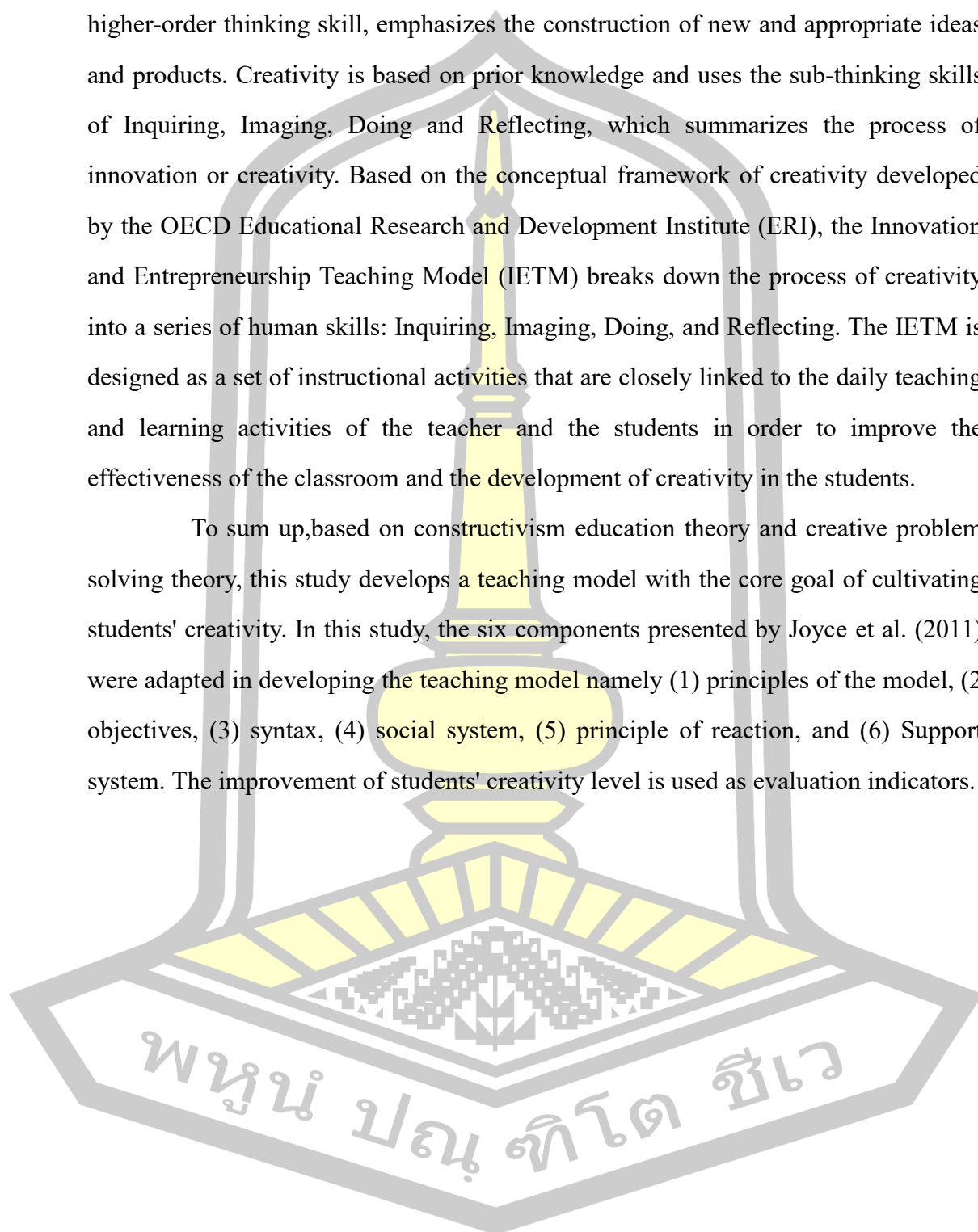
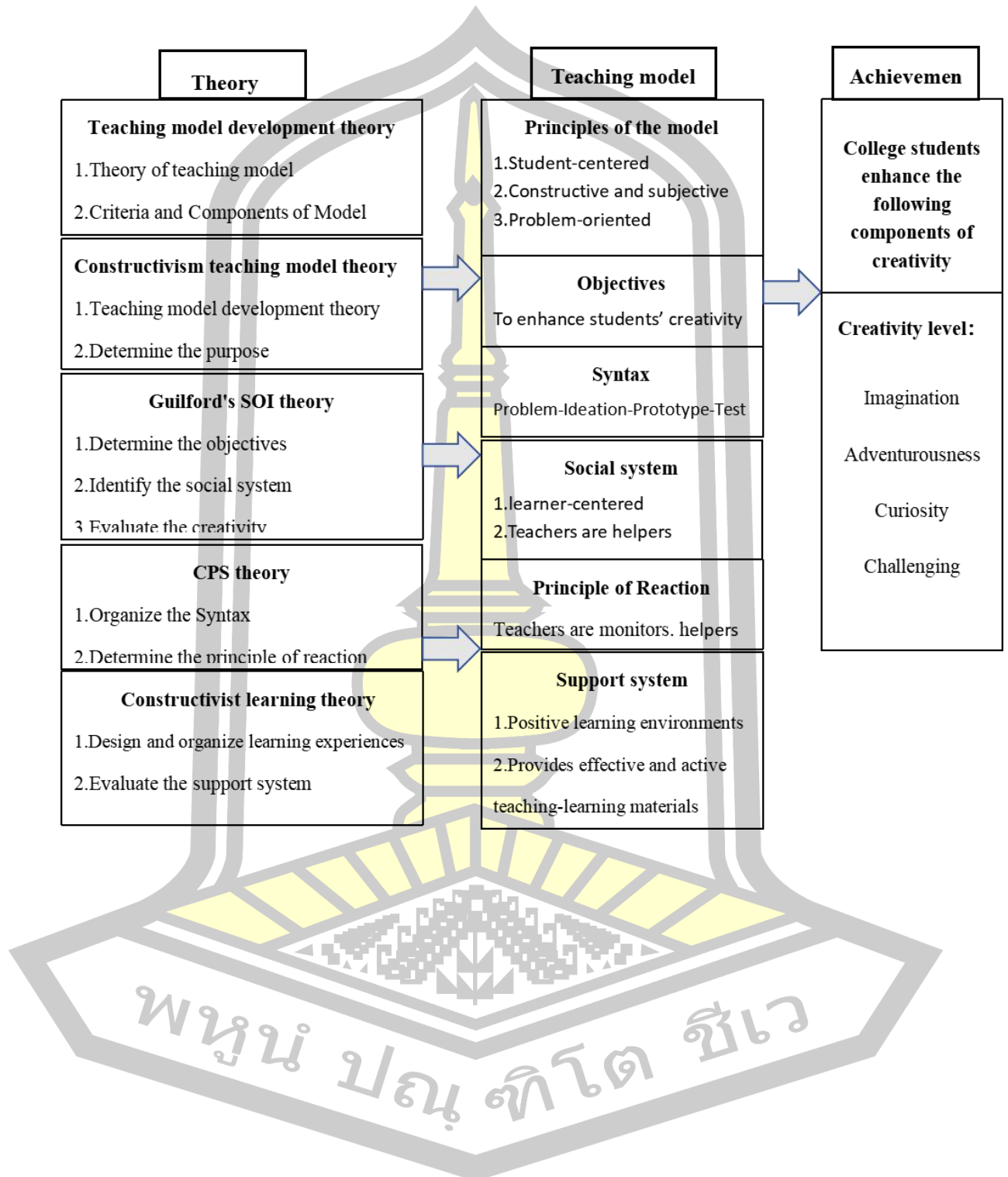


Figure 1 Conceptual Framework



CHAPTER III RESEARCH METHODS

The researcher developed a teaching model based on innovation and entrepreneurship courses in Chinese college to promote the creativity of students. The research process is divided into three stages as follows:

Phase I - Contextual Study

1. Research and study the theories, concepts and principles of creativity
2. Study the current situation of college students' creativity
3. Study the guidelines for developing teaching model to enhance college students' creativity

Phase II - Developing teaching model

1. Development of the teaching model
2. Assess the quality of the teaching model

Phase III - implementation

1. To implement the teaching model
2. To compare the creativity level of college students before and after using the teaching model
- 3.3 To compare post-test of creativity in the experimental and control groups

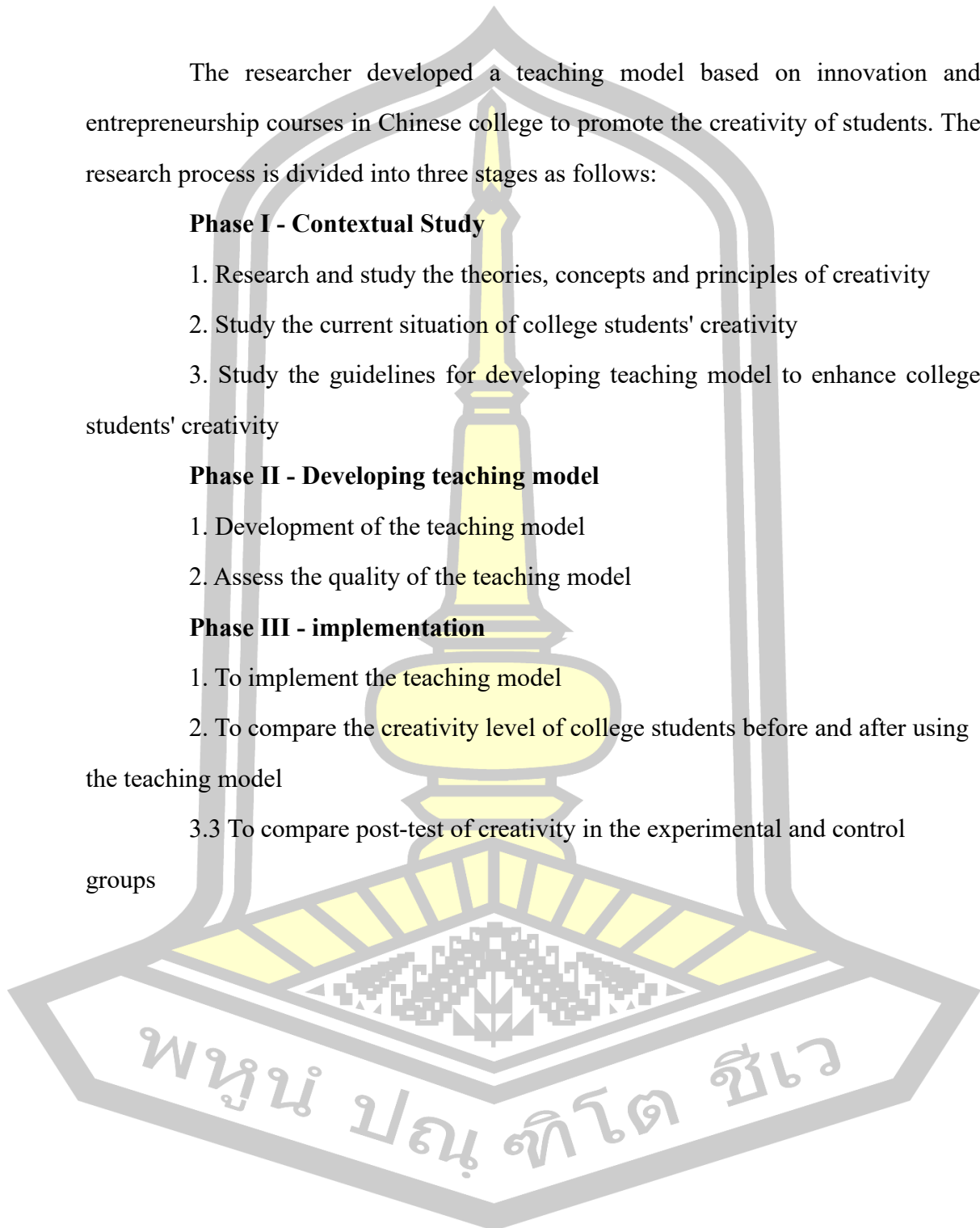


Figure 2 Research Design

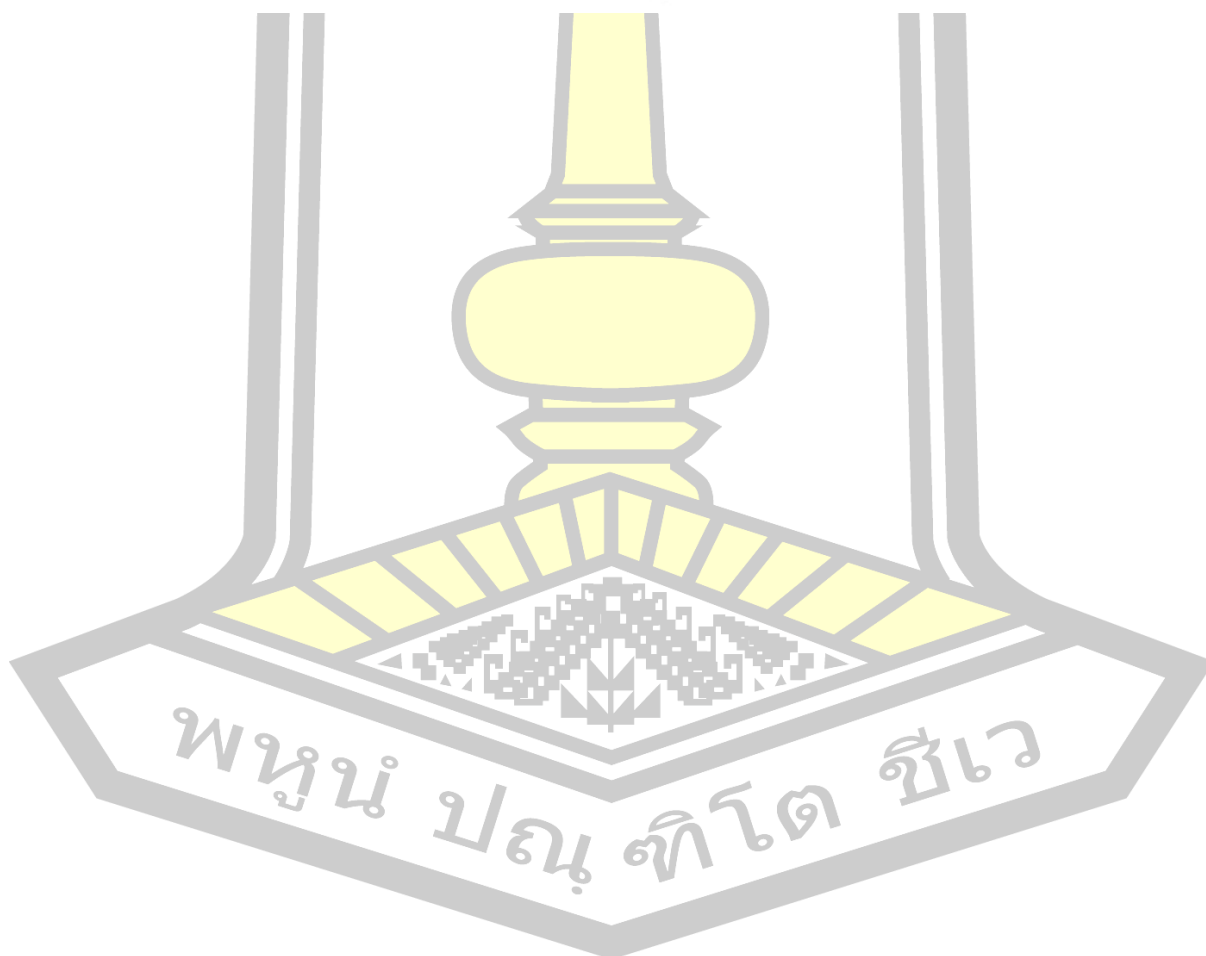
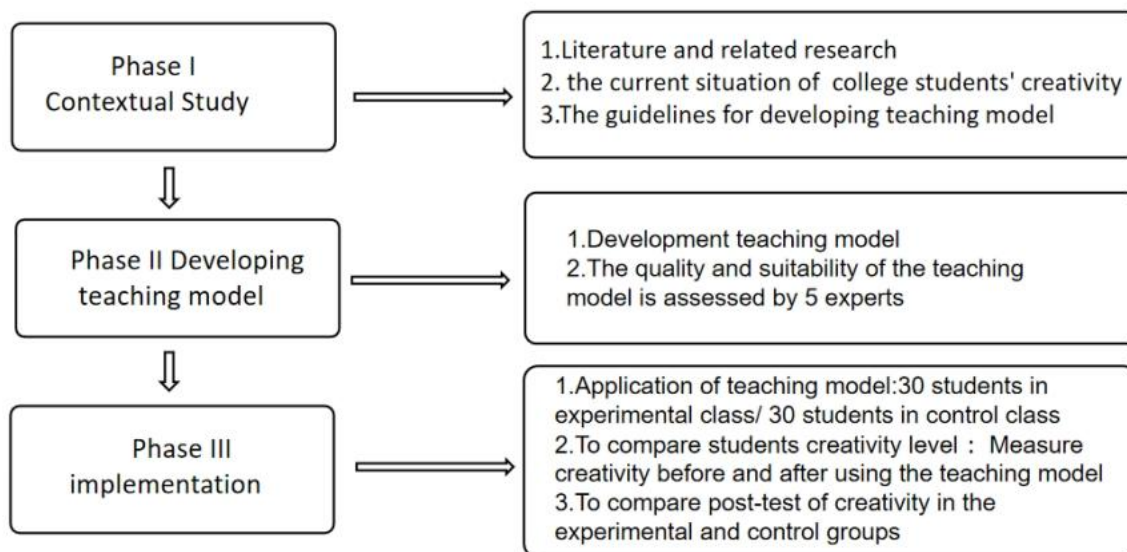


Table 1 Research Process

Phase	Purpose	Methods/Tools	Data Collection	Output
Phase I Contextual Study	1. To study the theories, concepts, principles of college students' creativity	Documentary Research	Literature and related research	Conceptual frame theory
	2. To study the current situation of college students' creativity	Related literature Existing document	researcher	Diagnosing the necessity of improving college students' creativity from a practical perspective
	3. To study the guidelines of cultivating college students' creativity	Semi-structured interviews	5 experts (2 in curriculum and teaching/1 in research and evaluation/ 2 in innovation and entrepreneurship education)	Supply a bias for a further guidelines for developing the teaching model
Phase II Developing teaching model	1. To develop teaching model	Teaching model was drafted to improve creativity for college students.	Research results and theoretical basis from Phase I	Developing teaching model to enhance the creativity
	2. To assess the quality of teaching model	Assessing the quality of teaching model by 5 experts	5 experts	The validity and reliability of the teaching model
Phase III Implement- ation	1. To implement the teaching model	Experimental research: Contents. P rocess. Effect etc.	30 students in experimental class/ 30 students in control class	Implement the teaching model
	2. To compare the creativity level of college students before and after using the teaching model	Pre/post-test of creativity	30 students in experimental class/ 30 students in control class	Information of the creativity level of college students before and after using the teaching model
	3. To compare post-test of creativity in the experimental and control groups	Post-test of creativity	30 students in experimental class/ 30 students in control class	Information from the creativity post-test for students in the experimental and control groups

Phase I Contextual Study

In this stage, researcher studies the theories, concepts, principles and influencing factors related to the cultivation of creativity of college students in order to provide guidance for the development of teaching model. Researcher mainly used Documentary Research and Survey Research methods.

Step 1: Study relevant theories, concepts, and principles

At this stage, researcher conducted literature research on the theories, concepts and principles of creativity cultivation of college students. The relevant literature is studied to obtain information for the development of teaching model. The goal of this research is to develop a teaching model for Chinese college students to improve creativity levels.

The researcher consulted relevant books, journals and policy documents to obtain theories and concepts, and searched relevant researches on the cultivation of college students' creativity in China and other countries through CNKI Scholar, Springer, ERIC, Google Scholar and other databases. In order to understand the teaching mode, subject characteristics and creativity training effectiveness.

Step 2: Study the the current situation of college students' creativity

At this stage, the current status of creativity level of college students is studied through existing literature and survey reports.

Step 3: Study the guidelines for developing teaching model to enhance college students' creativity

Select 5 experts with relevant qualifications, including 2 expert in curriculum and teaching, 1 expert in research and evaluation, and 2 expert in innovation and entrepreneurship education ,to conduct in-depth interviews to understand the effectiveness of creativity training in universities and the guidelines of creativity.

1. Population and Sampling

5 experts with relevant qualifications, including 2 expert in curriculum and teaching, 1 expert in research and evaluation, and 2 expert in innovation and entrepreneurship education

2. Tools for collecting data

The objective of this interview was to examine the current state of creativity development among Chinese college students and to gather insights from experts regarding instructional models aimed at enhancing the creativity of these students. The interview is divided into four parts.

2.1 General information about the interviewer

2.2 Current Situation and Problems of Creativity Cultivation and Teaching Models for College Students

2.3 Guidelines for the Development of Teaching Models to Enhance Creativity

2.4 Opinions and Suggestions

3. Tool creation and quality assurance

Semi-structured interview for experts

3.1 Select key factors and conduct comprehensive analysis by consulting research literature to guide the creation of the questionnaire

3.2 Consult survey reports and literature to study the current situation of college students' creativity

3.3 Semi-structured interviews were used to determine the types of questions for expert interviews in order to obtain more specific information.

3.4 Write questions from the information obtained to create interview questions for experts

3.5 Submit the interview questionnaire to the instructor for accuracy and appropriateness check and modification

3.6 Quality assurance for the Semi-structured interview

Phase II Developing teaching model

This stage of research aims to develop a teaching model. Design and develop the teaching model through theoretical research and data information from the first stage, including developing the teaching model and evaluating the quality of the teaching model by professionals. The detailed steps are as follows:

Step 1: Developing a teaching model

Based on the study of relevant theories, concepts, principles and relevant research on the cultivation of creativity in college students, the researcher developed teaching models to promote the creativity level of college students.

Step 2: Expert assessment

The researcher invited professionals in related fields, including curriculum and teaching experts, educational evaluation experts and educational psychologists, to evaluate the teaching model. Experts assess and provide feedback on the quality and feasibility of the teaching model.

1.Population and Sampling

It includes 5 experts with relevant qualifications, including 1 expert in educational technology, 1 expert in curriculum and teaching, 1 expert in educational psychology, 1 expert in research and evaluation, and 2 experts in innovation and entrepreneurship education. The course and expert information is as follows:

1.1 Ms.Jun Wu,PhD,Dean and Professor of the faculty of Innovation and Entrepreneurship,Guangzhou Panyu Polytechnic

1.2 Ms.Baijun Deng,master,Associate professor of Guangzhou Panyu Polytechnic

1.3 Ms.Shuwei Wang,master,Associate professor of Guangzhou Panyu Polytechnic

1.4 MR.Xiaozhao Lin,PhD,Associate professor of South China Normal University

1.5 MR.Yanhua Bu,master,Associate professor of South China Agricultural university

2. Development process

2.1 Confirm the principles of development and ensure that the design of teaching mode is based on theory and research, as well as practical operability and applicability, so as to promote the creativity of Chinese university students.

2.2 Extract data from the analysis results of the first-stage research to determine the components of the teaching framework and teaching model.

2.3 Design the framework of the teaching model. This study adopts the six-element teaching model theory of Joyce and Weil to determine the curriculum framework, including:

(1) Principles of the model

(2) Objectives

(3) Syntax

(4) Social system

(5) Principle of Reaction

(6) Support System

2.4 Submit to expert evaluation. Evaluate and improve established teaching models to confirm their accuracy and suitability.

After receiving advice from the instructor, the researcher examined the quality and appropriateness of the teaching model to improve teaching effectiveness.

The teaching model was evaluated by five professional reviewers, including one expert in educational technology, one expert in curriculum and instruction, one expert in educational psychology, one expert in research and evaluation, and one expert in innovation and entrepreneurship education.

2.5 Improve the teaching model. Revise and improve the teaching model according to the feedback of experts.

3. Instrument

3.1 Instruments stages

The instruments used in this study are divided into two stages, as follows:

(1)The instrument of planning research is structured interview model,which adopts experts interview.

(2)The instruments used in constructing curriculum development.The scale is characterized by 5-point rating scale. The scale is very low, low, moderate, high, very high.

The construction of the teaching model to improve collage students' creativity comes from the investigation of the needs of Innovation and entrepreneurship teaching activities and the necessity of developing teaching model.

The survey results are divided into five levels:

Score: 5 Grade: the most needed

Score: 4 Grade: need

Score: 3 Grade: the medium need

Score: 2 Grade: low need

Score: 1 Grade: minimum need

The scores of the five grades are as follows:

Mean: 4.51-5.00 Demand level: the most needed

Mean: 3.51-4.50 Demand level: need

Mean: 2.51-3.50 Demand level: medium need

Mean: 1.51-2.50 Demand level: low need

Mean: 1.00-1.50 Demand level: minimum need

3.2 Construction and Quality of Instrument

(1) Evaluate the Validity of the teaching model.

(2) Construct the evaluation model of the teaching model.

1) Identify the problem framework to be evaluated, analyze the the teaching model outline and elements in detail, and then establish the problem framework to integrate the various elements of the the teaching model.

2) Establish the applicability evaluation model of the teaching model, and analyze the consistency of the teaching model according to the focus.

3.3 Quality of Instrument

(1) Introduction of the Evaluation Model: The generated evaluation model is presented to the supervisor for verification of its applicability, alignment with the curriculum objectives, and clarity of linguistic expression.

(2) Modification and Review: In accordance with the supervisor's recommendations, the evaluation model undergoes modifications and is subsequently reviewed by subject matter experts.

(3) Evaluation and Resubmission: Based on the experts' feedback, the organizational learning activities are assessed, and the revised paper is submitted once again to the supervisor.

4. Data collection and Date analysis

4.1 Data collection

(1) Apply to experts for data collection and research.

(2) Actual data entry by researchers and experts.

(3) Analyze the quality of the tools with Index of Item Objective Congruence (IOC)

$$IOC = \frac{\sum R}{N}$$

IOC: Consistency between test and learning objectives

R: Synthesis of expert opinion scores

N: Total number of experts

4.2 Data analysis

(1) Through the evaluation and weight analysis of the teaching model, the following are selected:

- 5 represents Strongly agree
- 4 represents Agree
- 3 represents Neutral or unknown
- 2 represents Disagree
- 1 represents Strongly disagree

(1) According to the standard interpretation average, as follows:

Average score	Explanation Result
4.51-5.00	Strongly agree
3.51-4.50	Agree
2.51-3.50	Neutral or unknown
1.51-2.50	Disagree
1.00-1.50	Strongly disagree

4.3 Statistic for Data Analysis

(1) Basic statistics are as follows:

$$\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n} = \sum_{i=1}^n x_i$$

\bar{x} : Mean

$\sum X$: Sum of all scores

n: Total number of studies

(2) The formula used for standard deviation is as follows:

$$\sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}}$$

SD: Standard deviation

X: Each score

N: Total number of studies

Σ : Summation

5. IOC

The content in Table 2 were evaluated by five experts in Curriculum and Instruction. Considering the consistency (IOC) between the evaluation items and the evaluation criteria, the evaluation criteria are as follows:

Make sure that the evaluation item meets the evaluation criteria and the score is +1

Uncertainty that the evaluation item meets the evaluation criteria and the score is 0

When you are sure that the evaluation item does not meet the evaluation criteria, the score is -1

Table 2 Results of expert assessment of PIPT teaching models

No.	Content for Evaluation	Expert opinion					IOC
		1	2	3	4	5	
1	Vision of the model	+1	+1	+1	+1	+1	1
2	Theories and Principles	+1	+1	+0	+1	+1	0.8
3	Objective	+1	+1	+1	+1	+1	1
4	Syntax	+1	+1	+1	+1	+1	1
5	Social system	+1	+1	+1	+1	+1	1
6	Principle of Reaction	+1	+1	+1	+1	+0	0.8
7	Support System	+1	+0	+1	+1	+1	0.8
8	Consistency of elements	+1	+1	+1	+1	+1	1

It can be seen that the clear, flexible and important objectives of the lectures meet the needs of Guangzhou Panyu Polytechnic, with a consistency value of 0.71-1.00. The teaching structure and content are consistent with the freshman in college, the length of teaching activities is consistent with the teaching method process, and the structure of teaching content can meet the evaluation standard. In the teaching process, teachers can complete the performance activities of teaching through diversified teaching activities, and encourage students to find their own ways to master knowledge and enhance creativity.

Phase III Implementation

This stage applies the teaching model to the research target group in order to promote creativity cultivation and study the performance of students in creativity. This stage mainly include the following steps:

Step 1: Implementing the teaching model

The researcher applied the teaching model to an innovation and entrepreneurship course at Guangzhou Panyu Polytechnic, China. The experiment was conducted among 60 students from two classes of the same major. The researcher conducted a experiment study to investigate and solve the problem of creativity cultivation in Chinese college students.

Step 2: Study the results of the teaching model

1. Pre-test for experimental class and control class
2. Conduct teaching arrangements according to the method of experimental research, implementing the teaching model
3. Post-test for experimental class and control class
4. Compare the students' creativity level before and after using the teaching model
5. Compare the experimental group and the control group creativity level

1. Population and Sampling

1.1 Population

60 freshmen students from Guangzhou Panyu Polytechnic, China

1.2 Sampling

The sample for this phase is 60 college students in the academic year 2024 from Guangzhou Panyu Polytechnic, China. They come from different classes of the same major, one is an experimental class that implements a specific teaching model, and the other is a control class that implements a traditional teaching model.

2. Research Methods

2.1 Experimental research method. This study uses the teaching model to carry out teaching practice research through the process of making plans, implementing actions and reflecting evaluation.

2.2 Comparative teaching method. Application of teaching model to compare students creativity level : Measure creativity before and after using the teaching model

3. Instrument

There were two categories of instruments: instruments used in the research procedure and instruments used in data collection.

3.1 Instruments used in the research procedure

The instruments used in this research procedure were one semester lessons based on PIPT teaching model implementing the innovation and entrepreneurship course.

Two different classes of the same major were selected, one experimental group implemented the PIPT teaching mode and one control group implemented the

traditional teaching mode, and teaching activities were carried out at the same time, and the pre- and post-tests of creativity were synchronized in order to compare the data and thus verify the teaching effect.

3.2 Instruments used in data collection

This study utilized the Creative Tendency Scale developed by Williams, an American psychologist, as a measurement tool to assess the creativity of students in both the experimental and control groups. Data were collected through pre-test and post-test statistics. The scale is grounded in the four dimensions of creative tendency defined by Williams: adventurousness, curiosity, imagination, and challenge. These dimensions were sequentially measured using his developed scale, which is well-established and recognized for its authority in the international community, demonstrating high reliability and validity.

The Creativity Tendency Scale was subsequently revised by Lin Hsing-tai, based on the Creativity Portfolio Test developed by F.E. Williams, and it also exhibits good reliability and validity. The scale consists of 50 items, including 42 positively framed questions and 8 negatively framed questions, employing a five-point Likert scale for scoring. For the positively framed questions, scores range from 5 points for full compliance to 1 point for complete noncompliance. Conversely, for the negatively framed questions, scoring is reversed: 1 point for full compliance and 5 points for complete noncompliance. Scores are interpreted such that higher values indicate greater creativity, while lower scores suggest weaker creativity.

The scale encompasses four subscales: adventurousness, curiosity, imagination, and challenge. The final score can be assessed for each subscale, as well as a cumulative total score.

Adventurousness includes: (1) being brave enough to face failure or criticism; (2) daring to guess; (3) completing tasks in messy situations; and (4) defending one's own viewpoints.

Curiosity includes: (1) the spirit of inquisitiveness; (2) the abundance of

ideas; (3) the willingness to approach ambiguous and uncertain situations; (4) the willingness to think deeply about the wonders of things; and (5) the ability to grasp special phenomena and observe the results.

Imagination includes: (1) visualization and creation of mental images; (2) fantasizing about things that have not yet happened; (3) intuitive speculation; and (4) the ability to transcend the boundaries of the senses and reality.

Challenging includes: (1) searching for possibilities; (2) understanding what is possible and the gaps between what is possible and what is real; (3) being able to make sense out of chaos; and (4) being willing to explore complex problems or ideas.

4. Construction and Quality of Instrument

Before conducting empirical analysis, the reliability of the scale used by the malefactor is often analyzed, and the next step of the study can only be carried out if it meets the requirements for statistical analysis of the data. Reliability testing of scales is a general method of verifying the feasibility of a research instrument.

Reliability refers to the likelihood of obtaining the same result using different measures for the same subject. Researchers utilize the internal consistency method to test the reliability of questionnaires, and a common indicator of this method is Cronbach α coefficient (between 0 and 1). It is widely recognized in academia that the internal consistency coefficient of the overall scale must be above 0.7 (including 0.7) and above 0.8 is preferable, and the minimum internal consistency coefficient of the subscales must be greater than 0.5 and preferably higher than 0.6. The present study utilized SPSS 22.0 to test the reliability of the sample. The results show that the Cronbach α coefficient of the total creativity scale is 0.927, and for each dimension, the Cronbach α coefficients of the four dimensions of adventurousness, curiosity, imagination, and challenge are 0.729, 0.781, 0.812, and 0.742, respectively. Thus, the scale of this malefactor meets the standards for conducting scientific research.

Validity refers to the degree to which a measurement tool can accurately measure the thing to be tested, and is one of the methods to verify whether the measurement results truly reflect and realize the purpose and intention of the measurement. The scale used in this study is compiled on the basis of the theory of institutional influence and with reference to the mature scales applied by previous scholars. The creativity scale used in this article has been applied by many scholars in empirical research, which is sufficient to prove its good content validity.

Structural validity is the degree to which the concepts and features of the measurement theory are reflected, i.e., if the results of the questionnaire survey can confirm the features of the theory, and at the same time the results of the survey are in line with the theoretical expectations, it means that the scale has good structural validity. The researchers firstly conducted KMO test and Bartlett's sphere test on the data. According to the established criteria, the closer the KMO value is to 1, the stronger the correlation between the variables; the closer the Sig value is to 0.000, the better. The results show that $KMO = 0.925$, $df = 1225$, and $Sig\ value = 0.000$, which meets the requirements for conducting factor analysis. The present study measured the structural validity of the Creative Tendencies Scale by means of a validated factor analysis (Confirmatory Factor Analysis, CFA). Due to the large number of scale items, researcher used the validation analysis step adopted in many researchers - packing the scale items (Item Parceling). The various model fitness indices such as RMSEA, X^2/DF , GFI, and CTI are listed in the table below. Referring to the fitness indexes and standards given by Wu Minglong, all the indexes meet the requirements, indicating that the data structure validity of the scale is good.

Table 3 Indicators of confirmatory factor analysis

Index	RMSEA A	χ^2/DF	GFI	CFI	NFI	AGFI	RFI	IFI	TLI
This research	0.028	3.012	0.999	1.000	1.000	0.994	0.997	1.000	0.998
Adaptation standard	<0.05	<5 ²	>0.9	>0.9	>0.9	>0.9	>0.9	>0.9	>0.9

Summarizing the above analysis, the scale and data used in this malefactor

have good reliability and validity (content validity and structural validity), which meet the conditions to be met by general scientific researchers, and can be carried out in the next step of empirical research.

5.Measurement and Data Collection

The data was collected during one semester. Researcher tried to obtain the students' views either inside the classroom or outside it. Researcher's main purpose was to be more indirect and implicit in order to obtain natural and unbiased data.

Statistical t-test was used to test the pre-test and post-test results of the students of the intercultural communication curriculum, and use the mean and standard deviation to calculate the performance of the curriculum.

The test in this study was designed according to mature scale in previous studies to ensure high reliability and validity. The test was filled out separately by the respondents in two rounds (before class, and after class) to avoid the influence of differences in common methods. Finally, the dynamic panel data is established by sorting out and counting these matching questionnaires. The following is the experimental design of the teaching model:

Table 4 Quasi-experimental

Group	Pre-test	Treatment	Post-test
Experiment	01	X1	02
Control	03	X2	04

X1: Using PIPT teaching model, the experimental results of students' creativity are analyzed.

X2: Using traditional teaching model, the Control results of students' creativity are analyzed.

01: Pre-test of to the experimental group

02: Post-test of to the experimental group

03: Pre-test of to the control group

04: Post-test of to the control group

By using the following formula, find the consistency index between the test students' creativity and the learning objectives, to determine the student' creativity and effectiveness of the test.

$$IOC = \frac{\sum R}{N}$$

IOC: Consistency between test and learning objectives

R: Synthesis of expert opinion scores

N: Total number of experts

6. Statistic for Data Analysis

(1) The Williams Prefer Measurement Forms a total of 50 questions, including adventure, curiosity, imagination, challenge. After passing the test, four scores are obtained, and the total score is added to the final five scores. The higher the overall and each dimension scores, the higher the creativity tendency of the participants. Through the evaluation and weight analysis of the applicability of the curriculum outline, the following are selected:

≥ 135 excellent creativity

120-134 Good creativity

90-119 Medium creativity

≤ 90 poor creativity

(2) The mean is calculated according to the following formula:

$$\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n} = \sum_{i=1}^n x_i$$

\bar{x} : Mean

$\sum X$: Sum of all scores

n: Total number of studies

(3) The formula used for standard deviation is as follows:

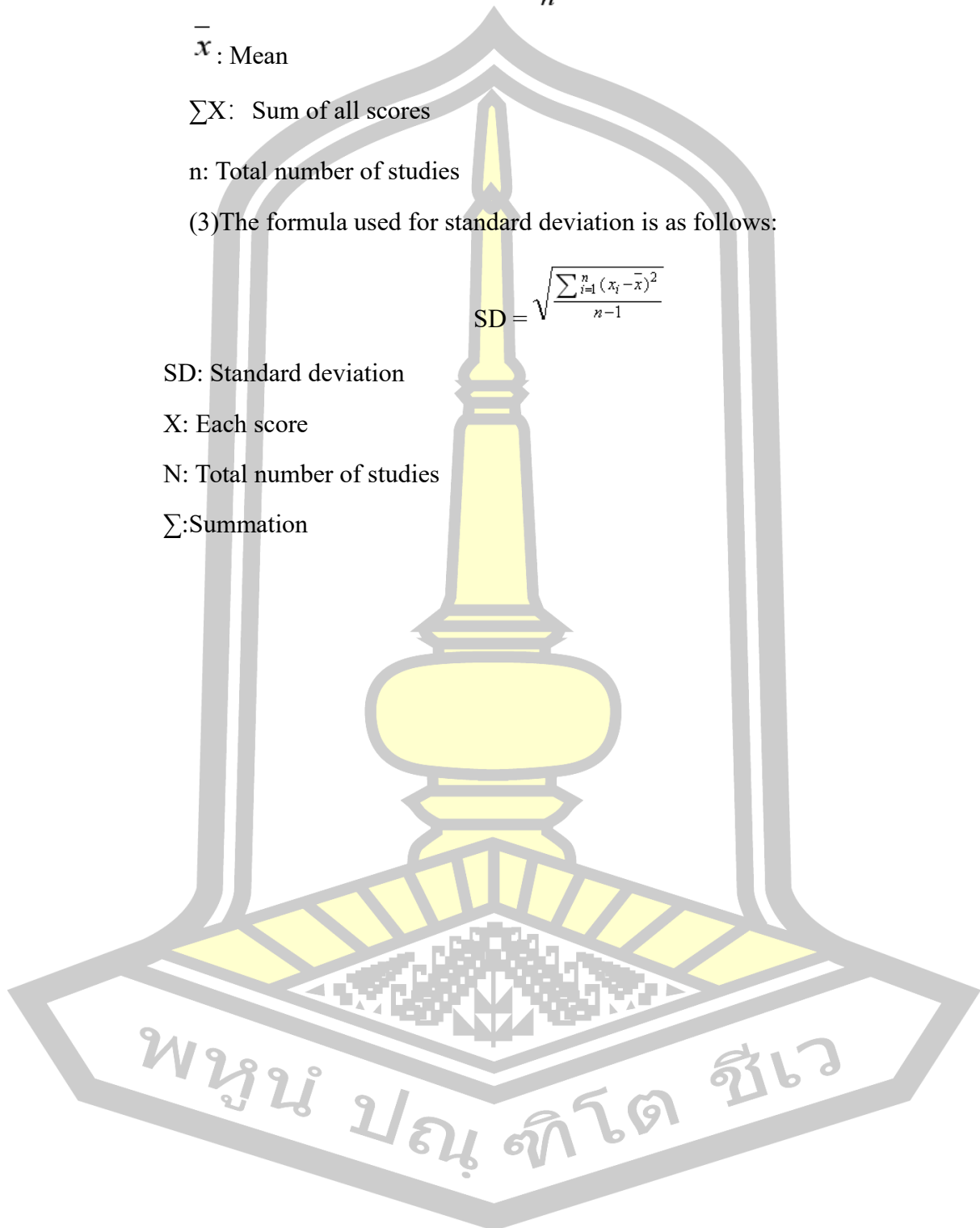
$$SD = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}}$$

SD: Standard deviation

X: Each score

N: Total number of studies

\sum : Summation



CHAPTER IV DATA ANALYSIS

RESULTS

In this research, a PIPT teaching model is developed to enhance the creativity for college students. The Research is a Research and Development (R&D) effort, and the research analyzed the data in the following sequence:

Phase I: Contextual Study

The research objective of this section is to study the basic information of the teaching model of innovation and entrepreneurship courses based on creativity cultivation.

1. To study the theories and principles related to college students' creativity
2. To study the current situation of college students' creativity
3. To study the guidelines for developing teaching model to enhance college students' creativity

The results of an investigation into fundamental data and information for developing a teaching model of innovation and entrepreneurship course aimed at enhance college students' creativity.

1. Results of theories, concepts and principles related to develop a teaching model to enhance college students' creativity
2. Results of college students' creativity status
3. Results of Semi-structure interview with experts

Results of contextual study

1. The government attaches great importance to the development and improvement of college students' creativity.

2. Existing literature focuses on the research of certain antecedent factors affecting college students' creativity, while there are few empirical studies on the impact of teaching models on creativity.

3.The results show that the overall creativity level of Chinese college students is low, and their creativity literacy needs to be greatly improved.

4.The teaching model development strategy requires emphasis on student-centered, problem-oriented and collaborative learning.

Phase II : Developing teaching model

The research objective of this section is to develop teaching model to enhance college students' creativity

1. To develop a teaching model to enhance the creativity of college students
2. To assessing the quality of the teaching model

The result of development of teaching model to enhance creativity of college students include:

1. The theories, concepts and principles that support the creative teaching model
2. Results of the teaching model assessment

Results of development of the teaching model

1.The PIPT teaching model, oriented toward SOI and CPS theories, follows the "problem-Ideation-Prototype-Testing" process with the primary objective of cultivating students' creativity.

2.The PIPT teaching model transforms creativity development into four instructional phases: problem discovery, program conceptualization, production and execution, and evaluation and reflection. This transformation involves reconstructing teaching content, activities, contexts, and assessment methods while focusing on evaluating college students' imagination, adventurousness, curiosity, and ability to confront challenges.

3.An IOC score of 0.71, assessed by five experts, indicates that the PIPT teaching model possesses a sound structure and quality, making it suitable for enhancing the creativity of college students.

Phase III: Implementation

The research objective of this section is to study the results of using specific teaching model to enhance college students' creativity

1. To implement the teaching model
2. To compare the creativity level of college students before and after using the teaching model
3. To compare post-test of creativity in the experimental and control groups

The results of the assessment of creative ability of college students after learning to develop the teaching model of the course

1. Results of the classroom effect of teaching mode implementation
2. Results of creativity improvement of college students before and after the implementation of teaching model
3. Results of the creativity post-test for students in the experimental and control groups

Results of implementation

1. The creativity levels of students who participated in the PIPT teaching model were significantly higher than those of students who participated in the traditional teaching model.
2. The post-test creativity scores of students in the experimental group were higher than their pre-test scores.
3. The post-test creativity scores was significantly higher in the experimental group than in the control group.

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Phase I Contextual Study

In this stage, researcher studied the theories, concepts, principles and guidelines related to the cultivation of college students' creativity in order to provide guidance for the development of teaching model. Researcher used Documentary Research and Survey Research methods.

1. Results of theories, concepts and principles related to develop a teaching model to enhance college students' creativity

Based on the theory of creativity, researcher conducted the research on the teaching model and consulted information from CNKI, Scholar ProQuest, Springer, ERIC and Google Scholar databases, mainly inquiring the latest research achievements in the past five years. Based on experts in the field of creativity, curriculum teaching, doctoral and master's theses, there are a total of 50 topics, as shown in the following tables:

Table 5 Research types of papers

Type	Quantity	Percent
Research articles	34	68
Doctoral thesis	12	24
Master' s thesis	4	8
In total	50	100

Table 6 Theoretical types of papers

Type	Quantity	Percent
Constructivism teaching model theory	15	30
SOI theory	12	24
CPS Theory	15	30
Constructivist Learning Theory	8	16
In total	50	100

In China, innovation has never been given the key role of promoting national revitalization, enterprise development and individual progress as it is today. "Creativity" is not only China's national development strategy, but also the only way to achieve the "Fourteenth Five Year Plan" and the 2035 development goals in the fields of economy, politics, rule of law, science and technology, culture and education.

Through literature research, There are many theoretical and practical explorations on how to cultivate and train creative thinking and creative tendency in education, no matter in the developed countries of Europe and America, or in the developing countries such as China and India. Anna Her Bert (2014) borrowed the theories of Lacan and Freud to study how to develop unconscious subject creativity and apply it to teaching. A relaxed classroom atmosphere, he argues, is conducive to ideas, but such classrooms require less control from the teacher to be effective; Successful creative teachers can coexist with university discourse and master discourse. Innovation exists in different forms in all discourses. Repetition and clinging to old knowledge are not conducive to innovation; The other is the core of the subject's creativity. When people exile themselves and listen to the other creatively, the subject will talk freely and become the source of creativity. James C. Kaufman and Ronald A. Beghetto (2013) carefully sorted out some important views of foreign scholars on the cultivation of creativity, and proposed that mentors and environment are very important for the cultivation of creativity. The partnerships educators form in the classroom are critical to fostering creativity. Some researchers put forward some educational strategies from the perspective of educational philosophy, educational system and teaching methods. For example, North American educators advocate the establishment of learning communities with knowledge construction and creation, real learning centered on solving problems, the expansion and specialization of subject knowledge, personalized and customized learning in the Internet era, and flexible and diverse education systems for talents.

Modern psychological research also provides us with three ideas of

creativity training: first, we should consciously train creative thinking and creative ways, cultivate critical consciousness and adventurous spirit in teaching; Second, students are encouraged to construct reality, knowledge and meaning uniquely according to their own strengths and interests, leaving space for students in curriculum setting and teaching; Third, by participating in some creative and practical activities of the community in specific fields (art, technology, etc.), we cultivate related habits, sexual orientation and knowledge, so as to form expertise and generate new ideas, new methods and new technologies.

It can be seen that creativity is not related to intelligence, but can be cultivated. Whether a person is creative or not is the dividing line between a first-class talent and a third-rate talent. According to Professor Liu Daoyu (2009) of China, the essential difference between a first-class university and an ordinary university lies in creativity. A first-class university should have a creative idea of running a school, a creative president and the cultivation of creative talents. From the perspective of higher education philosophy, creative education is an educational activity that stimulates people's creative nature in essence, and its value should be the unity of individual standard, social standard and knowledge standard value orientation beyond individual standard value orientation. Therefore, creativity education in colleges and universities is an education that respects students' subjectivity, and its core is to develop students' subjectivity and creativity. Colleges and universities should cultivate students' creative consciousness, creative thinking and creative ability, and its main position is in the classroom, which lies in whether each teacher can organically integrate the idea of creative education into subject teaching.

Through literature research, both academia community and colleges have realized that the training of creative talents cannot be separated from the corresponding curriculum, and the teaching model is the basic condition to achieve the goal of talent training. The academic circles generally agree that the implementation of innovation and entrepreneurship education needs to follow certain

principles and adopt appropriate teaching models. Innovation education is born out of management education, but the two exist in essence. "Creative education should not only be separated from traditional management education, but also have a breakthrough in teaching and learning methods." The classroom teaching method can not achieve the results of creative education. Innovation and entrepreneurship education calls for simulation teaching and experiential courses (Cao Shengli, 2009); Innovation and entrepreneurship should be implemented in all aspects of education and teaching, such as classroom teaching, experimental teaching, practice and ability cultivation, guided by innovation and entrepreneurship education, and comprehensively deepen education and teaching reform (Xie Heping, 2017) Innovation and entrepreneurship education should be fully integrated into college classroom teaching system (Chen Wenjuan et al., 2012).

Creativity teaching model does not completely point to the latest field of human cognition development, nor does it require students to "produce" the latest knowledge that human beings have not yet obtained in the process of learning. Its most basic feature lies in its creative character and basis in terms of its goal, value, function and so on. Researcher had a guideline:

(1) Constructivism

Teaching model is not only a construction process of internal elements interacting with each other, but also a construction process of external elements interacting with each other. According to the constructivism teaching model theory and constructivist Learning Theory, it needs the full collaboration of faculty and staff, but also needs the active participation of students, and needs various support and guarantee conditions. At the same time, it advocates the active construction of students' learning, social interaction and situational. From the external point of view, creativity education is essentially the interactive relationship between science, technology and society, and the process of interaction and restriction between relevant actors such as schools, governments, enterprises, capital and parents. Creativity

education is an open and interactive education, rather than a closed education model.

(2) Problem-centered

In China, most college students are in the stage of youth development, typically between the ages of 18 and 22. During this period, their knowledge structures, cognitive levels, and thinking patterns are not yet fully developed. Through the reform of educational models, we can provide the necessary knowledge and skill foundation for the formation of creativity. According to the problem solving criteria proposed by Ausubel and Robinson, creativity is the highest expression of problem solving, which is solving problems in a novel and unique way. According to the SOI theory and CPS theory, we can reveal the nature and laws of creativity by studying the process of problem solving, adopt the principle of "problem-centered" in the teaching mode, and cultivate students' creativity by training their problem-solving ability.

(3) Subjectivity

Innovation and entrepreneurship education is people-oriented education, which emphasizes student-centered, fully respects students' main body status, independent personality and individual differences, pays attention to tapping students' potential, encourages students' personality development, cultivates students' originality and pioneering, and cultivates students' critical thinking, innovative thinking and divergent thinking. Improve students' innovative spirit and entrepreneurial ability, and this kind of subjective education is not for a small number of students, but for all students, and is all-inclusive. Innovation and entrepreneurship education is also a kind of humanized and personalized education, which advocates the full play of the subjectivity of the educatees, the full release of learning initiative and creativity, and requires deep communication, exchange and cooperation between teachers and students, students and the society. It advocates students to actively participate in the discussion, debate and even debate in the teaching process. In this interactive teaching, enhance the ability of innovation and entrepreneurship. In

addition, innovation and entrepreneurship education also focuses on the lifelong development of the subject.

2. Results of college students' creativity status

An important symbol reflecting the quality of higher education is the intensity and effect of creative personnel training. But in reality, there are many survey reports and literature showing that the actual effect of Chinese colleges in cultivating creative talents is worrying. Every year since 2016, the Ministry of Education issued "China's higher education quality report, report to the social demand for fitness, training goal to achieve, managerial condition support, quality assurance, effective degrees, students, and user satisfaction and so on five big standard dimension, tries to fully answer and complete the whole of China higher education quality. The report pointed out that in the process of promoting innovation and entrepreneurship education in recent years, Chinese institutions of higher learning have made great progress in the construction of innovation and entrepreneurship courses, atmosphere and practice platform. However, the report also put forward five weaknesses and "soft spots" of China's higher education, among which the cultivation of innovative talents is prominent. "The cultivation of innovative talents is not enough, and the innovation and entrepreneurship education in colleges and universities is still the" soft spots "of China's higher education." It can be seen that how to cultivate creative talents with innovative consciousness and creative ability is a theoretical and practical topic that needs to be paid attention to in the current higher education circle, and it is also urgent to find a new breakthrough path.

Through literature review and authoritative investigation, it is found that the overall creativity level of Chinese college students is low, and their creativity literacy needs to be greatly improved, mainly as follows:

(1) Overall low creativity levels among college students

Authoritative surveys indicate a low proportion (4.7%) of Chinese college students exhibiting preliminary creative traits, a considerable gap when compared to

innovative nations like the United States, Canada, Western Europe, and Israel. International assessment data from the 2009 World Education Progress International Assessment Organization revealed that while Chinese students ranked first in computational and computer skills, they ranked fifth from the bottom in creativity (Wu Xueling, Liu Ying, 2012). The 2018 Program for International Student Assessment (PISA) results released by the OECD in December 2019 showed Chinese students excelling in reading, mathematics, and science, ranking first globally in these competencies. However, compared to Western countries with high academic performance, Chinese students demonstrated lower learning efficiency, average collaborative problem-solving abilities, and faced ongoing skepticism regarding creative thinking skills (Yu Yang, 2019; Geng Chao et al., 2020).

(2) Personality obstacles hindering creative thinking development in half of college students

A three-year-long national survey, "National Youth Creativity Capability Cultivation Survey and Countermeasure Research," conducted by Chinese authorities, aimed to understand the creativity status among university students. The study surveyed 11,800 students across 31 provinces and municipalities through questionnaires. Results revealed that 59.3% of respondents considered themselves confident and individualistic, 48.1% exhibited strong interests and curiosity, 43.1% demonstrated a skeptical mindset, and 51.1% recognized possessing strong willpower and an enterprising spirit. Respondents possessing all four personality traits were considered to have preliminary creative characteristics, accounting for 11%. However, half of the university students still exhibited personality obstacles to creative thinking, including excessive rigor, fixed mindset, conformity mentality, and information saturation across four aspects.

(3) Imitation tendency and lack of curiosity and imagination among college students

Under continuous pressure from the examination-oriented education

system, students excessively focus on exam-oriented advantages, neglecting the development of creative, practical, non-intellectual, and attitudinal skills. Students become risk-averse, lacking imagination, leading to prevalent imitation and regurgitation of others' viewpoints, with innovative spirit and creative awareness being depleted through successive rounds of standardized testing.

(4) Conservative tendencies and reluctance to take risks and challenges among college students

Present-day university students generally lack ambitious aspirations and tend to favor a comfortable lifestyle. They appear content with current material living conditions and exhibit a degree of fear towards intense social competition. This mindset, accompanied by a somewhat indifferent attitude, is incongruent with the urgent need for a significant number of innovative and entrepreneurial talents in an era marked by socio-economic development transition.

(5) Fear of authority and weak problem-solving skills among college students

The majority of Chinese youth tend to follow established norms in problem-solving, adhering strictly to predefined steps. They hesitate to pose questions that may appear ignorant, refrain from doubting teachers or textbook statements, and avoid challenging authority. In the predominant traditional education model with a "transmission-reception" teaching mode, students exhibit passive learning, remaining at the surface levels of "cognition" and "understanding." Deep critical thinking is lacking, preventing them from utilizing acquired knowledge to solve concrete problems, achieve higher-order thinking skills such as "application," "analysis," "synthesis," "evaluation," and even "innovation."

Through literature review, creativity evaluation research can not be presented comprehensively and effectively with a single component or tool. In terms of the content of evaluation, it is necessary to consider not only cognitive factors, such as thinking qualities such as divergent thinking, but also non-cognitive factors such as

motivation and cognitive style. Williams, an American psychologist, found in his research that people with high creative ability will possess the following main 4 traits, namely, rich imagination, full curiosity, strong challenge and high risk-taking. Accordingly, he defined creativity tendency as four dimensions: (1) Adventure. (2) Curiosity. (3) Imagination. (4) Challengeing.

The current weak performance of Chinese college students in creativity convenience, such as lack of curiosity and imagination, not daring to take risks and challenges, fear of authority, etc., corresponds exactly to the four dimensions of William's creativity theory. Thus, William's creativity theory is a very suitable indicator for measuring the creativity of Chinese college students. The Williams Creativity Inclination Scale, which he created in the study, measures the above four dimensions in turn, which is recognized by the international community as a relatively mature and authoritative scale with high reliability and validity. In this study, this scale was adopted to measure college students' creativity.

3. Results of Semi-structure interview with experts

Using a mixed method of qualitative research and analyzing interview data from five experts, the researchers studied the main problems that current teaching models affect the development of creativity of college students, as well as the guidelines for developing teaching models. Select 5 experts with relevant qualifications, including 2 expert in curriculum and teaching, 1 expert in research and evaluation, and 2 expert in innovation and entrepreneurship education ,to conduct in-depth interviews to understand the effectiveness of creativity training in colleges and the guidelines of creativity.

Table 7 General information of experts

name	Educational working life	Educational background	Research institution
Jun Wu	16	PhD	Guangzhou Panyu Polytechnic
Baijun Deng	15	master	Guangzhou Panyu Polytechnic
Shuwei Wang	13	master	Guangzhou Panyu Polytechnic
Xiaozhao Lin	5	PhD	South China Normal University
Yanhua Bu	10	master	South Agricultural University

Semi-structured interview for experts on the effectiveness and influencing factors of college creativity training.

Part 1: Basic information of interviewees

Part 2: Views on the effectiveness of creativity training in colleges

Part 3: Views on influencing factors of creativity of college students

Part 4: Comments and suggestions

3.1 The problem of teaching model

Through interviews with experts, creative education has entered the educational practice of colleges and universities for nearly 30 years, but today, “China's education has been criticized most for not paying attention to the cultivation of creativity and imagination.”

In the teaching practice, “we also found that there are serious problems in the teaching mode of innovation and entrepreneurship course. In China, innovation and entrepreneurship courses aiming at creativity are still following the traditional teaching mode: knowledge-oriented, teacher-oriented, and academic performance as the assessment standard.”

(Expert 1, 2024.11 interview)

Experts believe that “the current situation of China's education is described as: the behavior restriction that imprisons the mind, the teaching blind spot that deviates from creativity, the academic competition under the pressure of survival, the

talent management that lacks the pursuit of innovation, the cultural gene that changes and weakens, and the self potential that remains to be explored. Therefore, how to find a breakthrough path for creative education and improve the effectiveness of creativity training has posed a new severe challenge to China's higher education. ”

(Expert 2, 2024.11 interview)

“The higher vocational colleges have introduced the course of innovation and entrepreneurship into the educational practice for more than ten years, and its effect on the cultivation of college students' creativity is very noteworthy.”

(Expert 3, 2024.12 interview)

“In teaching practice, we found that compared with undergraduate colleges, the basic courses of innovation and entrepreneurship in higher vocational colleges started late and their foundation was weak, and the weaknesses of the curriculum system and teaching model were increasingly prominent. On the one hand, due to the lack of systematic accumulation of entrepreneurship and innovation theories, higher vocational colleges have a strong randomness in curriculum design and practice design. They one-sided focus on the coverage and formalization of innovation and entrepreneurship education, ignoring the cultivation of students' abilities. On the other hand, compared with other professional education, innovation and entrepreneurship education has strong practicality, applicability and comprehensiveness. However, in China's education based on examination, the innovation and entrepreneurship curriculum still follows the traditional theoretical teaching model, the teacher classroom student curriculum setting model, and the knowledge assessment based evaluation model.”

(Expert 4, 2024.11 interview)

“The recent teaching model can no longer meet the needs of creative talent training, and needs to be reformed urgently. This requires the innovation and entrepreneurship course to change the paradigm, change the talent training and teaching model, establish a teaching form based on the cultivation of students' core

competence, and cultivate creative talents with innovative awareness and creativity.”

(Expert 5, 2024.12 interview)

After the researcher's investigation and interview, researcher obtained the survey results of the needs and necessity of the development of the teaching model,

which results in a high level of overall demand ($\bar{X} = 4.34$).

In September 2024, the researcher conducted a questionnaire survey on the development needs of innovation and entrepreneurial teaching models in Guangzhou Panyu Polytechnic, China. The survey results are as follows:

Table 8 Results of the necessity of teaching model development

No.	Questions on Requirements for Curriculum	\bar{X}	S.D.	Level
1	Pay attention to students' nature and interests, explore educational ideas suitable for students' creativity	4.51	0.82	Most
2	Pay attention to the development of students' Problem solving ability	4.51	0.82	More
3	The thinking skills of students	4.49	0.8	More
4	Focus on students' imagination	4.44	0.76	More
5	Students' spirit of adventure	4.42	0.75	More
6	Awaken students' curiosity	4.42	0.75	More
7	Enhance students' cooperation and coordination ability	4.49	0.8	More
8	Improve students' creativity	4.51	0.82	Most

3.2 The guidelines of teaching model

Through interviews with experts, creativity-enhancing teaching models should change the traditional theories and methods of instructional design. The four

elements of the teaching model, i.e. teacher, students, teaching materials and media, have completely different roles and relationships with each other compared with traditional teaching. These roles and relationships are very clear and well-defined, and thus become another form of stable structure for the process of teaching and learning activities, i.e., the model of teaching and learning in a constructivist learning environment.

In this model, students are active constructors of knowledge meaning, rather than passive recipients of external stimuli; teachers are the organizers of the teaching process, instructors, helpers and facilitators of the construction of meaning, rather than the transfer of knowledge, indoctrination; textbooks provide knowledge is no longer the content of the teacher's teaching, but the object of the students' active construction of meaning; the media is no longer to help the teacher to teach the knowledge of the means, The media is no longer a means or method to help teachers impart knowledge, but is used to create situations, collaborative learning and conversational communication, i.e. as a cognitive tool for students' active learning and collaborative exploration.

(1) Emphasizing student-centeredness

“A clear student-centered approach to instructional design is essential. The best way for learners to complete the construction of meaning for what they have learned, i.e., to achieve a deep understanding of the nature of the things reflected in the knowledge, the laws, and the connection between the things and other things, is to let the learners go to the real world in the real environment to feel, to experience, rather than just listening to others about the experience of the introduction and explanation.”

(Expert 1, 2024.11 interview)

“Students should be able to form an understanding of objective things and solutions to practical problems based on feedback from their own actions. Teaching requires students to solve the real problems they face, the learning process is the

process of problem solving, that is, the process can be directly reflected by the students' learning effect.”

(Expert 2, 2024.11 interview)

(2) Emphasize the important role of “context” in learning.

“In the traditional classroom teaching, due to the inability to provide the vividness and richness of the actual situation, the assimilation and adaptation process is more difficult to occur, which will make it difficult for the learner to construct meaning to the knowledge.”

(Expert 3, 2024.12 interview)

“Learning is always associated with a certain socio-cultural background, i.e., “context”. Learning in actual contexts enables learners to use their own original cognitive structure to assimilate and index the new knowledge they have learned, thus giving the new knowledge some meaning. It is only through “assimilation” and “adaptation” that the construction of new knowledge can be achieved.”

(Expert 5, 2024.12 interview)

(3) Emphasizing the critical role of collaborative learning in the construction of meaning

“One of the core concepts of constructivism is that the interaction between learners and their surroundings plays a key role in the understanding of learning content. Students are organized and guided by the teacher to discuss and communicate with each other, to build a learning community and become part of it. Through the collaborative learning environment, the whole group of learners can work together to realize the meaning construction of what they have learned.”

(Expert 4, 2024.11 interview)

(4) Emphasize the design of the learning environment and use various information resources to support learning

“According to constructivism, the learning environment is a place where learners can explore freely and learn independently. In this environment, students can

utilize various tools and information resources to achieve their learning goals. Teachers need to provide learners with a variety of information resources to support independent learning and collaborative exploration during the teaching process.”

(Expert 2, 2024.11 interview)

“In such a learning environment, the instructional design usually does not start from analyzing the teaching objectives, but from how to create a situation conducive to the construction of students' meaning, and the whole instructional design process is closely centered on the center of meaning construction.”

(Expert 5, 2024.12 interview)

Results of contextual study

1.The government attaches great importance to the development and improvement of college students' creativity;

2.Existing literature focuses on the research of certain antecedent factors affecting college students' creativity, while there are few empirical studies on the impact of teaching models on creativity.

3.The results show that the overall creativity level of Chinese college students is low, and their creativity literacy needs to be greatly improved.

4.The teaching model development strategy requires emphasis on student-centered, problem-oriented and collaborative learning.

Phase II Developing teaching model

In this stage, researcher designed and developed the teaching model from the data obtained in the first stage. This includes designing and developing teaching model and assessing the quality of teaching model through expert assessments.

Part I. Development of PIPT teaching model

Based on constructivist educational theory and SOI ,CPS theory, this study developed a PIPT teaching model oriented to “problem-based learning”and the process of “problem-Ideation-prototype-testing”with the core objective of cultivating

students' creativity. PIPT transforms creativity development into four teaching phases: problem discovery, program conceptualization, production and execution, and evaluation and reflection by reconstructing teaching contents, activities, contexts, and evaluation, and focuses on evaluating college students' imagination, adventurousness, curiosity, and willingness to face challenges, among other things. The model draws on the six components of a pedagogical model proposed by Joyce et al. (2011): Principles of the model, Objectives, Syntax, Social system, Principle of Reaction, Support System.

1. Principle of the model

1.1 Constructive: The teaching mode is a constructive process in which the elements interact with each other.

This teaching mode relies on constructivist development theory and constructivist learning theory, advocating that the teaching mode is a constructive process of the interaction of all elements, advocating the active constructive nature of student learning, the interactive nature of teaching and the situational nature. The “scaffolding” and contextualization approach to teaching emphasizes, first, that the learner is the center and that the learner is the active constructor of knowledge. Secondly, it emphasizes the guidance of the teacher, who assumes the roles of organizer, guide, and helper in the construction of meaning. Again, it emphasizes the creation of learning environments and learning activity support systems in authentic contexts, and particularly emphasizes interactive and collaborative learning methods.

1.2 Subjectivity: a teaching mode is a learning environment.

Creativity education emphasizes student-centeredness and the cultivation of students' originality and creativity. Creative teaching mode advocates the full play of the subjectivity of the educated, the full release of learning initiative and creativity. It requires in-depth communication, exchange and cooperation between teachers and students, between students and students, and between teachers and students and the society, and advocates the active participation of students in discussions, debates and

even arguments in the teaching process, which helps to cultivate problem-solving ability and creativity of college students in this kind of interactive teaching.

1.3 Problem-oriented: problem-driven learning and creativity.

The teaching model is problem-oriented in designing teaching activities, guiding students to understand and solve “problems” in the process of completing classroom teaching activities. The main reason for these problems is that students are unable to make connections between their previous knowledge and new knowledge. In problem-oriented instructional design, learning activities are driven by urgent problems to be solved, and learners learn content and theories in order to solve problems. Students generate new concepts, knowledge, abilities, behaviors, attitudes and other learning outcomes through a series of cognitive strategies such as thinking, discovery and inquiry in the learning process.

2.Objectives

The objective of the PIPT teaching model is to enhance the creativity of college students. In terms of teaching design, PIPT combines the two processes of creativity, i.e. divergent thinking and convergent thinking, and breaks down the creative process into a series of skills according to the scientific research on creativity, based on the classification framework proposed by Williams, Lucas, Claxton, and Spencer, focusing on the four dimensions of creativity: imagination, adventurousness, curiosity, and challenge, which are transformed into the following competencies in the teaching process : investigative, imaginative, executive and reflective skills.

2.1 Investigative skills. One of the dimensions of the creative cognitive process is very similar to scientific investigation. Terence emphasizes the importance of identifying different problems, knowledge gaps, knowledge blind spots and factors in the creative process. Because creativity is about finding relevant information, identifying problems, and recognizing that one of the main focuses of the creative process is that there may be different dimensions, creativity cannot occur if there is a lack of knowledge about the relevant field or research problem. Depending on the

problem, creativity can take different forms, ranging from human feelings and empathy (possibly from the client) to a more objective way of looking at the different dimensions that may be present to describe and analyze exactly what the potential difficulties and problems are.

2.2 Imagination. Imagination refers to the ability to construct ideas in one's mind and think about those ideas and things. This behavior allows people to break out of the constraints of traditional reality, pursue novel ideas and come up with new stories, plunge into the future, pursue different possibilities, envision counterfactuals, simulate the outcomes of different ideas and solutions, and so on. In the context of creativity, imagination refers to the creation of ideas, theories, and hypotheses on a whim, according to a certain level of purpose. Imagination can take the form of independently generating multiple ideas or related ideas by viewing realistic or sometimes metaphorical connections. One of the cognitive processes that creativity may involve is the ability to think ideas to the extreme, exploring non-traditional ideas within the safety of reality, or even exploring ideas that seem silly.

2.3 Execution. Creativity refers to creating something novel and applicable based on investigation and imagination. It is a typically amplitudinal or integrative creative process. The product of its creation can take different forms based on different domains: it may be a product, a performance, an idea, a physical or mental model, etc. This means that in order to realize the two main aspects of creativity, it is necessary to sift through the ideas that have already been thought of or investigated, and thus to make a degree of reflection and bold choices. While the product may be related to the final stage of the creative process, the creative process may also involve a process of experimentation and correction of errors, or the development of prototypes and models at various stages of the process.

2.4 Reflective skills. Ultimately, creativity is centered on purpose and reflection. Purpose suggests that creativity is not random innovation, such as the whims of young children. While purpose and reflection vary significantly by age, they

also vary according to each individual's creative proficiency. In summary, reflection is also present at all stages of the creative process, such as when a person decides which ideas to choose and how to move forward with them.

3.Syntax

The PIPT teaching model takes “Problem-Ideation-Prototype-Test” as the teaching process, and by reconstructing the teaching content, activities, context and evaluation, it transforms the creativity development into four teaching phases: Problem Discovery, Program Conceptualization, Production and Execution, and Evaluation and Reflection.

Step I: Problem discovery. creativity is the highest expression of problem solving, and it is with problem solving at its core that the PIPT model fosters creativity in students. Identifying and defining problems is an indispensable part of the course design process and is the fundamental key to grasping problems. The problem identification stage not only lays a good foundation for the conceptualization stage of the problem solution, but also helps students to establish empathy and discover the essence of the problem through the cultivation of user empathy and problem identification ability, prompting them to explore and solve the problem and realize creativity.

The process of instructional design activities in the problem discovery stage is arranged as follows: first, teachers can start the learning situation analysis through questionnaires and interviews to understand the learners' existing knowledge and experience and skill reserves, learning ability and other characteristics. Secondly, designing contextual and practical activity themes, setting a certain range of themes, giving students the power of free choice, and stimulating students to think creatively. Third, formulate the learning outcome objectives around the core content and activity themes, design the output forms and activity evaluation rules, and explain them to students. In this process, students need to understand the problem content and activity tasks according to the specific context. By promoting students' perception of tasks and

situations, generating empathy, stimulating students' interest in learning, and guiding them to stand in the user's point of view to discover problems and dig into the root causes of problems. Finally, the teacher actively organizes communication and discussion on the activity topic, providing guidance on ideas as learners state and define the problem. Students refine the key problem based on the multiple requirements information analyzed in the previous stage.

Step 2: Ideation: The Ideation phase is a stage in which students actively think of solutions to the problems of the previous phase and provide creative ideas. At this time, the students are the implementers of ideas, the providers of creative ideas, the main body of the activity, the teacher is mainly on the group activities of the students to play the role of organization, arrangement, is the activity of the guide, the student's helper. This stage means that students, on the basis of the discovery of the problem in the first stage, collect multi-faceted inspirations from different sources by carrying out problem identification, transform the inspirations into ideas through conceptualization, then select the optimal solution, and develop the best idea into a concrete implementation plan with comprehensive considerations. After the previous stage of preparation, students have internalized the problem to be solved. Next, students have to conduct in-depth analysis of the problem in the existing problem context and use learning resources to collect and process the required information, put forward the final hypothesis through group work, and then judge the feasibility of the proposed hypothesis through deductive reasoning, and continue to execute the problem solving by revising the plan if it is not feasible stage until the problem is solved.

The main purpose of this stage is to conceptualize and optimize the design solution under the organization and guidance of the teacher, and then find and develop the best solution to the problem. This phase consists of the following four key steps: first, the teacher organizes brainstorming activities to inspire learners to generate inspiration and ideas, and students brainstorm ideas. Each group carries out

unrestricted free association and discussion for the problems defined in the previous stage, continuously generates new ideas, stimulates creative conceptions, and puts forward as many options as possible. Second, the teacher guides the group to explore the problem, and learners analyze the creative ideas generated in the brainstorming at a deeper level, put forward a brief proposal, and form a preliminary solution to the problem through the group's exchanges and discussions. Third, group members further analyze and discuss, adjust and optimize the design scheme, and determine the optimal solution to the problem solution. Through brainstorming, creative conception, group collaboration, preliminary design, program optimization, determine the optimal solution of the three steps to form a gradual, iterative program conception link, the teacher in this link to organize brainstorming, inspire creativity and encourage design innovation, guide the learners to share the inspiration and conception, to ensure that the group collaborative activities are carried out effectively.

Step 3: Prototype. Practice is an important feature of the Creative Entrepreneurship Program, where students transform ideas into reality through hands-on practice. Through the creation of practical activities, students are guided to use their hands and brains, and ultimately learn to create through activities. This stage is the key part of the practice. The prototype stage is the manifestation of the conceptualization stage, the outward manifestation of the idea or solution, emphasizing rapid prototyping and low precision, focusing on problem solving, verbalizing the idea, and communicating quickly and smoothly with others to explore more possibilities for realizing the idea, thus iterating a more refined prototype. In this phase, members of the group work together to produce the work or test the solution, iterating in a problem-feedback-revision cycle to improve the work/solution. Students are the users of the tools, producers of the work, and testers of the solution, while the teacher participates as the provider of the tools, the evaluator of the work, and the facilitator of the activity. Students operate and execute according to the identified ideas, and according to the problems during the operation and the task of the activity,

they continue to modify and improve the creative ideas, and then enter into the next iteration of the cycle again. Teachers pay attention to the problems of the students in this process, provide timely assistance, maintain or enhance the students' motivation, and provide centralized lectures on the commonly occurring problems.

Step 4: Test. The test and feedback phase is the process of testing and collecting feedback on the prototype developed in the prototype phase, and it is a necessary step to produce results. In this phase, members of the group work together to produce the work or test the solution through a division of labor, iterating in the form of problem-feedback-revision of the solution to make the work/program better and better. Students are the users of the tools, producers of the work, and testers of the solution, while the teacher participates as the provider of the tools, the evaluator of the work, and the facilitator of the activity. Students operate and execute according to the determined ideas, and according to the problems in the operation process and the tasks of the activity, they constantly revise and improve the creative ideas, and enter into the next iteration cycle again. Teachers pay attention to the problems of students in this process, provide timely help, maintain or enhance students' motivation, and provide centralized explanations for the problems that commonly occur. Commonly used methods include testing on different user groups, questionnaire survey method, interview method and so on. And after the test, through the analysis of the feedback, choose whether the solution is completed or not, if not, according to the feedback information, choose to modify the prototype or generate new ideas, so as to enter the prototype stage or the idea stage, i.e., to enter the next cycle of the iterative process.

4.Social system

Students are the main body of active learning. Teachers are monitors and helpers. PIPT is a learner-centered teaching model. In the whole learning process, students are the main body and teachers should always play the role of "observer guide".

The identity of students as the main body of teaching is embodied in:

(1) to give full play to the initiative of students in the learning process, to reflect the initiative of students;

(2) To give students multiple opportunities to apply what they have learned in different situations (to "externalize" knowledge);

(3) Students should be able to form their understanding of objective things and solutions to practical problems according to the feedback information of their own actions.

Teachers are responsible for guiding and supporting the learning process during the implementation phase. This may include explaining concepts, providing feedback, motivating students to participate in discussions and activities, and ensuring that students are able to understand and apply what they have learned during the learning process.

5.Principle of Reaction

Teachers observe students performance,give suggestions. use positive reinforcement for boosting their confidence and exchange feedback.

Unlike traditional classroom learning, PIPT emphasizes students' subjectivity and active learning rather than passive acceptance of knowledge taught by teachers.PIPT is based on real-world problems and project-oriented, combined with the teaching objectives of innovation and entrepreneurship courses in colleges , scientifically breaks down the teaching objectives in terms of theory and practice, and puts students in a complex and changeable environment to carry out active and meaningful learning and exploration to improve problem-solving ability and practical hands-on work. The teaching objectives are scientifically decomposed from both theory and practice, putting students in complex and changing environments to conduct active and meaningful learning and inquiry, and improving their problem-solving ability and practical hands-on ability. 4 Steps to Problem-Based Learning. Using the project as a beginning, the very beginning of the teaching task is to complete an innovative entrepreneurial project, the whole teaching process around

a project to start, the teacher will gradually refine the project before the class, the different components of the business plan is divided into different sub-tasks, and each class is centered on different tasks to carry out learning, with the continuation of the teaching, the student's knowledge system is gradually complete, in a collaborative group practice way To complete a series of tasks set, accompanied by the constant guidance and help of the teaching staff, learners gain knowledge, master the corresponding skills, and finally complete the project and write a business plan. In terms of teaching methods, PIPT insists on taking students as the main body and advocates group cooperation in problem solving, and its application in the teaching of innovation and entrepreneurship courses can encourage students to actively participate in problem exploration, cultivate students' information literacy, knowledge construction, problem solving and communication, and other abilities required for innovation and entrepreneurship; in addition, based on real-life contexts, the teacher is able to integrate the problems of innovation and entrepreneurship practice into the classroom teaching, to Breaking the limitations of students' thinking, strengthening inspirational education, expanding students' horizons, and enabling students to obtain more practical knowledge, not only improves students' professional ability and literacy, but also enhances students' comprehensive abilities such as professionalism and independent innovation.

PIPT teaching mode advocates diversified evaluation methods, which can be applied to the teaching of innovation and entrepreneurship courses to solve the problem that the traditional test paper examination can not fully demonstrate the innovation and entrepreneurship ability of students. PIPT utilizes a variety of evaluation modes and attaches importance to the process evaluation, in the process evaluation, students' online and offline learning, test scores, participation in the discussion, speech performance, etc., are incorporated into the process evaluation content to minimize the proportion of summative evaluation, and the summative evaluation is based on students' mastery of basic knowledge. In the process evaluation,

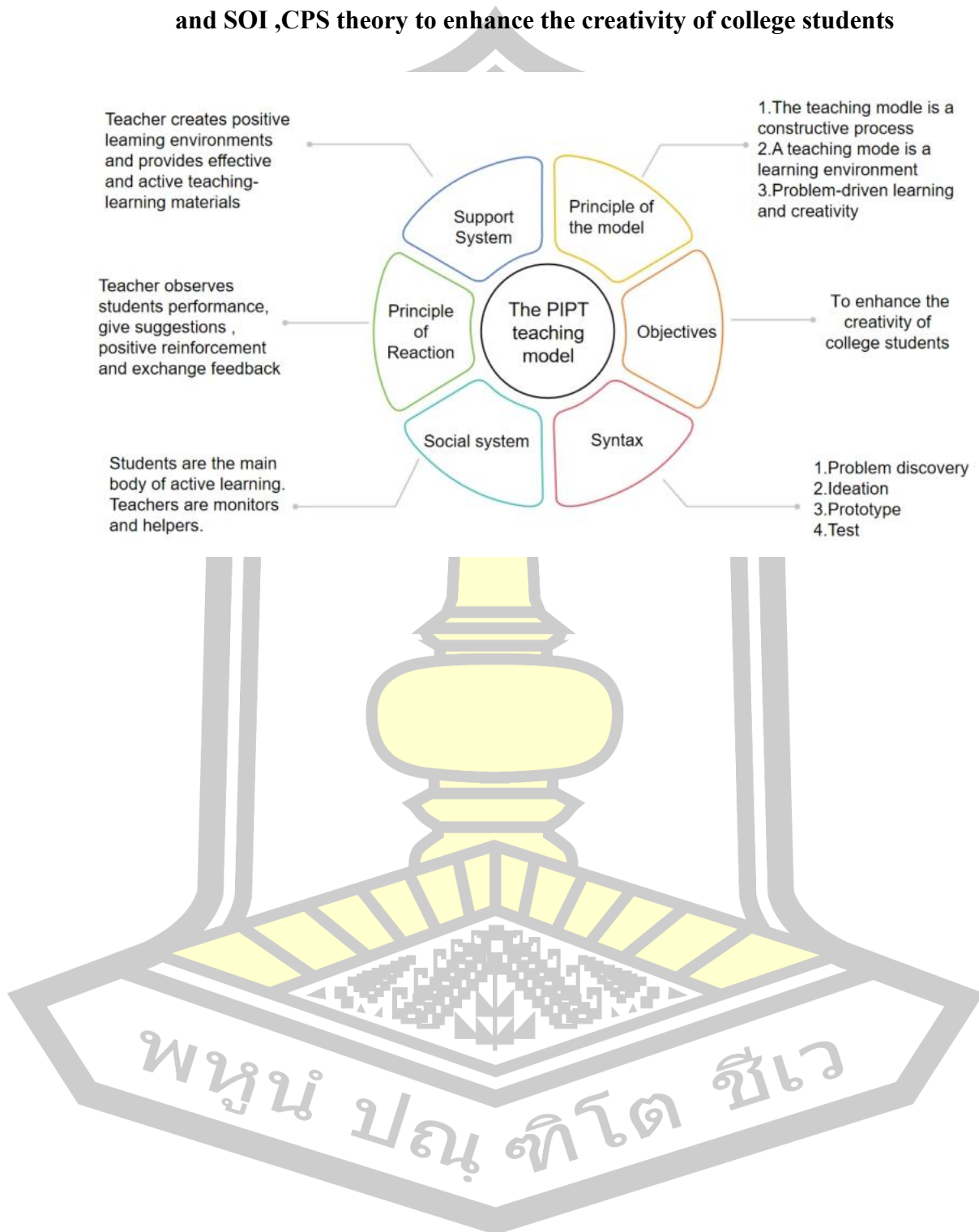
the students' online and offline learning, test scores, participation in discussions, speaking performance, etc. are included in the process evaluation, try to reduce the proportion of summative evaluation, and the summative evaluation is based on the students' mastery of basic knowledge, using a combination of process evaluation and summative evaluation of a variety of evaluation modes, which can relatively objectively and realistically reflect the learning situation of the students and the enhancement of their abilities. By increasing the proportion of learning process assessment in the course assessment, it can effectively combine the students' performance with the performance in the learning process, which is conducive to the implementation of comprehensive assessment and evaluation of students' innovation and entrepreneurship.

6.Support System

Good organization is the key to the implementation of this model. Teachers who are flexible and master methods are needed. The classroom environment should also be suitable for group activities, such as movable desks and chairs and appropriate space. Teachers provide videos, quizzes, guidance, help, a good language environment and relaxed atmosphere, and make suggestions. Students acquire knowledge through self-study and testing, and transform knowledge into skills through participation in activities, cooperation and exchanges.

In order to support active exploration and the construction of meaning, a variety of information resources should be made available to learners during the learning process. However, it is important to be clear that the use of these media and materials is not intended to supplement the teacher's explanations and presentations, but rather to support students' independent learning and collaborative exploration.

Figure 3 The PIPT teaching model based on constructivist educational theory and SOI ,CPS theory to enhance the creativity of college students



Part II: Assessment of the teaching model

In November 2024, the researchers carried out a music activity teaching implementation plan in the Guangzhou Panyu Polytechnic, China. The evaluation results are as follows:

Table 9 Results of the PIPT teaching model assessment

No.	Content for Evaluation	\bar{X}	S.D.	Level
1	Vision of the teaching model	4.51	0.82	Most
2	Theories and Principles	4.41	0.72	More
3	Objective of the teaching model	4.41	0.72	More
4	Syntax of the teaching model	4.44	0.76	More
5	Social system	4.49	0.8	More
6	Principle of Reaction	4.42	0.75	More
7	Support System	4.49	0.8	More
8	Consistency of teaching elements	4.51	0.82	Most

It can be seen from above table that the five experts in curriculum and teaching all think that the Theories and Principles, Objective, Syntax, Social system, Principle of Reaction, Support System are the high level. The vision, Consistency of teaching elements are the highest level. The curriculum and teaching experts believe that the teaching implementation plan on innovation and entrepreneurial knowledge, students' cooperation and coordination ability is consistent and the highest level. When considering each problem, it is found that the principles of the teaching model are achievable. The clear, flexible and important objectives of the lectures meet the needs of Guangzhou Panyu Polytechnic, with a consistency value of 0.71-1.00. The teaching structure and content are consistent with the freshman in college, the length of teaching activities is consistent with the teaching method process, and the structure of teaching content can meet the evaluation

standard. In the teaching process, teachers can complete the performance activities of teaching through diversified teaching activities, and encourage students to find their own ways to master knowledge and enhance creativity.

In addition, the experts provided the following recommendations:

(1) The teaching model needs to improve students' learning motivation and interest.

(2) The evaluation in teaching should add tools for measuring and evaluating the range of innovation and entrepreneurship skills to match the goals of the activity plan. The researcher added tools for evaluating the level of innovation and entrepreneurial knowledge. The evaluation is to measure students' performance and satisfaction with teaching activities, and its basis is to meet the goals of the teaching implementation plan;

(3) The learning objectives in teaching activities should increase students' psychological objectives. In appropriate teaching activities, researcher had increased the psychological scope in the target education plan to adapt to and meet the teaching objectives.

Results of development of the teaching model

A teaching model based on the innovation and entrepreneurship course was developed to enhance the effectiveness of creativity training for college students.

1. The PIPT teaching model oriented to “problem-based learning” and the process of “problem-Ideation-prototype-testing” with the core objective of cultivating students' creativity.

2. PIPT teaching model transforms creativity development into four teaching phases: problem discovery, program conceptualization, production and execution, and evaluation and reflection by reconstructing teaching contents, activities, contexts, and evaluation, and focuses on evaluating college students' imagination, adventurousness, curiosity, and challenges.

3. A IOC score tested by 5 experts is 0.71, shows that the PIPT teaching

model has a good structure and quality, suitable for promoting the creativity of students.

Phase III Implementation

This stage applied the teaching model to the research target group in order to promote creativity cultivation and study the performance of students in creativity. This stage mainly adopted the method of experimental Research to study the teaching effect.

From October to December 2024, the researcher applied the PIPT teaching model to the innovation and entrepreneurship course at Guangzhou Panyu Polytechnic, China. The experimental subjects were 30 students in a freshman class.

The sample for this phase is 60 college students in the academic year 2024 from Guangzhou Panyu Polytechnic, China. They come from different classes of the same major, one is an experimental class that implements a specific teaching model, and the other is a control class that implements a traditional teaching model.

1. Results of the classroom effect of teaching mode implementation

1.1 Main contents and requirements of the course

The new entrepreneurship course is a public compulsory course for students in Chinese universities and colleges, and is one of the core courses for the implementation of innovation and entrepreneurship education in the country, aiming at cultivating creative thinking and creative talents. The course has a total of 32 credit hours, including two parts online and offline:

(1) 8 credit hours of online classroom learning for students' self-study, adopting the form of independent study + knowledge quiz + teachers' online comments and interactions, which is completed by students on their own before the development of each unit of the offline course, and the learning effect is supervised by teachers' online statistics and sampling in the offline classroom.

(2) The offline classroom teaching is 24 credit hours, including eight

modules. The course is problem-oriented, project-based, and teaches students to develop a project from 0 to 1 by guiding them to learn and apply innovative methods, cultivating their problem-solving ability and creativity.

Table 10 Contents of the course

NO.	Contents	Requirements	Effect	Class hour
1	Creativity for all	Understanding creativity	<ol style="list-style-type: none"> 1. Be able to recognize the elements of innovation in life and work practice. 2. Be able to identify problems in practice and propose innovative ideas to solve them. 	2
2	Problem Discovery	<ol style="list-style-type: none"> 1. Master the method of finding pain points 2. Understand how to find several solutions for one pain point 	<ol style="list-style-type: none"> 1. Be able to recognize pain points 2. Be able to think of more and different possible solutions for the existing ones. 	4
3	Innovative methods	<ol style="list-style-type: none"> 1. Learn methods such as HIVI table, 5WHY, etc. 2. Understand the 36 innovation methods 	<ol style="list-style-type: none"> 1. Be able to recognize common innovation methods 2. be able to use one or two or even more innovative methods to solve problems 	4
4	Patent declaration	<ol style="list-style-type: none"> 1. Understand the value of patents 2. Master the skills and methods of patent writing 	<ol style="list-style-type: none"> 1. Be able to use patent search and analysis methods to analyze the innovation of the project 2. Be able to write patents for self-developed products. 	2
5	Team and	1. Master the method of equity	1. Be able to use the method of	4

	Resources	<p>design of startup team</p> <p>2.Be able to master the method of acquiring and assembling entrepreneurial resources.</p>	<p>equity design to design the equity structure of their own entrepreneurial team.</p> <p>2.Be able to assess their own entrepreneurial resources</p>	
6	Business Models	<p>1. Understand how to design a business model</p> <p>2. Master the content and structure of the business model canvas</p>	<p>1.Understand the value of a business model</p> <p>2.Be able to fill in the business model canvas</p>	4
7	MVP	<p>1. understand the MVP</p> <p>2. Master the MVP presentation methodology</p> <p>3. Understand user testing</p>	<p>1. Be able to design MVP form carriers</p> <p>2. Master the method of MVP</p> <p>3. Be able to utilize the tools of user testing</p>	2
8	Roadshow Presentation	<p>.Master the method of writing business plan</p> <p>2.Master the presentation skills of roadshow</p>	<p>1.Be able to divide up the work of writing a business plan</p> <p>2.Be able to make a public presentation of the business plan</p>	2

1.2 The steps and process of teaching activities

The course is designed according to the PIPT teaching model, and takes “Problem-Ideation-Prototype-Test” as the teaching process, and by reconstructing the teaching content, activities, context and evaluation, it transforms the creativity development into four teaching phases: Problem Discovery, Program Conceptualization, Production and Execution, and Evaluation and Reflection.

Phase I: Problem discovery

How to identify problems: Identifying problems is the foundation of

everything, and if you lack a sense of initiative to identify deficiencies and keen observation, innovation is impossible to talk about. Teachers will use various inspirational tools to lead students to look for pain points and needs, explore the root causes behind them, and develop a pair of eyes to “see” the pain points.

Phase2: Ideation

How to utilize innovation skills: Innovation is not just a flash of insight or an idea that comes out of the head of a smart person, it can follow certain steps and methods. Teachers will lead students to explore innovative ideas together, presenting 36 specific innovation methods for students to use in the innovation process.

Phase3: Prototype

How to create conditions: Successful implementation of an innovation attempt requires judging whether the innovation meets the customer's needs, whether it has commercial value, and how to make the innovation more valuable. At the same time, you need to learn to explore resources and utilize them creatively.

Phase4: Test

How to validate the implementation: Through testing tools to verify whether the customer is satisfied with our proposed innovative solutions, turn the solutions into reality and iterative, complete the presentation and expression of the overall innovative solutions, and ultimately complete the discovery - problem solving process.

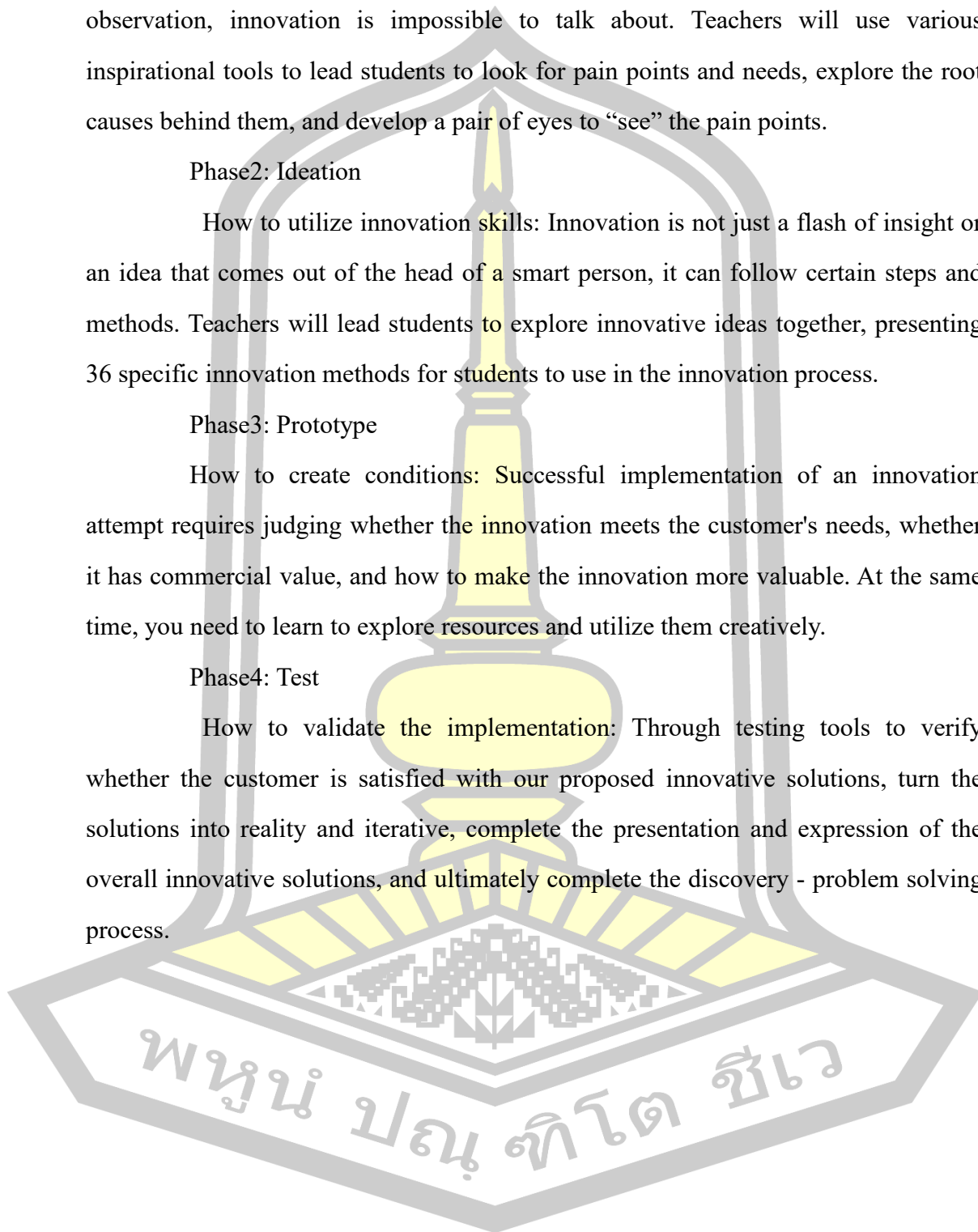


Table 11 Steps of the teaching model

Step	Content	Teacher Activities	Student Activities
Phase I: Problem discovery	What is the pain point	1. From “cell phone battery problem” Starting from “cell phone power problem”, elicit students' personal pain.2. Guide students to think about what kind of needs these pain points reflect. Are they willing to spend money to solve this need?	1. Think carefully and answer the questions. 2. Appreciate the difference between a need and a pain point.
Phase2: Ideation	How to identify pain points	Show case studies to guide students in a group discussion:1. what types of groups are the products and services designed for respectively? 2. do the products and services fulfill the needs of such groups? Are people willing to pay for them?	1. Think carefully about the discussion and answer the questions. 2. analyze what are the characteristics of pain points.
Phase3: Prototype	How to identify pain points	1. guide students to find pain points using Maslow's Hierarchy of Needs theory. 2. find pain points through the PEST model	1. identify true and false pain points, high and low frequency pain points. 2. analyze business opportunities using the PEST model
Phase4: Test	Learn to find pain points	1. how to adapt to the demands of the political, economic, social, and technological environment to find product innovation opportunities 2. encourage students to find pain points through modeling tools	1. learn to identify product needs in four areas: economic, political, social, and technological. 2. find pain points in learning or life and analyze what has been met and what has not been met

1.3 Implement classroom effect

This course organizes assessment and evaluation by the degree of achievement of learning objectives, following the principles of combining process evaluation and outcome evaluation, and integrating online and offline evaluation. All teaching evaluations are completed on the Super Star platform, so that “there are objectives in teaching and the objectives can be measured and evaluated”. Specifically, it includes three stages before, during and after class, as well as three dimensions of intra-group evaluation, inter-group mutual evaluation and teacher evaluation, and strives to establish a diversified evaluation system to promote students' independent learning, process learning and experiential learning.

Process evaluation accounts for 50% and final assessment accounts for 50%. Process evaluation includes inter-group mutual evaluation of each module task, mutual evaluation of group members (individual score), stage task scoring (team score), and inter-group mutual evaluation of the closing roadshow.

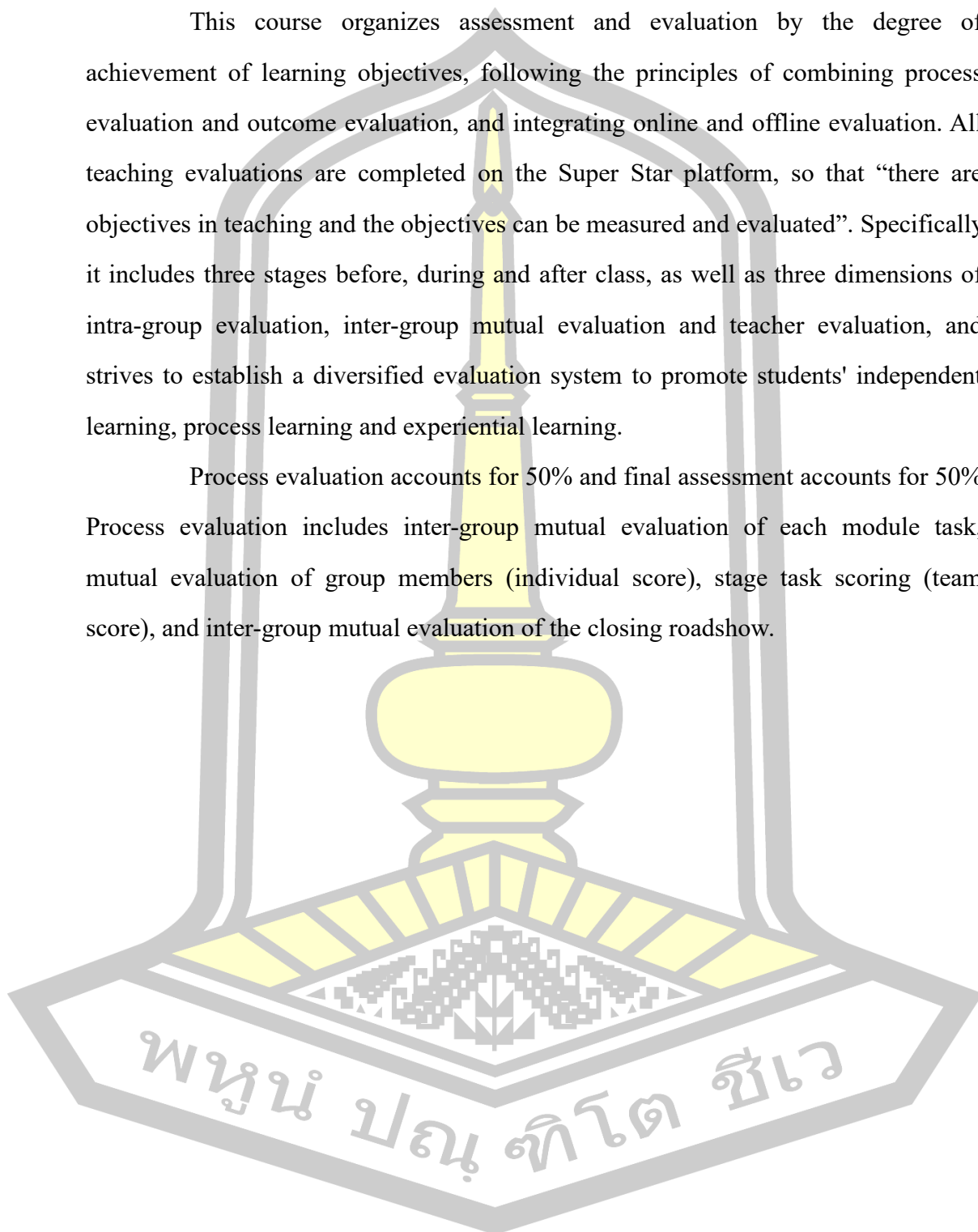


Table 12 Evaluation index

Scoring items	First class (15-20points)	Second class (8-14 points)	Third class (0-7 points)
Project Overview Analysis	Concise, succinct, and able to effectively summarize the entire program; distinctive and attractive; clear ideas and goals; and able to highlight its own unique strengths.	Can basically summarize the whole plan; Have a certain appeal; Have clear ideas and goals; Can highlight their own unique advantages.	Can basically summarize the whole plan; The idea and goal are vague; Their own unique advantages are not obvious.
Project development idea	Creativity is unique and novel, and innovation is strong.	Some details of the project are creative and attractive	The project idea is not new enough. No idea.
Whether to meet customer pain points analysis in place	The pain points are real and frequent, and the design of the project hits the customer's pain points.	Customer pain point analysis is reasonable, the pain point is real but the frequency is low	Pain point analysis is not feasible, and what is found is the pseudo-pain point, which cannot form the real demand.
Business model design and return on investment	The business model is feasible, the key financial factors, indicators, main statements are listed, the financial plan and indicators are reasonable and accurate, and the return on investment is clear.	The business model is basically feasible. The financial factors, financial indicators and main financial statements are basically listed. The return on investment is clear.	The business model is not viable and key financial factors, financial metrics and key financial statements are not listed. There is little return on investment
Project operability analysis	The feasibility of each analysis and budget of the project, service or product is high, and the operation plan is clear.	The feasibility of each analysis and budget of the project, service or product is general, and the operation plan is basically clear.	The analysis and budget of the project, service or product is not feasible.

2. Results of creativity improvement of college students before and after the implementation of teaching model

During the development of the PIPT instructional model, the researchers presented the results of the data analysis in the following way:

Part I: Creativity performance of students in the experimental and control groups before using the teaching model

Part II: Comparing the creativity performance of students in the experimental group before and after learning through the implementation program of the PIPT teaching model

Part III: Comparing the creativity performance of students in the experimental and control groups after using the teaching model

2.1 Pre-test data results of experimental group and control group

The sample group was 60 freshmen students from Guangzhou Panyu Polytechnic(China) in the 1st semester of the academic year 2024.They come from two natural classes in the same major .The researcher selected the same innovation and entrepreneurship course to implement the teaching activities at the same time. These students came from two natural classes of one major in the same grade, of which 30 were in the experimental group, implementing the PIPT teaching mode. The control group, 30 students, implemented the traditional teaching model. Before the teaching activities, the researchers tested the creativity level of the students in both classes at the same time. The test results are shown in table 13:

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Table 13 Experimental and control group pre-test data results

Creativity indicators	Group	N	Mean	Std. Deviation	Std. Error Mean
Adventurousness	Experimental group	30	3.4192	.76069	.12678
	Control group	30	3.4492	.49790	.08539
Curiosity	Experimental group	30	3.3294	.69237	.11540
	Control group	30	3.3424	.50776	.08708
Imagination	Experimental group	30	3.3483	.81043	.13507
	Control group	30	3.1742	.61197	.10495
Challenging	Experimental group	30	3.5231	.74711	.12452
	Control group	30	3.3480	.55523	.09522
Total Creativity Score	Experimental group	30	3.4050	.67437	.11239
	Control group	30	3.3285	.48162	.08260

2.2 The creativity level of the experimental group students in the pre- and post-test

The researchers compared the pre- learning and post-learning test scores of students activities using the PIPT teaching model, and the results are shown in Table 14:

Table 14 Pre- and post-test results of the experimental group using the PIPT teaching model

Creativity indicators	Group	N	Mean	t	sig
Adventurousness	Pre-test	30	3.4435	-4.23*	0.00
	post-test	30	4.0634		
Curiosity	Pre-test	30	3.3918	-6.00*	0.00
	post-test	30	4.1710		
Imagination	Pre-test	30	3.2354	-4.69*	0.00
	post-test	30	4.1562		
Challenging	Pre-test	30	3.5530	-5.25*	0.00
	post-test	30	4.3157		
Total Creativity Score	Pre-test	30	3.4059	-5.81*	.00
	post-test	30	4.1765		

*Statistical Sig .00

According to table 14, the pre-test average scores of creativity in adventurousness,curiosity,imagination,challenging were 3.4435, 3.3918,3.2354 and 3.5530, whereas the post-tests' average scores were 4.0634, 4.1710,4.1562 and 4.3157.

The post-test levels of all four metrics increased significantly, with Challenging and Adventurousness being the metrics that improved the most, followed by Imagination and Curiosity. In addition, the pre-test average score of total creativity was 3.4059, whereas the post-tests' average scores were 4.1765. This can be inferred that the students had a significantly higher improvement of creativity both in overall and each individual aspect at the statistical level of .005.

The results of the study showed that students' overall level of creativity as well as sub-scores of adventurousness, curiosity, imagination, and challenging were statistically significantly higher after using the PIPT teaching model than before the study. Consequently, the students had a higher creativity achievement after learning through the developed model than that assessed before learning.

2.3 Comparing the creativity performance of students in the experimental and control groups after using the teaching model

Different from the experimental group, the researcher implemented the traditional teaching mode in the control group and tested the creativity level of students before implementing the teaching activities. The results are shown in Table 15:

Table 15 Pre- and post-test results of the control group using the traditional teaching model

Creativity indicators	Group	N	Mean	t	sid
Adventurousness	Pre-test	30	3.4492	0.04	0.97
	post-test	30	3.4435		
Curiosity	Pre-test	30	3.3424	-0.42	0.68
	post-test	30	3.3918		
Imagination	Pre-test	30	3.1742	-0.43	0.67
	post-test	30	3.2354		
Challenging	Pre-test	30	3.3480	-1.45	0.15
	post-test	30	3.5530		
Total Creativity Score	Pre-test	30	3.3285	-0.67	0.50
	post-test	30	3.4059		

As can be seen from Table 15, the overall performance of creativity of the

students in the control group before and after the implementation of teaching activities is roughly equal and there is no significant difference. And there is no significant difference in the performance of the indicators of adventurousness, curiosity, imagination, and challenge in the table of creative power.

So far, from the results of the study, it can be seen that there is a significant difference in the performance of creativity of students in the experimental and control groups by implementing different teaching modes for the same course.

3.Results of the experimental and control group post-creativity tests

The researchers compared the post-test scores of students' creativity in the experimental and control groups after the implementation of different instructional models, and the results are shown in Table 16:

Table 16 Post-test results for experimental and control groups

Creativity indicators	Group	Experimental group	Control group	t	sig
Total Creativity Score	post-test	4.18±0.37	3.41±0.46	7.50*	0.00
Adventurousness	post-test	4.06±0.45	3.44±0.59	4.80*	0.00
Curiosity	post-test	4.17±0.43	3.39±0.45	7.18*	0.00
Imagination	post-test	4.16±0.59	3.24±0.54	6.58*	0.00
Challenging	post-test	4.32±0.46	3.55±0.60	5.81*	0.00

*Statistical Sig .00

As can be seen from Table 16, there is a significant difference in the performance of creativity of students in the experimental and control groups by implementing different teaching modes for the same course. The overall level of creativity of the experimental group with the PIPT teaching model was significantly higher than that of the control group with the traditional teaching model, and significant differences were found in the overall level of creativity, as well as in the indicators of adventurousness, curiosity, imagination, and challenge.

Result of implementation

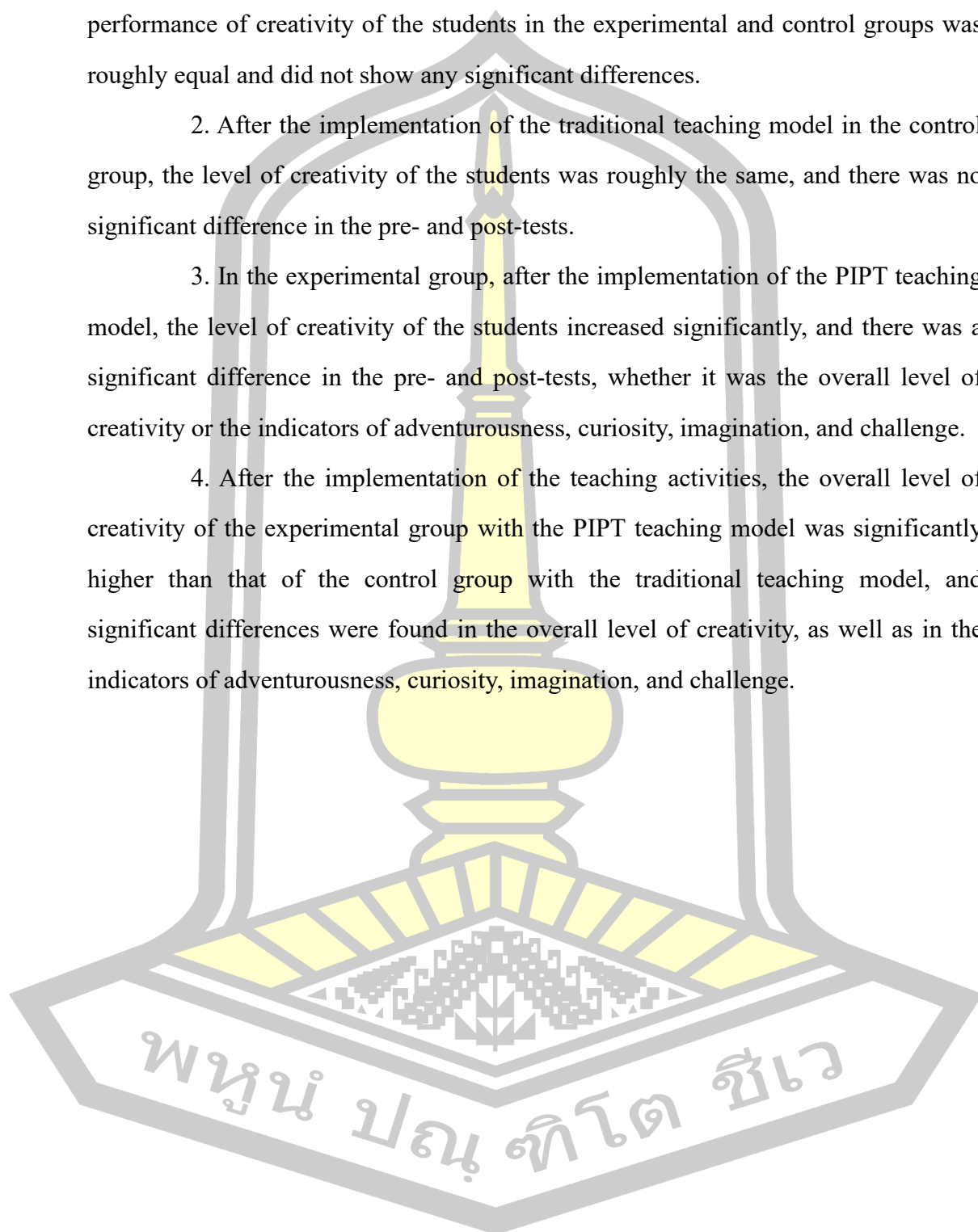
The independent and paired sample tests are both significant demonstrating that:

1. Before the implementation of the teaching activity, the overall performance of creativity of the students in the experimental and control groups was roughly equal and did not show any significant differences.

2. After the implementation of the traditional teaching model in the control group, the level of creativity of the students was roughly the same, and there was no significant difference in the pre- and post-tests.

3. In the experimental group, after the implementation of the PIPT teaching model, the level of creativity of the students increased significantly, and there was a significant difference in the pre- and post-tests, whether it was the overall level of creativity or the indicators of adventurousness, curiosity, imagination, and challenge.

4. After the implementation of the teaching activities, the overall level of creativity of the experimental group with the PIPT teaching model was significantly higher than that of the control group with the traditional teaching model, and significant differences were found in the overall level of creativity, as well as in the indicators of adventurousness, curiosity, imagination, and challenge.



CHAPTER V CONCLUSION

The aim of this study was to develop a teaching model to promote the development of creativity for Chinese college students, and the researcher present the findings in the following order

1. Research objectives
2. Conclusion
3. Discussion
4. Suggest

Research objectives

1. To study the basic information of the teaching model of innovation and entrepreneurship courses based on creativity cultivation:

- 1.1 To study the theories and principles related to college students' creativity
- 1.2 To study the current situation of college students' creativity
- 1.3 To study the guidelines for developing teaching model to enhance college students' creativity

2. To develop teaching model to enhance college students' creativity

3. To study the results of using specific teaching model to enhance college students' creativity

3.1 To implement the teaching model

3.2 To compare the creativity level of college students before and after using the teaching model

3.3 To compare post-test of creativity in the experimental and control groups

Conclusion

This project researched and developed the PIPT teaching model based on innovation and entrepreneurship course in Chinese college to promote the creativity of students. The researcher summarized the results of the development of the teaching model.

1. Through literature research, There are many theoretical and practical explorations on how to cultivate and train creative thinking and creative tendency in education. James C. Kaufman and Ronald A. Beghetto (2013) carefully sorted out some important views of foreign scholars on the cultivation of creativity, and proposed that mentors and environment are very important for the cultivation of creativity. The partnerships educators form in the classroom are critical to fostering creativity. Both academia community and colleges have realized that the training of creative talents cannot be separated from the corresponding curriculum, and the teaching model is the basic condition to achieve the goal of talent training. The academic circles generally agree that the implementation of innovation and entrepreneurship education needs to follow certain principles and adopt appropriate teaching models.

2. The survey results on the demand and necessity of the development of a teaching model to enhance the creativity for college students show that: both academic experts and Chinese colleges teachers and students has the same view, they believe that it is necessary to develop a teaching model in innovation and entrepreneurship course, the results of the survey overall demand is at a high level ($\bar{x} = 4.34$).

3. Based on constructivist educational theory and CPS theory, this study developed a PIPT teaching model oriented to “problem-based learning” and the process of “problem-Ideation-prototype-testing” with the core objective of cultivating students' creativity. The PIPT teaching model draws on the six components :

Principles of the model; Objectives; Syntax; Social system; Principle of Reaction; Support System. The teaching model has the highest quality and appropriateness ($\bar{x} = 4.61$).

The goal of each step of the teaching model is clear and the content is flexible. The consistency value is 0.71-1.00. The consistency between the evaluation of the teaching model and the research objectives can be tested. Teaching experts believe that the syllabus of the teaching model is at the highest level in terms of the tasks of teaching activities, the consistency of teaching activities principles (IOC), the goals of teaching activities, the functions and evaluation of teaching activities, and the teaching structure and teaching content are in line with the college students.

4. The results of the implementation of the teaching model show a significant change in the level of students' creativity. Before the implementation of the teaching activities, the average score of students' overall creativity was 3.4050, and after the implementation of the PIPT teaching model, the average score of students' overall creativity was 4.1765, which means that a significant increase in students' creativity occurred. Of the four evaluation indicators of creativity, the mean score of risk-taking increased from 3.4192 to 4.0634, the mean score of curiosity increased from 3.3294 to 4.1710, the mean score of imagination increased from 3.3483 to 4.1562, and the mean score of challenging increased from 3.5231 to 4.3157.

It can be seen that the implementation of the PIPT teaching model resulted in a significant increase in the overall level of creativity of the students, as well as on the indicators of adventurousness, curiosity, imagination, and challenge.

summarize

1. **Basic Information Study:** The highlight of the college students' creativity from government and the existing limited level, also the cultivation strategies supplied evidence support for the construction of a teaching model.

2. **Developing the Teaching Model:** The study developed the PIPT teaching model, rooted in Constructivist SOI and CPS theories, designed to follow the

process of "Problem-Ideation-Prototype-Testing". The model's components-principles, objectives, syntax, social systems, reactions, and support systems-proved highly effective in achieving teaching goals, with an evaluation score of 4.61.

3. **Implementation:** The implementation of the PIPT model showed a significant improvement in students' creativity. Pre- and post-implementation evaluations revealed an increase in the overall creativity score from 3.41 to 4.18. Notable improvements were seen in the four creativity indicators: risk-taking, curiosity, imagination, and challenging, showing that the model was effective in cultivating creativity. An independent T test and paired T-tests show that the PIPT teaching model effect is better than the traditional one and it can significantly improve the creativity of college students.

Discussion

The PIPT teaching model, designed to enhance creativity among college students, was developed based on established theories of creativity, Creative Problem Solving (CPS), and constructivist theory. This model comprises three stages organized in a specific syntax and sequence, while also considering three phases in its development. Throughout the research and development process, the model was thoroughly investigated, refined, and evaluated to ensure its effectiveness in fostering student creativity. The PIPT model encompasses the entire instructional process, addressing the needs and characteristics of students, defining learning objectives, implementing teaching strategies, and conducting measurement and evaluation. The findings of this study are systematically discussed and clearly detailed in the following sections.

1. The first phase of the study revealed that SOI Theory (Guilford's Creativity Theory), CPS Theory and constructivist theory are the most appropriate theories in this context. Through the study of these theories, researchers can find a teaching model that can promote the creativity of college students. From the steps of

the PIPT teaching model and the teaching evaluation, it is found that it has a clear teaching process, flexible content structure, and rich knowledge of activities to enhance the creativity of college students. When considering each question, it is found that the principles of the teaching model are achievable, the teaching objectives are clear, the teaching links are flexible, and the importance of the teaching process is in line with the needs of the Chinese college, and the consistency value is 0.71-1.00. The research on the problems and needs of the relevant objects for the development of this teaching model shows that the basic information is used to formulate the goals and content of the teaching involved, and select the appropriate steps of the teaching model.

2. The second phase of the study was to develop an instructional model. Based on well-accepted components of teaching models by Joyce et al. (2011), the model comprised of 6 components: principles of the model, objectives, syntax, social system, principle of reaction, and support system, was averagely rated as "high appropriate" by the experts who specialized in innovation and entrepreneurship education, research and development, curriculum, and instruction.

To cultivate college students' creativity, the core is to cultivate creative consciousness and broaden their thinking ability. In order to make students truly willing to create, have the ability to create, we should start from the four dimensions of cultivating creative tendency and creative thinking ability. To improve students' creative consciousness, it is necessary to focus on students' curiosity, imagination, adventurous spirit and challenging spirit. It's important to be curious, to be hungry for the unknown, and with this spirit, you are motivated to create. At the same time, students should not be afraid of failure when they encounter new problems, failure is the mother of success, and do not lose confidence in failure, in order to explore the way forward; Nor do they obey authority, for whom authority has only one answer and creates thousands of answers. In this way, students will realize the infinite potential of their creative thinking.

Based on SOI Theory and CPS Theory, PIPT teaching model proposes to combine creativity directly with problem solving and cultivate students' creativity by using innovative strategies and methods in the process of problem solving. This is consistent with the academic research on creativity. Guilford (1959) first proposed the theory of the combination of creativity and problems; Basadur (1994) proposed that the process of creation is also a theory of problem solving; Parnes (1987) proposed the theory of the combination of problem solving and creative thinking. It is shown that creative problem solving, as a high-level and complex comprehensive creative activity, is a process of seeking creative solutions to problems in a novel, flexible and original way.

Therefore, in order to cultivate students' creative ability, it is necessary to pay attention to the number of ideas, the horizontal breadth of ideas, the vertical depth of ideas and the degree of attention to details after students accept challenges. These conditions will have a great impact on creative thinking ability. On the one hand, broaden the mind in the process of creation; On the other hand, it is also necessary to refine the number and precision of ideas. Teachers should strengthen the control of the rhythm of the class, communicate with students in a timely manner, and give students feedback information, so that students cannot have the situation of caring for one thing and losing another. Based on this, researchers propose that in teaching activities, teachers should adopt problem-based learning and creative problem solving teaching models according to the process of problem solving, provide appropriate questions, inspire students' sensitivity to problems, stimulate students' flexibility of thinking, and assist students to think about problems as a whole. And encourage students in the learning process through exploration, discovery, reflection, discussion to solve difficult problems to obtain knowledge, develop students' creativity.

3. Enlightenment on the development of teaching model based on college students' creativity. According to Joyce, Weil, and Calhoun's Teaching Model (2008), the framework of teaching model should not only focus on the organization of subject

content and the design of teaching process, but also emphasize the importance of social environment and the promoting role of student participation. And the need for student support. PIPT teaching model based on constructivism is suitable for cultivating students' problem-solving ability and creativity. It is based on the learning model under the constructivism learning theory, which believes that learning takes place in the process of learners actively participating in the construction of meaning and knowledge, rather than passively accepting knowledge, and learners are the creators of meaning and knowledge.

The teaching model can directly affect the creativity of college students, which is consistent with the results of many empirical studies. First of all, good teaching design can effectively stimulate the cultivation of students' creativity. Based on the constructivism education theory, PIPT teaching mode adopts the method of "building scaffolding" and creating situations in teaching to help students cultivate and strengthen their creative thinking ability and attitude of independent thinking, discussion and negotiation, expressing personal opinions and constantly questioning. PIPT teaching mode is problem-oriented to design teaching activities and guide students to understand and solve "problems" in the process of completing classroom teaching activities. Students solve problems in exploration and activities to achieve training goals. This study not only supports the cultivation path of teaching mode on creativity, but also further finds that the effect of problem solving path on creativity is realized through the design dimension of teaching mode, which makes us more clear about the development principle of teaching mode.

Secondly, the higher the level of teachers' autonomy support, the stronger the positive effect on college students' creativity. This is consistent with the research results of Shalley (2004) and others. When teachers support students' novel ideas and encourage students to think from multiple angles, students' creativity level will be higher. The results of the implementation of the teaching model show that the independent support from teachers has a remarkable effect on the improvement of

college students' creativity. This is consistent with the empirical research results of scholars. Deci et al. found that students who feel independent support from teachers are more curious and confident, and thus have stronger intrinsic motivation and learning autonomy, and are more challenging. Angela proposed that improving teachers' behaviors, guidance strategies and students' learning atmosphere could effectively stimulate students' creative motivation and promote the development of college students' creativity. Beghetto found that the way teachers gave feedback to students and the evaluation atmosphere they created significantly affected students' creative motivation and ability of creative expression.

The more important finding of this conclusion is that teacher autonomy support, as an environmental variable among the influencing factors of students' creativity, moderates the influence of individual factors on college students' creativity. The creativity ecosystem model points out that the medium and external systems influence creativity by influencing Microsystems. This study confirms that the middle system (teacher autonomy support) influences students' creativity by regulating the relationship between micro system (internal motivation) and creativity. This study further suggests that when students perceive a higher level of teacher autonomy support, on the one hand, internal motivation will be enhanced; On the other hand, internal motivation has a stronger positive effect on creativity.

summarize

1. The current state of college students' creativity is essential to develop an effective teaching model, it can foster creativity, improve problem-solving skills, and meet the demands of innovation and entrepreneurship education in higher education.

2. SOI, CPS Theory, and problem-solving as a process for fostering student creativity provide theory support for PIPT teaching model development.

3. PIPT is closely related to students' creativity. The model's design includes clear principles, objectives, and a flexible structure, aligning with the needs of Chinese college students and contributing to the enhancement of creativity in

innovation and entrepreneurship education. Therefore, creating an appropriate teaching model is key to fostering student creativity. PIPT framework as an independent variable, to incorporation in various courses, as to affect students competence and skill.

Suggest

Create is classified as a higher-order cognitive skill for students according to Rum's classification of teaching objectives. In this research, a teaching model was developed to study students' creativity. The results indicated that the developed teaching model had the highest level of quality and appropriateness, and students' creativity skills had improved. Based on the above research results, some recommendations will be proposed.

1. Suggestions for the implementation of the teaching model

1.1 The teaching model was determined to be appropriate for improving creativity of college students comprised of 6 components including principles, objectives, syntax, principle of reaction, and support system. A higher learning achievement for college indicated that the developed model was productive in enhancing their creativity skills.

1.2 Teachers should have enough comprehensive cognition to cultivate students' creativity, that is, it is reasonable and effective to cultivate creativity by designing appropriate creative teaching practice and creative thinking training.

1.3 According to the teaching objectives, teachers should create a learning environment and support system of learning activities in real situations, and master interactive and collaborative learning methods.

1.4 Creativity classrooms should be free, collaborative, and relaxed, and teachers should use methods that encourage, instruct, and encourage rather than force or pressure. Teachers should be able to adjust flexibly according to the actual situation.

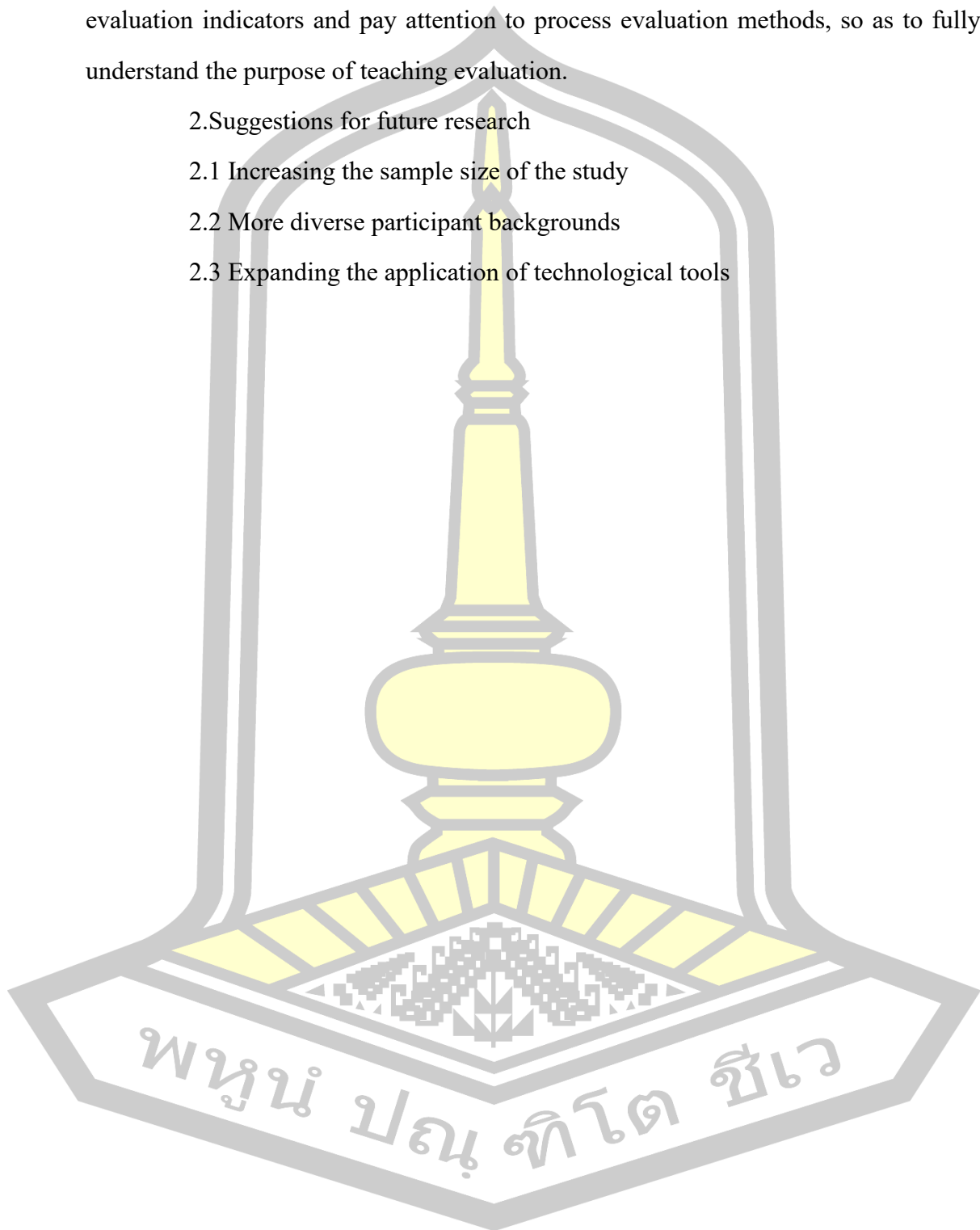
1.5 When evaluating students' creativity, evaluators should adopt diversified evaluation indicators and pay attention to process evaluation methods, so as to fully understand the purpose of teaching evaluation.

2. Suggestions for future research

2.1 Increasing the sample size of the study

2.2 More diverse participant backgrounds

2.3 Expanding the application of technological tools



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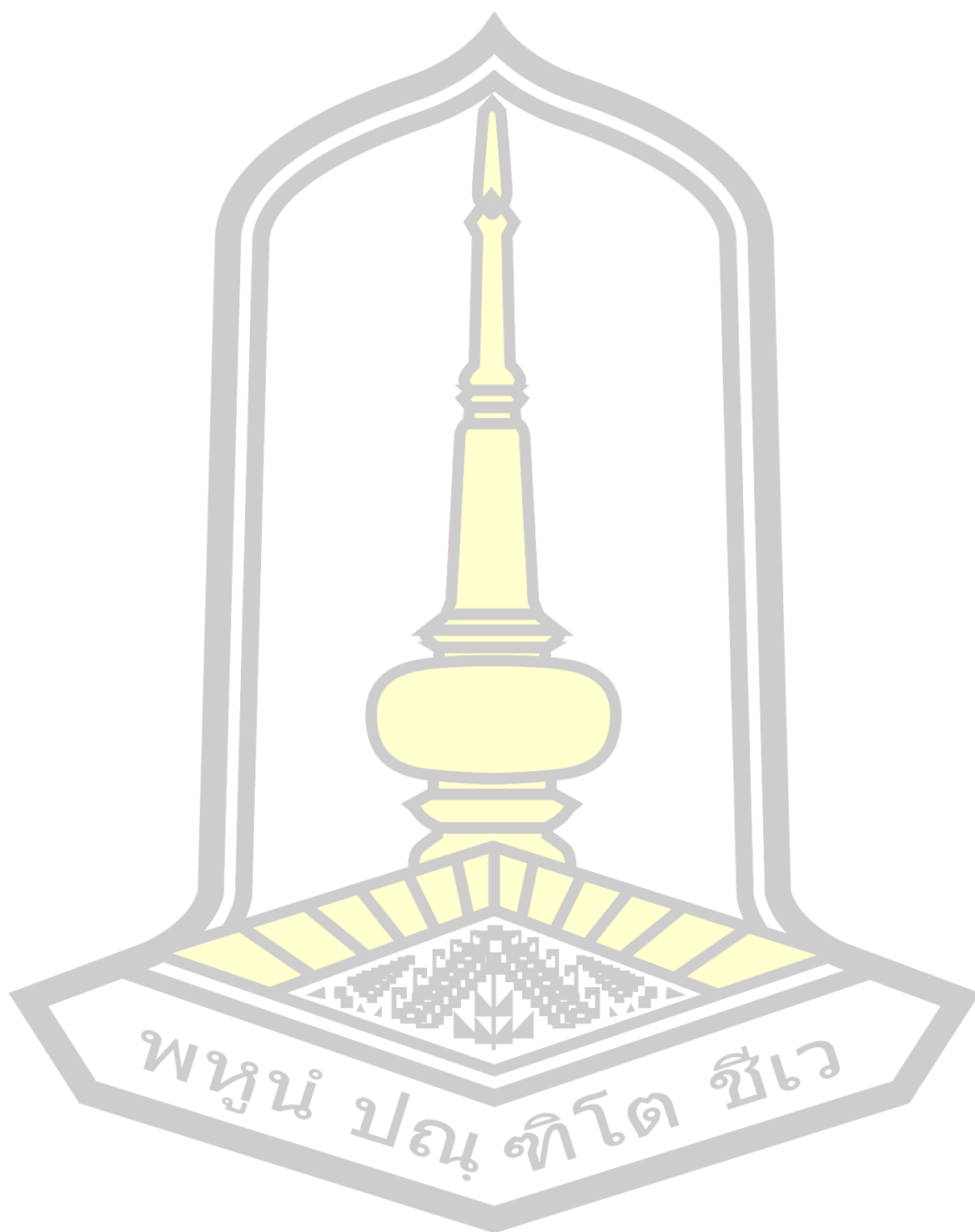
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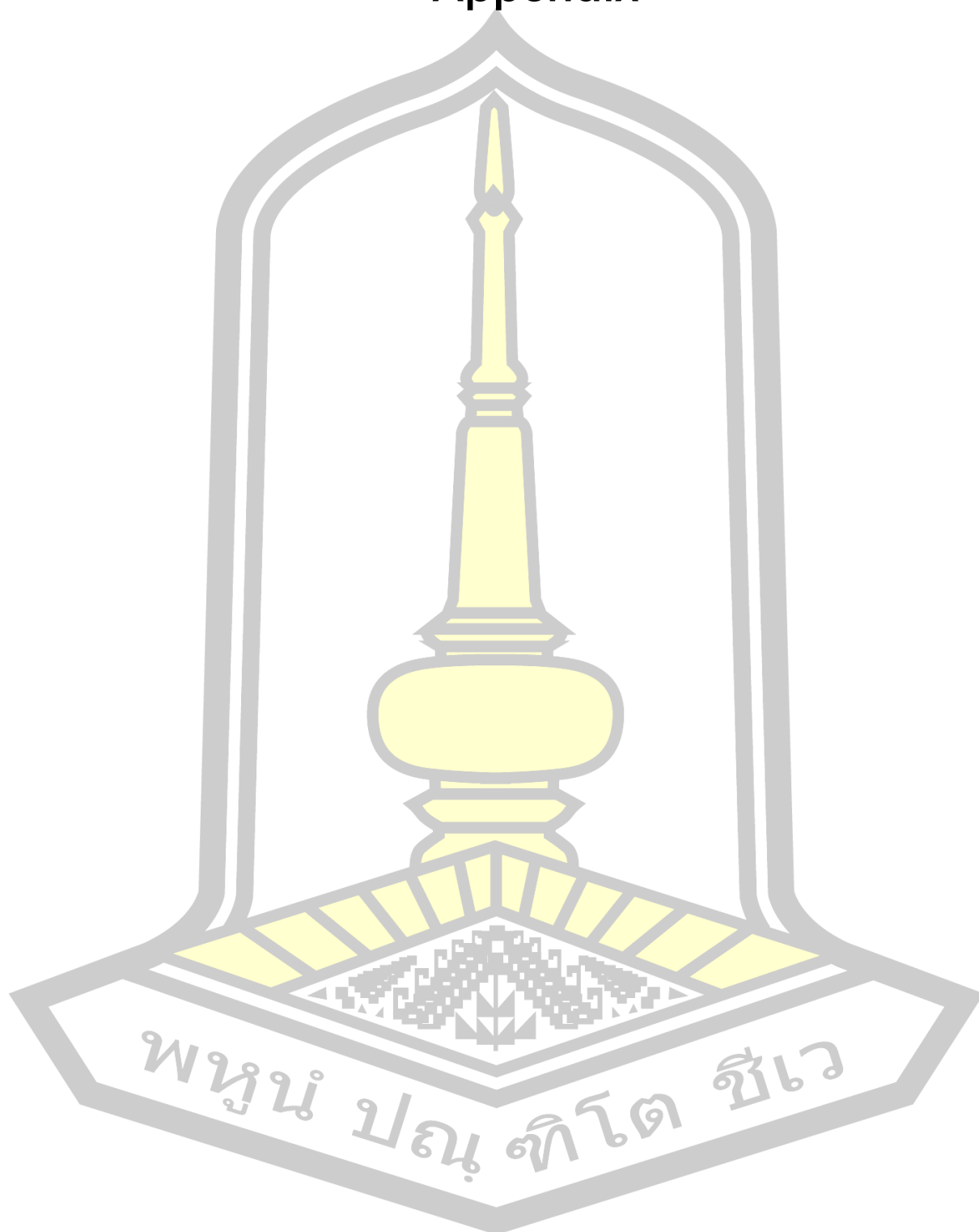
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Appendix



Ethics Certificates



MAHASARAKHAM UNIVERSITY ETHICS COMMITTEE FOR RESEARCH INVOLVING HUMAN SUBJECTS

Certificate of Approval

Approval number: 763-710/2024

Title : Developing the teaching model of innovation and entrepreneurship courses to enhance the creativity for college students.

Principal Investigator : Jieqi Huang

Responsible Department : Faculty of Education

Research site : Guangzhou city, Guangdong, China

Review Method : Expedited Review

Date of Manufacture : 25 December 2024

Expire : 24 December 2025

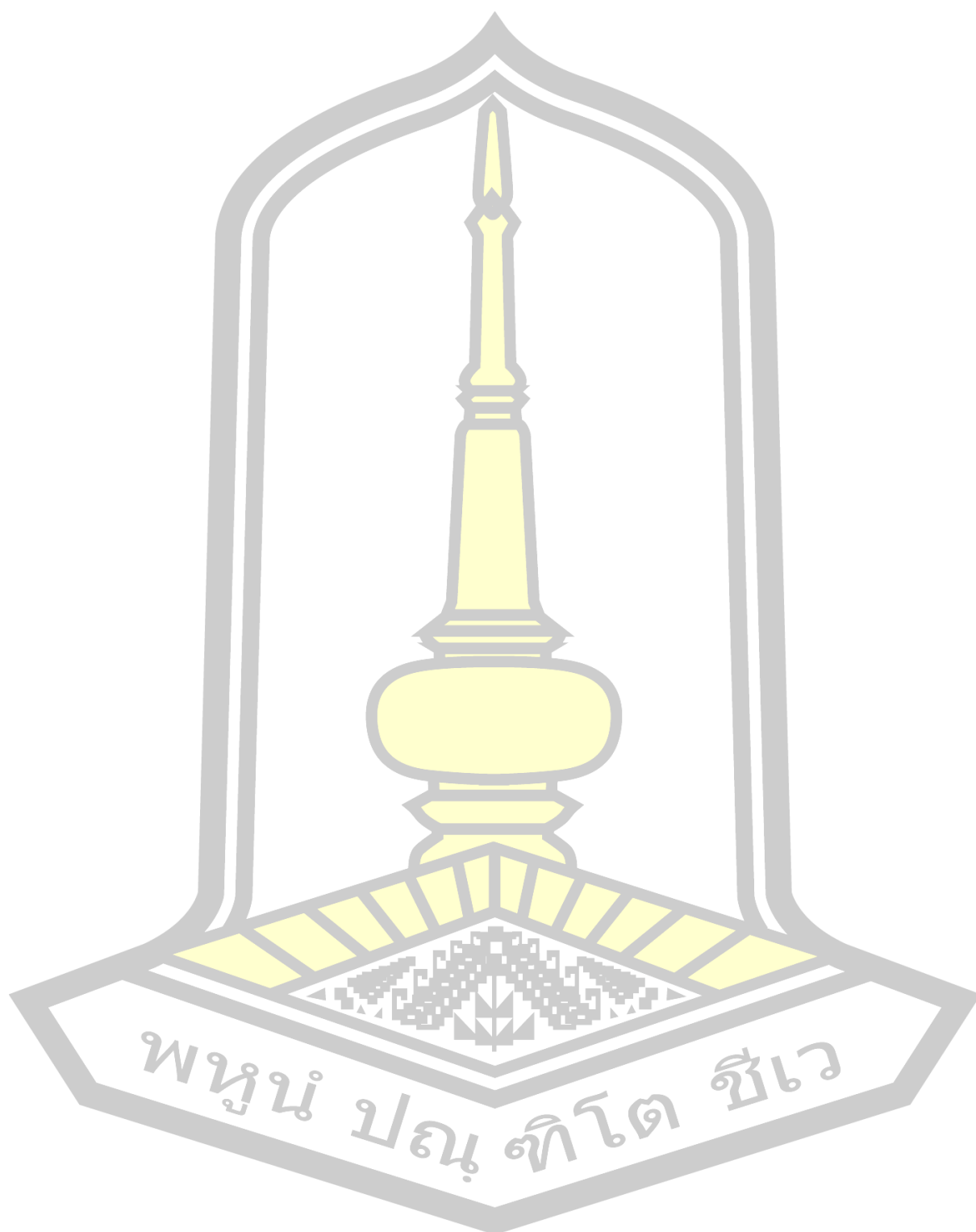
This research application has been reviewed and approved by the Ethics Committee for Research Involving Human Subjects, Maharakham University, Thailand. Approval is dependent on local ethical approval having been received. Any subsequent changes to the consent form must be re-submitted to the Committee.

(Assistant Professor Ratre S Sawangjit)

Chairman

Approval is granted subject to the following conditions: (see back of this Certificate)

Structment



Semi-structured interviews on the current state of creativity and guidance for college students

Dear expert:

The purpose of this interview is to investigate the current situation of creativity cultivation of Chinese College Students, and to listen to experts' guidelines on teaching models based on the enhancement of college students' creativity. The interview is divided into four parts.

Part 1: General information about the interviewer

Part 2: Current Situation and Problems of Creativity Cultivation and Teaching Models for College Students

Part 3: Guidelines for the Development of Teaching Models to Enhance Creativity

Part 4: Opinions and Suggestions

Part 1: General information about the interviewer

1. name age
2. position university
3. Tel e-mail

Part 2: Current Situation and Problems

1. How would you rate the current level of creativity among Chinese college students?

2. What do you see as the main problems with the current teaching model based on enhancing creativity among college students?

3. What do you think are the main problems with the current model of teaching innovative entrepreneurship programs?

Part 3: Guidelines for the Development of Teaching Models to Enhance Creativity

1. How do you think teaching models affect the development of creativity in university students?

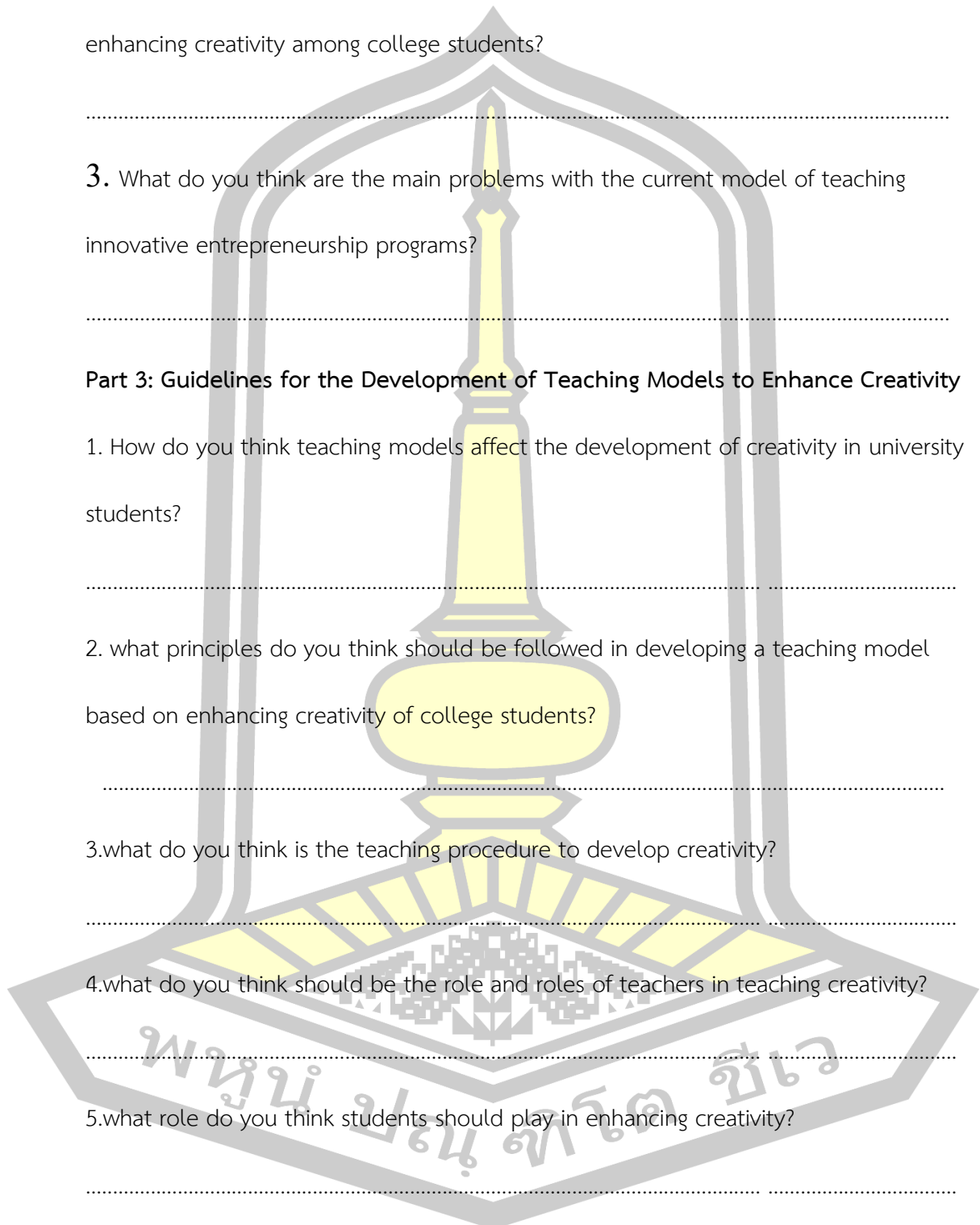
2. what principles do you think should be followed in developing a teaching model based on enhancing creativity of college students?

3.what do you think is the teaching procedure to develop creativity?

4.what do you think should be the role and roles of teachers in teaching creativity?

5.what role do you think students should play in enhancing creativity?

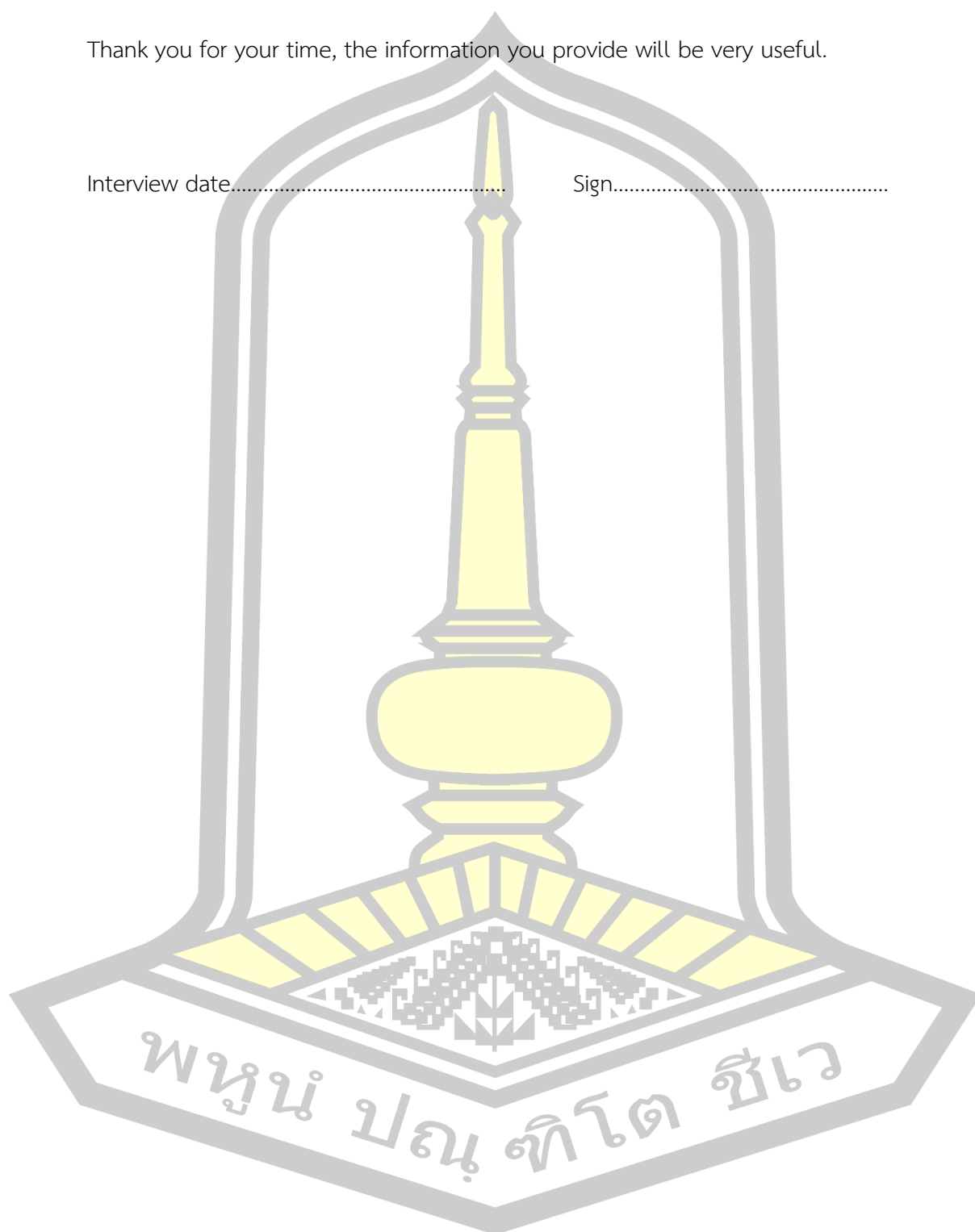
Part 4: Opinions and Suggestions



.....
Thank you for your time, the information you provide will be very useful.

Interview date.....

Sign.....



Questionnaire survey on the PIPT teaching model

Dear expert,

The purpose of this interview was to assess the applicability of the PIPT teaching model. The questionnaire was divided into two parts:

Part 1: Comments on the suitability of the model from people with relevant qualifications.

Part 2: Additional advice .

The scoring criteria were:

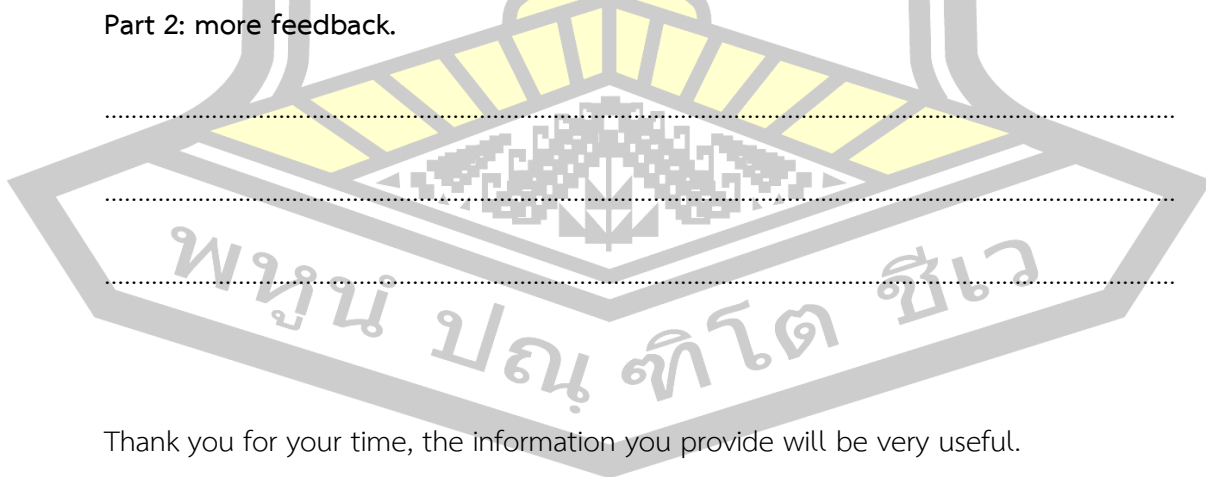
5: Very applicable 4: Applicable 3: Applicable in general 2: Slightly applicable 1: Not applicable

Part 1: Please rate the suitability for the teaching model by selecting one mark for each question to assess the appropriate content.

Theories and Principles	score					Suggestion
	5	4	3	2	1	
Constructivist Theory : Constructive						
SOI Theory: Subjectivity						
CPS Theory: Problem-oriented						
Objective						
to enhance the creativity of college students						
Syntax						
Phase I: Problem discovery						
Phase2: Ideation						
Phase3:Prototype						
<i>Phase4:Test</i>						
Social system						

Teachers are monitors and helpers. The role of teachers is to understand learners. Systematically prepare learning materials and organize learning activities. Teachers are the organizers of the facility, responsible for creating a learning environment and climate, and assessing the performance of learners.								
Students are the main body of active learning. The role of the learner is to actively participate in classroom activities and conversations and in doing so build knowledge, self-understanding, cooperation and communication.								
Principle of Reaction								
subjectivity and active learning								
Problem-oriented								
diversified evaluation methods								
Support System								
Instructional Materials: Teachers must provide a variety of primary instructional materials.								
Information resources: a variety of information resources should be made available to learners during the learning process.								
Teaching management and assessment: Teachers are required to use diverse assessment indicators to perform and evaluate teaching tasks.								

Part 2: more feedback.



Thank you for your time, the information you provide will be very useful.

date.....

Sign.....

Questionnaire survey on the creative tendency for college students

Dear Students,

We are conducting a classroom action research study using the Williams Creativity Aptitude Scale to assess the creativity levels among college students. In the following statements, if you find that certain statements accurately describe your feelings, please indicate your response by placing a check mark (✓) next to the option that best reflects your situation. The options are as follows: 1 represents "Strongly Disagree," 2 represents "Disagree," 3 represents "Not Sure," 4 represents "Agree," and 5 represents "Strongly Agree." This questionnaire is anonymous, and there are no right or wrong answers. Please respond based on what best represents you. Thank you for your support!

1.I enjoy making guesses about things or problems in school, even if I don't necessarily get them right.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

2.I like to observe things I have never seen before to understand the details.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

3.I enjoy listening to creative and imaginative stories.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

4.When drawing, I like to copy other people's works.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

5.I enjoy making fun things from waste materials like old newspapers, calendars, and cans.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

6. I like to imagine things I want to know or do.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

7. If something cannot be completed in one go, I will persist until I succeed.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

8. When doing homework, I like to reference various materials to gain multiple perspectives.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

9. I prefer to do things in the same way and don't like looking for other methods.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

10. I enjoy exploring the truth behind different things.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

11. I do not like doing many new things.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

12. I do not enjoy making new friends.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

13. I enjoy thinking about things that are unlikely to happen to me.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

14. I like to imagine one day becoming an artist, musician, or poet.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

15. I often forget other things because of exciting ideas that come to my mind.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

16. I would rather live in a space station than on Earth.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

17. I believe all problems have fixed answers.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

18. I enjoy things that are different from the norm.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

19. I often want to know what others are thinking.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

20. I enjoy things depicted in stories or TV shows.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

21. I like to share my thoughts with friends.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

22. If the last page of a storybook is torn out, I will make up a new ending.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

23. When I grow up, I want to do things that no one has ever thought of.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

24. I prefer to use innovative methods rather than traditional ones when doing tasks.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

25. I often conceive new inventions or ideas in my mind.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

26. I find it exciting to explore new places or new concepts.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

27. I often think about how things could be improved or changed.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

28. I enjoy brainstorming sessions with others to come up with unique ideas.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

29. I often daydream about future possibilities and potential changes in my life.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

30. I like to play with ideas, theories, and concepts even if they seem impractical.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

31. I am attracted to unusual or eccentric people and their stories.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

32. I enjoy activities that allow me to express my creativity, such as painting.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

33. I like to think outside the box and challenge common assumptions.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

34. I frequently seek out experiences that will push my creative boundaries.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

35. I often enjoy watching documentaries or educational programs that make me think deeply.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

36. I believe that trying new things, regardless of success or failure, is valuable.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

37. I often find inspiration in nature and the world around me.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

38. I enjoy collaborating on projects with people who have different viewpoints.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

39. I tend to take risks when it comes to expressing my ideas and opinions.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

40. I often find myself doodling or sketching ideas during meetings or lectures.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

41. I enjoy reading fiction or fantasy books that allow my imagination to wander.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

42. I believe everyone has the potential to be creative in their own way.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

43. I often feel motivated to create or design something new when I see others' work.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

44. I enjoy attending workshops or classes that focus on creative skills.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

45. I feel a sense of accomplishment when I finish a creative project.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

46. I believe creativity can be developed through practice and effort.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

47. I enjoy working on creative projects, even when they take a lot of time.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

48. I often find creative solutions to problems in my everyday life.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

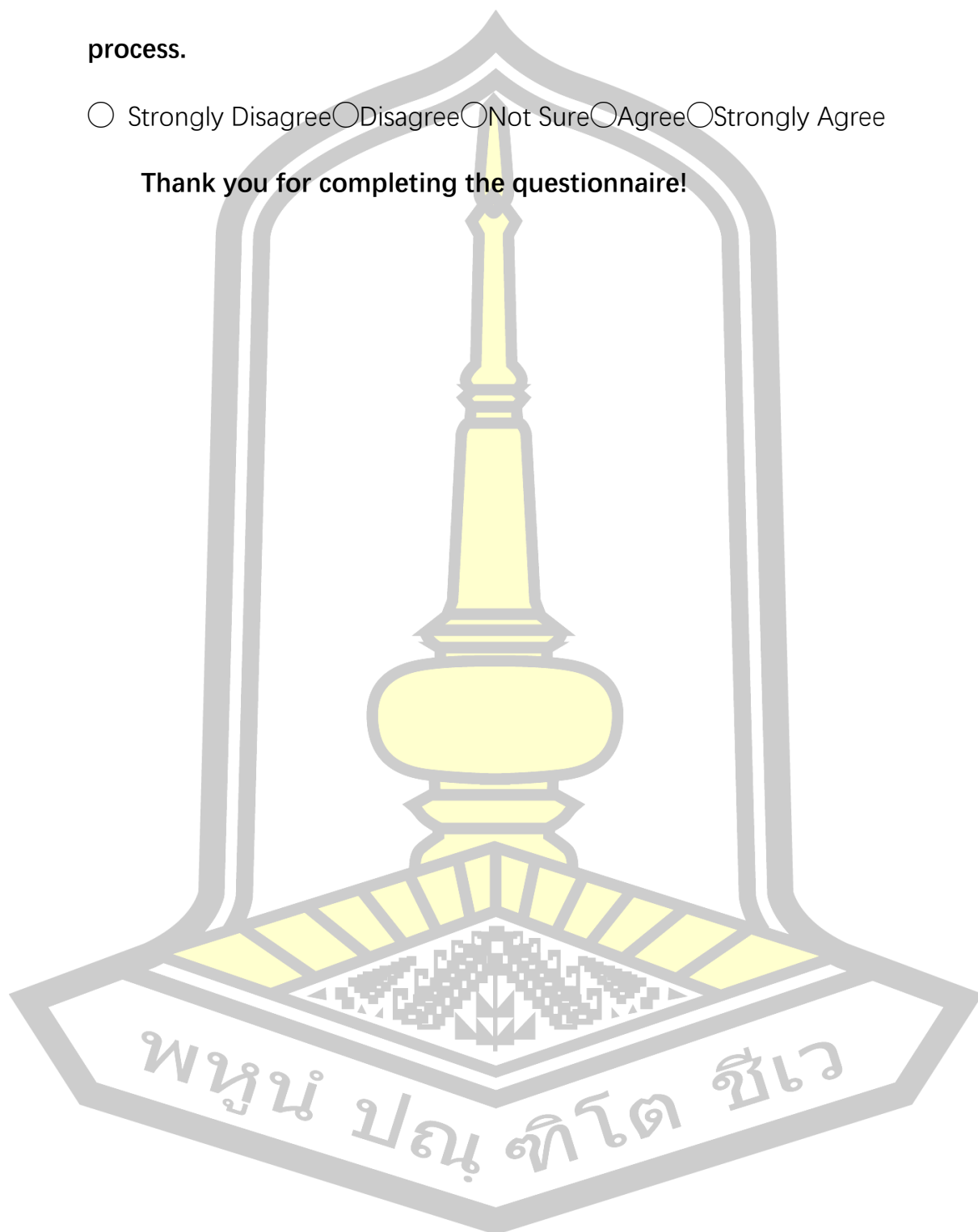
49. I find joy in sharing my creative work with others.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

50. I believe that experiencing failure is a critical part of the creative process.

Strongly Disagree Disagree Not Sure Agree Strongly Agree

Thank you for completing the questionnaire!



The PIPT Teaching Model

1.Principle of the model

1.1 Constructive: The teaching modle is a constructive process in which the elements interact with each other.

This teaching modle relies on constructivist development theory and constructivist learning theory, advocating that the teaching mode is a constructive process of the interaction of all elements, advocating the active constructive nature of student learning, the interactive nature of teaching and the situational nature. The “scaffolding” and contextualization approach to teaching emphasizes, first, that the learner is the center and that the learner is the active constructor of knowledge. Secondly, it emphasizes the guidance of the teacher, who assumes the roles of organizer, guide, and helper in the construction of meaning. Again, it emphasizes the creation of learning environments and learning activity support systems in authentic contexts, and particularly emphasizes interactive and collaborative learning methods.

1.2 Subjectivity: a teaching mode is a learning environment.

Creativity education emphasizes student-centeredness and the cultivation of students' originality and creativity. Creative teaching modle advocates the full play of the subjectivity of the educated, the full release of learning initiative and creativity. It requires in-depth communication, exchange and cooperation between teachers and students, between students and students,

and between teachers and students and the society, and advocates the active participation of students in discussions, debates and even arguments in the teaching process, which helps to cultivate problem-solving ability and creativity of college students in this kind of interactive teaching.

1.3 Problem-oriented: problem-driven learning and creativity.

The teaching model is problem-oriented in designing teaching activities, guiding students to understand and solve “problems” in the process of completing classroom teaching activities. The main reason for these problems is that students are unable to make connections between their previous knowledge and new knowledge. In problem-oriented instructional design, learning activities are driven by urgent problems to be solved, and learners learn content and theories in order to solve problems. Students generate new concepts, knowledge, abilities, behaviors, attitudes and other learning outcomes through a series of cognitive strategies such as thinking, discovery and inquiry in the learning process.

2.Objectives

The objective of the PIPT teaching model is to enhance the creativity of college students. In terms of teaching design, PIPT combines the two processes of creativity, i.e. divergent thinking and convergent thinking, and breaks down the creative process into a series of skills according to the scientific research on creativity, based on the classification framework proposed by Williams, Lucas,

Claxton, and Spencer, focusing on the four dimensions of creativity: imagination, adventurousness, curiosity, and challenge, which are transformed into the following competencies in the teaching process : investigative, imaginative, executive and reflective skills.

2.1 Investigative skills. One of the dimensions of the creative cognitive process is very similar to scientific investigation. Terence emphasizes the importance of identifying different problems, knowledge gaps, knowledge blind spots and factors in the creative process. Because creativity is about finding relevant information, identifying problems, and recognizing that one of the main focuses of the creative process is that there may be different dimensions, creativity cannot occur if there is a lack of knowledge about the relevant field or research problem. Depending on the problem, creativity can take different forms, ranging from human feelings and empathy (possibly from the client) to a more objective way of looking at the different dimensions that may be present to describe and analyze exactly what the potential difficulties and problems are.

2.2 Imagination. Imagination refers to the ability to construct ideas in one's mind and think about those ideas and things. This behavior allows people to break out of the constraints of traditional reality, pursue novel ideas and come up with new stories, plunge into the future, pursue different possibilities, envision counterfactuals, simulate the outcomes of different ideas and solutions, and so on. In the context of creativity, imagination refers to the creation of ideas,

theories, and hypotheses on a whim, according to a certain level of purpose. Imagination can take the form of independently generating multiple ideas or related ideas by viewing realistic or sometimes metaphorical connections. One of the cognitive processes that creativity may involve is the ability to think ideas to the extreme, exploring non-traditional ideas within the safety of reality, or even exploring ideas that seem silly.

2.3 Execution. Creativity refers to creating something novel and applicable based on investigation and imagination. It is a typically amplitudinal or integrative creative process. The product of its creation can take different forms based on different domains: it may be a product, a performance, an idea, a physical or mental model, etc. This means that in order to realize the two main aspects of creativity, it is necessary to sift through the ideas that have already been thought of or investigated, and thus to make a degree of reflection and bold choices. While the product may be related to the final stage of the creative process, the creative process may also involve a process of experimentation and correction of errors, or the development of prototypes and models at various stages of the process.

2.4 Reflective skills. Ultimately, creativity is centered on purpose and reflection. Purpose suggests that creativity is not random innovation, such as the whims of young children. While purpose and reflection vary significantly by age, they also vary according to each individual's creative proficiency. In summary,

reflection is also present at all stages of the creative process, such as when a person decides which ideas to choose and how to move forward with them.

3.Syntax

The PIPT teaching model takes “Problem-Ideation-Prototype-Test” as the teaching process, and by reconstructing the teaching content, activities, context and evaluation, it transforms the creativity development into four teaching phases: Problem Discovery, Program Conceptualization, Production and Execution, and Evaluation and Reflection.

Phase I : Problem discovery. creativity is the highest expression of problem solving, and it is with problem solving at its core that the PIPT model fosters creativity in students. Identifying and defining problems is an indispensable part of the course design process and is the fundamental key to grasping problems. The problem identification stage not only lays a good foundation for the conceptualization stage of the problem solution, but also helps students to establish empathy and discover the essence of the problem through the cultivation of user empathy and problem identification ability, prompting them to explore and solve the problem and realize creativity.

The process of instructional design activities in the problem discovery stage is arranged as follows: first, teachers can start the learning situation analysis through questionnaires and interviews to understand the learners' existing knowledge and experience and skill reserves, learning ability and other

characteristics. Secondly, designing contextual and practical activity themes, setting a certain range of themes, giving students the power of free choice, and stimulating students to think creatively. Third, formulate the learning outcome objectives around the core content and activity themes, design the output forms and activity evaluation rules, and explain them to students. In this process, students need to understand the problem content and activity tasks according to the specific context. By promoting students' perception of tasks and situations, generating empathy, stimulating students' interest in learning, and guiding them to stand in the user's point of view to discover problems and dig into the root causes of problems. Finally, the teacher actively organizes communication and discussion on the activity topic, providing guidance on ideas as learners state and define the problem. Students refine the key problem based on the multiple requirements information analyzed in the previous stage.

Phase2: Ideation: The Ideation phase is a stage in which students actively think of solutions to the problems of the previous phase and provide creative ideas. At this time, the students are the implementers of ideas, the providers of creative ideas, the main body of the activity, the teacher is mainly on the group activities of the students to play the role of organization, arrangement, is the activity of the guide, the student's helper. This stage means that students, on the basis of the discovery of the problem in the first stage, collect multi-faceted inspirations from different sources by carrying out problem

identification, transform the inspirations into ideas through conceptualization, then select the optimal solution, and develop the best idea into a concrete implementation plan with comprehensive considerations. After the previous stage of preparation, students have internalized the problem to be solved. Next, students have to conduct in-depth analysis of the problem in the existing problem context and use learning resources to collect and process the required information, put forward the final hypothesis through group work, and then judge the feasibility of the proposed hypothesis through deductive reasoning, and continue to execute the problem solving by revising the plan if it is not feasible stage until the problem is solved.

The main purpose of this stage is to conceptualize and optimize the design solution under the organization and guidance of the teacher, and then find and develop the best solution to the problem. This phase consists of the following four key steps: first, the teacher organizes brainstorming activities to inspire learners to generate inspiration and ideas, and students brainstorm ideas. Each group carries out unrestricted free association and discussion for the problems defined in the previous stage, continuously generates new ideas, stimulates creative conceptions, and puts forward as many options as possible. Second, the teacher guides the group to explore the problem, and learners analyze the creative ideas generated in the brainstorming at a deeper level, put forward a brief proposal, and form a preliminary solution to the problem through

the group's exchanges and discussions. Third, group members further analyze and discuss, adjust and optimize the design scheme, and determine the optimal solution to the problem solution. Through brainstorming, creative conception, group collaboration, preliminary design, program optimization, determine the optimal solution of the three steps to form a gradual, iterative program conception link, the teacher in this link to organize brainstorming, inspire creativity and encourage design innovation, guide the learners to share the inspiration and conception, to ensure that the group collaborative activities are carried out effectively.

Phase3: Prototype. Practice is an important feature of the Creative Entrepreneurship Program, where students transform ideas into reality through hands-on practice. Through the creation of practical activities, students are guided to use their hands and brains, and ultimately learn to create through activities. This stage is the key part of the practice. The prototype stage is the manifestation of the conceptualization stage, the outward manifestation of the idea or solution, emphasizing rapid prototyping and low precision, focusing on problem solving, verbalizing the idea, and communicating quickly and smoothly with others to explore more possibilities for realizing the idea, thus iterating a more refined prototype. In this phase, members of the group work together to produce the work or test the solution, iterating in a problem-feedback-revision cycle to improve the work/solution. Students are the users of the tools, producers

of the work, and testers of the solution, while the teacher participates as the provider of the tools, the evaluator of the work, and the facilitator of the activity. Students operate and execute according to the identified ideas, and according to the problems during the operation and the task of the activity, they continue to modify and improve the creative ideas, and then enter into the next iteration of the cycle again. Teachers pay attention to the problems of the students in this process, provide timely assistance, maintain or enhance the students' motivation, and provide centralized lectures on the commonly occurring problems.

Phase4: Test. The test and feedback phase is the process of testing and collecting feedback on the prototype developed in the prototype phase, and it is a necessary step to produce results. In this phase, members of the group work together to produce the work or test the solution through a division of labor, iterating in the form of problem-feedback-revision of the solution to make the work/program better and better. Students are the users of the tools, producers of the work, and testers of the solution, while the teacher participates as the provider of the tools, the evaluator of the work, and the facilitator of the activity. Students operate and execute according to the determined ideas, and according to the problems in the operation process and the tasks of the activity, they constantly revise and improve the creative ideas, and enter into the next iteration cycle again. Teachers pay attention to the problems of students in this process, provide timely help, maintain or enhance students' motivation, and provide

centralized explanations for the problems that commonly occur. Commonly used methods include testing on different user groups, questionnaire survey method, interview method and so on. And after the test, through the analysis of the feedback, choose whether the solution is completed or not, if not, according to the feedback information, choose to modify the prototype or generate new ideas, so as to enter the prototype stage or the idea stage, i.e., to enter the next cycle of the iterative process.

4.Social system

Students are the main body of active learning. Teachers are monitors and helpers. PIPT is a learner-centered teaching model. In the whole learning process, students are the main body and teachers should always play the role of "observer guide".

The identity of students as the main body of teaching is embodied in:

- (1) to give full play to the initiative of students in the learning process, to reflect the initiative of students;
- (2) To give students multiple opportunities to apply what they have learned in different situations (to "externalize" knowledge);
- (3) Students should be able to form their understanding of objective things and solutions to practical problems according to the feedback information of their own actions.

Teachers are responsible for guiding and supporting the learning

process during the implementation phase. This may include explaining concepts, providing feedback, motivating students to participate in discussions and activities, and ensuring that students are able to understand and apply what they have learned during the learning process.

5.Principle of Reaction

Teachers observe students performance,give suggestions. use positive reinforcement for boosting their confidence and exchange feedback.

Unlike traditional classroom learning, PIPT emphasizes students' subjectivity and active learning rather than passive acceptance of knowledge taught by teachers.PIPT is based on real-world problems and project-oriented, combined with the teaching objectives of innovation and entrepreneurship courses in colleges , scientifically breaks down the teaching objectives in terms of theory and practice, and puts students in a complex and changeable environment to carry out active and meaningful learning and exploration to improve problem-solving ability and practical hands-on work. The teaching objectives are scientifically decomposed from both theory and practice, putting students in complex and changing environments to conduct active and meaningful learning and inquiry, and improving their problem-solving ability and practical hands-on ability. 4 Steps to Problem-Based Learning. Using the project as a beginning, the very beginning of the teaching task is to complete an innovative entrepreneurial project, the whole teaching process around a project

to start, the teacher will gradually refine the project before the class, the different components of the business plan is divided into different sub-tasks, and each class is centered on different tasks to carry out learning, with the continuation of the teaching, the student's knowledge system is gradually complete, in a collaborative group practice way To complete a series of tasks set, accompanied by the constant guidance and help of the teaching staff, learners gain knowledge, master the corresponding skills, and finally complete the project and write a business plan. In terms of teaching methods, PIPT insists on taking students as the main body and advocates group cooperation in problem solving, and its application in the teaching of innovation and entrepreneurship courses can encourage students to actively participate in problem exploration, cultivate students' information literacy, knowledge construction, problem solving and communication, and other abilities required for innovation and entrepreneurship; in addition, based on real-life contexts, the teacher is able to integrate the problems of innovation and entrepreneurship practice into the classroom teaching, to Breaking the limitations of students' thinking, strengthening inspirational education, expanding students' horizons, and enabling students to obtain more practical knowledge, not only improves students' professional ability and literacy, but also enhances students' comprehensive abilities such as professionalism and independent innovation.

PIPT teaching mode advocates diversified evaluation methods, which

can be applied to the teaching of innovation and entrepreneurship courses to solve the problem that the traditional test paper examination can not fully demonstrate the innovation and entrepreneurship ability of students. PIPT utilizes a variety of evaluation modes and attaches importance to the process evaluation, in the process evaluation, students' online and offline learning, test scores, participation in the discussion, speech performance, etc., are incorporated into the process evaluation content to minimize the proportion of summative evaluation, and the summative evaluation is based on students' mastery of basic knowledge. In the process evaluation, the students' online and offline learning, test scores, participation in discussions, speaking performance, etc. are included in the process evaluation, try to reduce the proportion of summative evaluation, and the summative evaluation is based on the students' mastery of basic knowledge, using a combination of process evaluation and summative evaluation of a variety of evaluation modes, which can relatively objectively and realistically reflect the learning situation of the students and the enhancement of their abilities. By increasing the proportion of learning process assessment in the course assessment, it can effectively combine the students' performance with the performance in the learning process, which is conducive to the implementation of comprehensive assessment and evaluation of students' innovation and entrepreneurship.

6.Support System

Good organization is the key to the implementation of this model. Teachers who are flexible and master methods are needed. The classroom environment should also be suitable for group activities, such as movable desks and chairs and appropriate space. Teachers provide videos, quizzes, guidance, help, a good language environment and relaxed atmosphere, and make suggestions. Students acquire knowledge through self-study and testing, and transform knowledge into skills through participation in activities, cooperation and exchanges.

In order to support active exploration and the construction of meaning, a variety of information resources should be made available to learners during the learning process. However, it is important to be clear that the use of these media and materials is not intended to supplement the teacher's explanations and presentations, but rather to support students' independent learning and collaborative exploration.

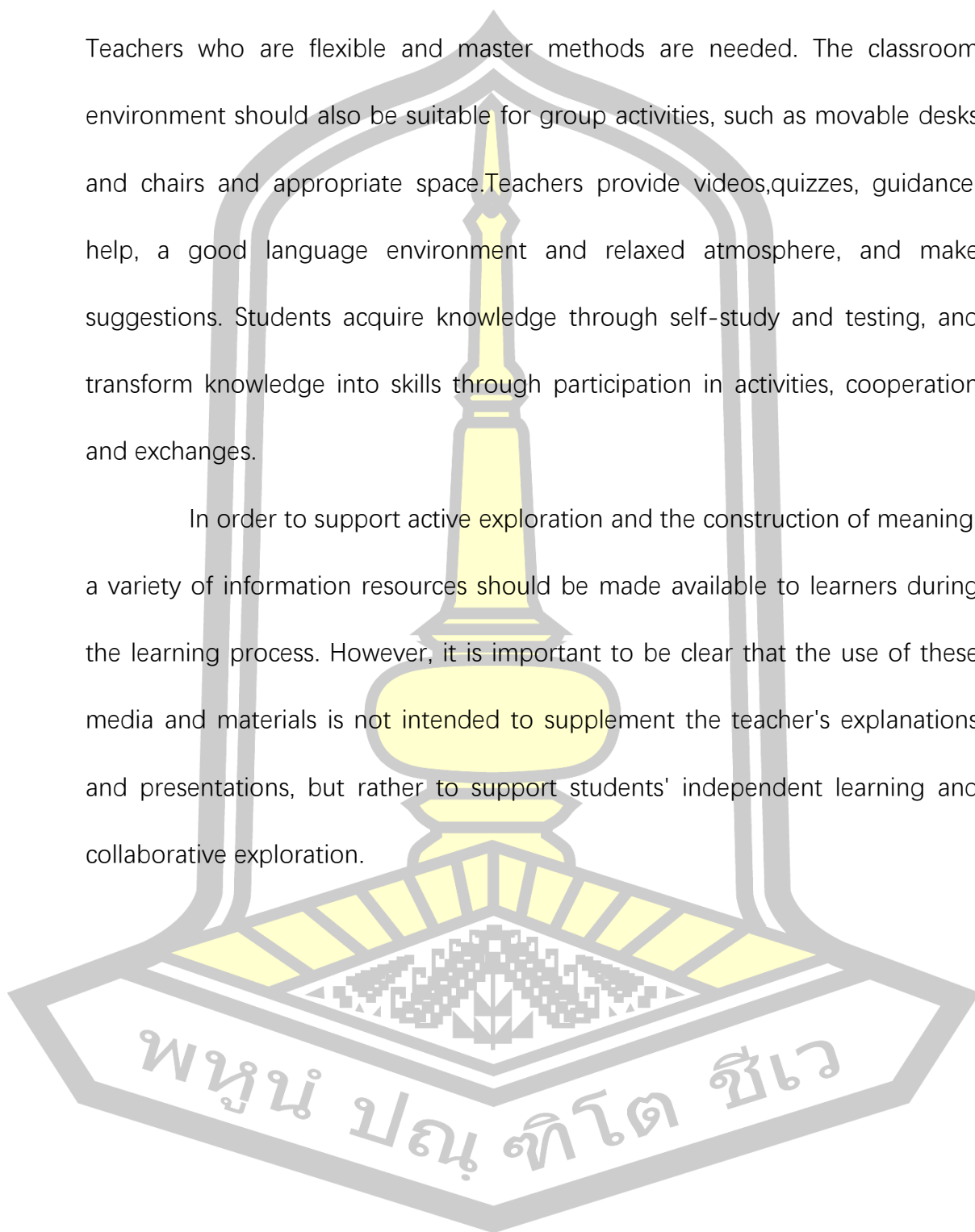
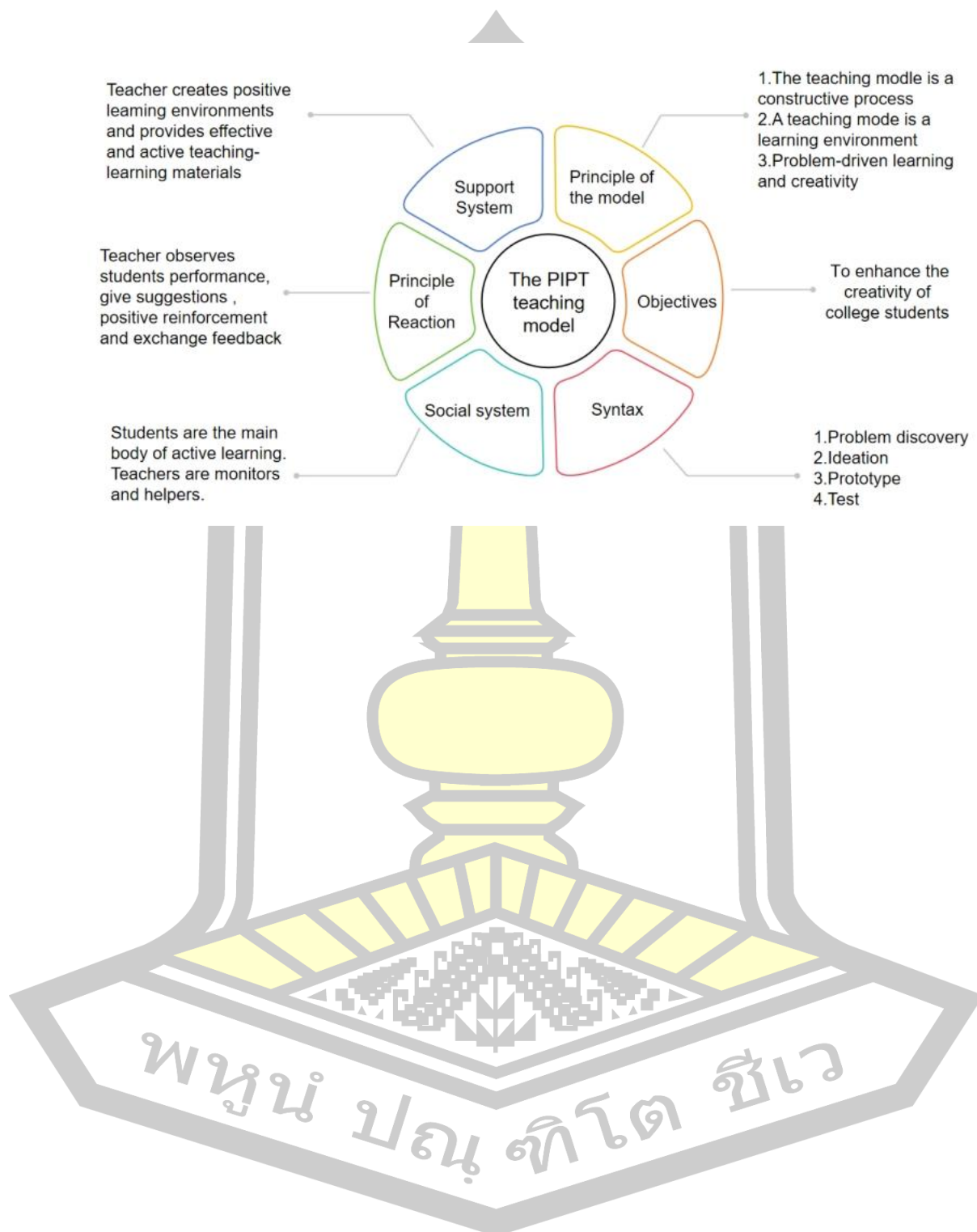


figure 1 The PIPT teaching model



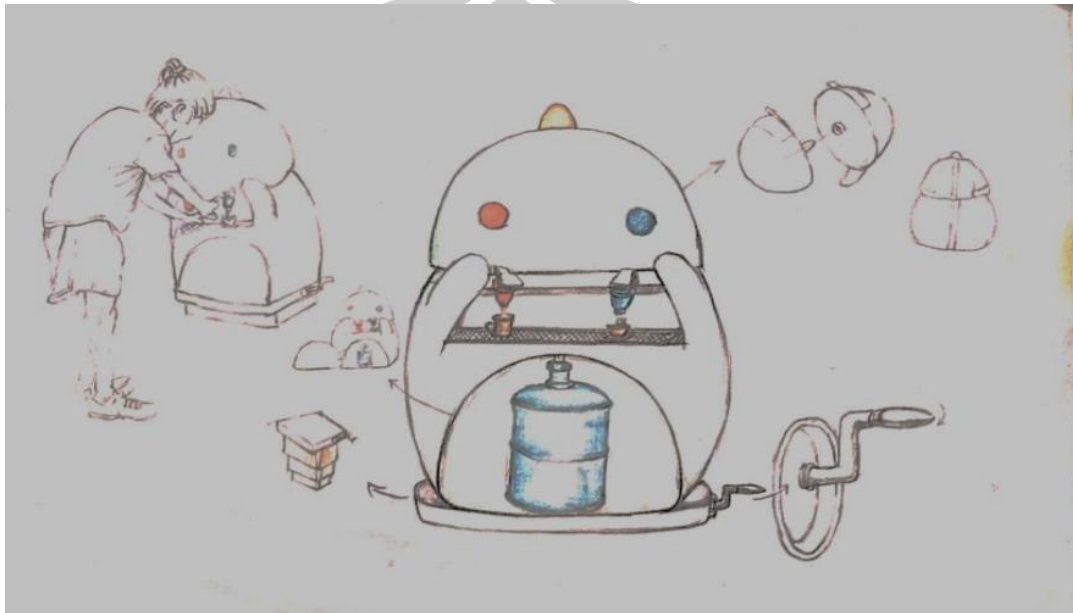
Teaching Model Classroom Practice Materials





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Students' classroom work



Minimum viable product



Patent design drawings

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