

DEVELOPMENT OF PROBLEM-BASED LEARNING INSTRUCTIONAL  
MODEL TO IMPROVE CRITICAL THINKING ABILITY FOR  
UNDERGRADUATE STUDENTS

YE TIANRU

A thesis submitted in partial fulfillment of the requirements for  
the Degree of Doctor of Philosophy Program in Curriculum and Instruction

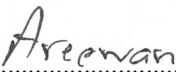
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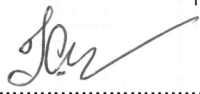
**Thesis Title**                      Development of Problem-Based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students

**Author**                                Mrs.Ye Tianru

**Thesis Committee**


  
..... Chairperson  
(Associate Professor Dr. Areewan Iamsa-ard)


  
..... Committee  
(Assistant Professor Dr. Wapee Kong-in)

  
..... Committee  
(Assistant Professor Dr. Tanaput Chanchaeroen)

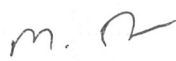
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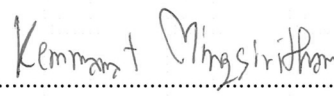
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Title	Development of Problem-Based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students
Author	Ye Tianru
Program	Curriculum and Instruction
Major Advisor	Associate Professor Dr.Areewan Iamsa-ard
Co-advisor	Assistant Professor Dr. Tanaput Chanchaoren
Co-advisor	Assistant Professor Dr. Wapee Kong-in
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## ABSTRACT

The objectives of this research were threefold: 1) to investigate the factors that enhance critical thinking abilities among undergraduate students; 2) to develop a problem-based learning instructional model aimed at improving critical thinking skills in this cohort; and 3) to evaluate the effectiveness of the implemented instructional model in fostering critical thinking. The study was executed in three distinct phases corresponding to each research objective.

In Phase 1, the study population comprised 150 undergraduate students enrolled in the Innovation Training Course at Guangxi Minzu University during the first semester of the 2024 academic year, along with three lecturers responsible for teaching the course. Phase 2 involved the purposive selection of three experts to validate the conformity of the problem-based learning instructional model. In Phase 3, the sample included 50 students enrolled in the Innovation Training Course during the second semester of the same academic year. The research instruments utilized were: 1) questionnaires for students and interview protocols for lecturers; 2) conformity assessment forms for validating the instructional model; 3) lesson plans integrating the problem-based learning model; and 4) scoring rubrics designed to assess critical thinking abilities. Data were analyzed using statistical methods including percentage, mean, and standard deviation.

The research yielded the following results:

1. Two primary factors influencing the critical thinking abilities of undergraduate students were identified: internal factors, including students' positive emotions, learning behaviors, attitudes, and physical health, and external factors, encompassing teaching methods, instructional materials, and the learning environment.

2. The problem-based learning instructional model designed to enhance critical thinking was validated by three experts, achieving 100% conformity with standards of utility, feasibility, propriety, and accuracy. The model was structured around five key components: 1) Principles and Rationale, which involved analyzing the course and students' critical thinking abilities, integrating findings from the first objective; 2) Objectives, derived from the second research objective; 3) Content, informed by the course structure used in the experimental phase; 4) Teaching Methods and Materials, aligned with the problem-based learning model; and 5) Evaluation, conducted using the critical thinking scoring rubric.

3. Post-experiment analysis indicated that 22% of the 50 students achieved an 'excellent' level of critical thinking, 70% attained a 'good' level, and 8% were at a 'fair' level. These outcomes align with the research hypothesis, which predicted that over 80% of participants would demonstrate a good or higher level of critical thinking following the problem-based learning instructional model.

**Keywords:** The Problem-Based Learning Instructional Model, Critical Thinking Ability, Undergraduate Students

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Ye Tianru

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# Chapter 1

## Introduction

### Rationale

Innovation Training Course is the general education compulsory course for undergraduate students' year 2023, in Guangxi Minzu University, provides the students with a survey and case studies of successful innovations that have led to new ventures, their components, strategies and financial structure. The course combines entrepreneurial, strategic, marketing, legal, societal and financial themes in support of innovative businesses and products. The course addresses the design of effective strategies given technological capabilities and competitive markets; and provides tools for the financial analysis that are essential for obtaining venture capital. The course aims to cultivate innovative, compound and application-oriented talents urgently needed by society. It aims to improve students' ability to apply interdisciplinary knowledge, find and solve problems, and cultivate students' entrepreneurial skills, critical thinking and practical ability as the main measures and important means (Guangxi Minzu University, 2024).

Critical thinking is one of the necessary abilities for talents in the twenty-first century. It emphasizes that in the process of learning and problem solving, should constantly reflect, revise, evaluate, and constantly correct existing cognition but the most students had the less in critical thinking ability so I studied many academic educators and found that critical thinking ability into six cognitive abilities, there were: 1) Interpretive ability, 2) Analytical ability 3) Reasoning ability 4) Explanatory ability 5) Evaluation ability and 6) Self-regulation ability.

According to students' problem in critical thinking ability, the researcher studied from textbooks, article paper and research and found that Problem-based learning instructional model can improve critical thinking ability for undergraduate students as follows.

Firstly, problem-based learning emphasizes problem-driven learning. The learning in PBL teaching mode starts with problems and ends with problem-solving, with problems running through the entire teaching process. Students need to independently ask questions, research problems, and find solutions. This process encourages students to think about the essence, causes, and solutions of problems, and cultivates their critical thinking abilities (Hao, 2009).

Secondly, self-directed learning: In PBL, students need to actively collect and organize relevant information on their own and conduct in-depth exploration and analysis. This learning style stimulates students' curiosity and thirst for knowledge, prompting them to engage in critical thinking and evaluate the effectiveness of different viewpoints and evidence (Wang, 2010).

Thirdly, teamwork: PBL encourages students to collaborate in small groups to solve problems. Students need to work together to develop work plans, collaborate, communicate with each other, and critically evaluate their respective perspectives. This collaborative process promotes cognitive collision and debate among students, cultivating critical thinking and teamwork skills (Li, 2008).

Fourthly, reflection and evaluation: In PBL, students need to reflect on their learning process and results and conduct self-evaluation and peer evaluation. This process encourages students to reflect on the effectiveness of their decisions, solutions, and outcomes, and to propose suggestions for improvement. Through reflection and evaluation, students can develop critical thinking and self-reflection abilities (Chen et al., 2013).

The overall process of problem-based learning instructional model and the process of cultivating and improving critical thinking can be consistent and corresponding, and both emphasize the need to focus on learners. In Problem-Based Learning Instructional Model, learners are required to actively explore and solve problems, and the cultivation of critical thinking is even more so. Only when learners actively develop themselves can they truly develop, form or improve.

Therefore, the problem-based learning instructional model is a positive response to the tendency towards critical thinking. Based on this, this article aims to

cultivate critical thinking among college students and observe its impact on critical thinking tendencies on the basis of the PBL teaching model.

As the founder, Barrows (1996) developed a 5-step PBL model to confirm the likelihood of improvements of critical thinking ability for students. He summarized six parts, namely: student-centered; Guided by teachers; Taking cooperation as the main form of learning; Focusing on problems as the focus of learning, as well as diversified ways of self-directed and cooperative learning, encourages students to obtain more information.

Based on previous research, Silver (2004) further refined the teaching process of PBL, viewing the entire teaching process as a cyclic process. He summarized the process of this cycle into seven steps, namely: problem scenario, identifying facts, problem hypotheses, identifying knowledge deficiencies, applying knowledge, summarizing, and evaluating. Teachers first need to present meaningful and continuously evolving problem scenarios to students. Then, students identify the facts in the scenario and start analyzing the problem, setting assumptions for solutions. Next, students enter the most important stage of "identifying knowledge deficiencies". When individuals identify the gap between the required content and existing reserves, the process of knowledge construction begins, Finally, reflect after the knowledge is resolved.

The PBL teaching model focuses on the process of thinking development, promoting the design of teaching activities not only to meet the needs of mastering subject knowledge and applying subject knowledge to solve problems, more importantly, it is important to focus on cultivating critical thinking patterns, ultimately forming teaching processes, and implementing them in specific teaching practices.

As the rationale shown above, the author realizes the importance of studying "Development of Problem-Based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students".

## Research Questions

1. What are the factors affecting critical thinking ability for undergraduate students?
2. Is problem-based learning instructional model to improve critical thinking ability for undergraduate students appropriate for further implementation and how?
3. What are the results of implementing problem-based learning instructional model to improve critical thinking ability for undergraduate students?

## Research Objectives

1. To examine the factors enhancing critical thinking ability for undergraduate students.
2. To develop problem-based learning instructional model to improve critical thinking ability for undergraduate students.
3. To study the result of problem-based learning instructional model to improve critical thinking ability for undergraduate students.

## Research Hypothesis

After implementing problem-based learning instructional model, students' critical thinking ability will be overall improved at 85% (Good Level).

## Scope of the Research

### Population

A total of 100 freshmen from 3 classes of students with different levels of learning achievements, enrolled in Innovation Training Course at Guangxi Minzu University (abbreviation: GXMINU) in semester 1 academic year 2024. Those sections involved the following.

- 50 students in class A
- 50 students in class B
- 50 students in class C

### **The Sample Group**

The 50 students who enrolled in Innovation Training Course from class section B are obtained by cluster random sampling.

### **The Variables**

#### **Independent Variable**

Problem-based learning instructional model

#### **Dependent Variable**

Undergraduate students' critical thinking ability

### **Contents**

According to the critical thinking ability of undergraduate students in this study, the researcher chooses Unit 3 for the experiment.

### **Time**

The duration of the research in the semester 2 academic year, 2024 (From February to July and experiment in classroom in May 2024).

## **Advantages**

To the students: They can effectively combine innovative learning and critical thinking learning is essential. In the long run, with the development of globalization, any competitive market really needs not only talented talents who are proficient in management but can perform well in their own professional fields and have good critical thinking ability.

To the lecturers: They have the new instructional model would be collected, lecturers might improve their Innovation teaching and get students equipped with what they need for their future career development in the global situation.

To the university: It is in line with the current social needs to construct a scientific and practical teaching model for Critical Thinking Ability development. Students' personal growth is the starting point and the foothold of a school's work, and schools should find out reasonable and specific ways and strategies to help students with their personal growth in the long run. In the 21st century, it is of more importance to cultivate students' critical thinking ability, rather than just imparting theory knowledge.



## Definition of Terms

The factors affecting critical thinking ability for undergraduate students refer to the internal and external factors collected from students using questionnaire and interviews for lecturers designed by the researcher. The internal factors include students' positive emotion, positive learning behavior, positive teaching behavior, attitude, and physical health. However, external factors include method of teaching, time, teaching environment and materials. In addition, the factors will be obtained by structured interviews with the lecturers.

**Development of the problem-based learning instructional model** refers to a new instructional framework which consisted of stable teaching activities and procedures (Mcgrath D, 2003). Such a developed instructional model with 5 components: 1) Principle & rationale, 2) Objectives, 3) Contents, 4) Methods of teaching & materials and 5) Evaluation. Meanwhile, the proposed instructional model is were confirmed by the experts in 4 aspects: 1) Utility standards, 2) Feasibility standards, 3) Propriety standards and 4) Accuracy standards (Stufflebeam, 2012) as the follows:

**Utility standards** are intended to ensure that the developed instructional model will serve the information needs of intended users.

**Feasibility standards** are intended to ensure that the developed instructional model will be realistic, prudent, flexible, and frugal.

**Propriety standards** are intended to ensure that the developed instructional model will be conducted in conformity to teaching principles and provide positive results

**Accuracy standards** are intended to ensure that the developed instructional model shows a measure of closeness to a true value.

**Problem-based learning instructional model** refers to a teaching model based on constructivism (MCGRATH, 2003). In the field of education, Chinese scholar Liu (2001) defined that problem-based learning instructional model which is promoting students to learn around a real and concrete problem, and taking this as the learning background, promoting students to master the necessary thinking skills and strategies, and building knowledge. Chinese scholar Li and Shi (2020) defined

that problem-based learning instructional model teaching operation process mainly follows 3 stages.

Step 1: Before the class preparation stage: The role of a teacher is as an organizer. Reasonable grouping and scientific problem design of teachers are the key for this step. Students analyze problems, widely collect data, prepare for discussion, and make PPT for report and display, to cultivate students' ability of autonomous learning and cooperative learning.

Step 2: In the class presentation stage: The role of teacher is as a guide and a demonstrator. Through pre-class self-directed learning and group discussions, students initially come up with solutions to problems and present their results. Students should explain the problem during the group presentation process. Teachers organize discussions and evaluations, guide critical reading of textbook materials, praise and encourage students to discover their own knowledge deficiencies, continue to learn new knowledge independently, and construct knowledge.

Step 3: After class reflection stage: The role of teacher is as a commentator. Students firstly evaluate and summarize the problems in the class, and write a reflection log, including their own gains and shortcomings, and conduct self-calibration and evaluation in time. Besides, the group members evaluate each other, and the teacher gives written evaluation and feedback.

**Critical thinking ability** refers to the ability of individual to observe, interpret, recognize, reason, evaluate, and reflect the questions by means of questioning, acknowledging and testing previously held assumptions, finally make decisions to solve the problems. Critical thinking ability in this study is summarized 4 dimensions: 1) Interpretive ability and analytical ability 2) Reasoning ability 3) Explanatory ability 4) Evaluation ability and self-regulation ability (Yang, 2017).

**Interpretive ability and analytical ability** refers to 2 standards. **Standard 1:** Be able to discover the innovation thinking theory. **Standard 2:** Identify the forms and characteristics of innovative thinking.

**Reasoning ability** refers to 2 standards. **Standard 1:** Be able to using innovative design thinking to design a personal life development plan that you enjoy.

Standard 2: Using the process of design thinking, design a jewelry that can be carried with you.

**Explanatory ability** refers to 2 standards. Standard 1: Ability to describe and define the innovation and entrepreneurship. Standard 2: Display the process of mobile phone innovation through text or graphics.

**Evaluation ability and self-regulation ability** refers to 2 standards. Standard 1: Be able to find personal value of life by using value creation canvas. Standard 2: Be able to evaluate the life value canvas of other members in the group.

**Undergraduate Students** refers to the students who enrolled in Innovation Training Course at Guangxi Minzu University in semester 1 academic year 2024.

**Guangxi Minzu University** refers to the university located in Nanning city, Guangxi Province, which is a first-class discipline construction university in Guangxi. Now the university has 24 teaching colleges, 84 undergraduate majors, 2395 teaching staff, including 1530 full-time teachers, 29,857 full-time students, and more than 50% of the total number of students from ethnic minorities.

## Research Framework

This research is a study of “Development of Problem-based Learning Instructional Model to Enhance Critical Thinking Ability of Undergraduate Students”. The researcher studied the concept of critical thinking ability consisted of 6 dimensions: 1) Interpretive ability, 2) Analytical ability 3) Reasoning ability 4 ) Explanatory ability 5) Evaluation ability and 6) Self-regulation ability (Yang, 2017), analyzed the method of researcher, studied the concept of problem-based learning instructional model to do research framework 4 steps: Step 1: Design problem-based learning tasks; Step 2: Student self-directed learning; Step 3: Group discussion and results presentation; Step 4: Evaluation and revision. (Silver, 2004; Dakabesi & Louise, 2019; Wahdaniyah, Agustini, & Tukiran, 2023; Barrows, 1996; Hmelo-Silver, 2004; Benjamin, 1999; Supianto et al., 2017; Liu, 2022; Li, 2021). For development of problem-based learning instructional model, the researcher studied from Stufflebeam (2012) consisted of 1) Principle & Rationale, 2) Objective, 3) Content,

4) Method of teaching & materials and 5) Evaluation for research framework as shown in figure 1.1.

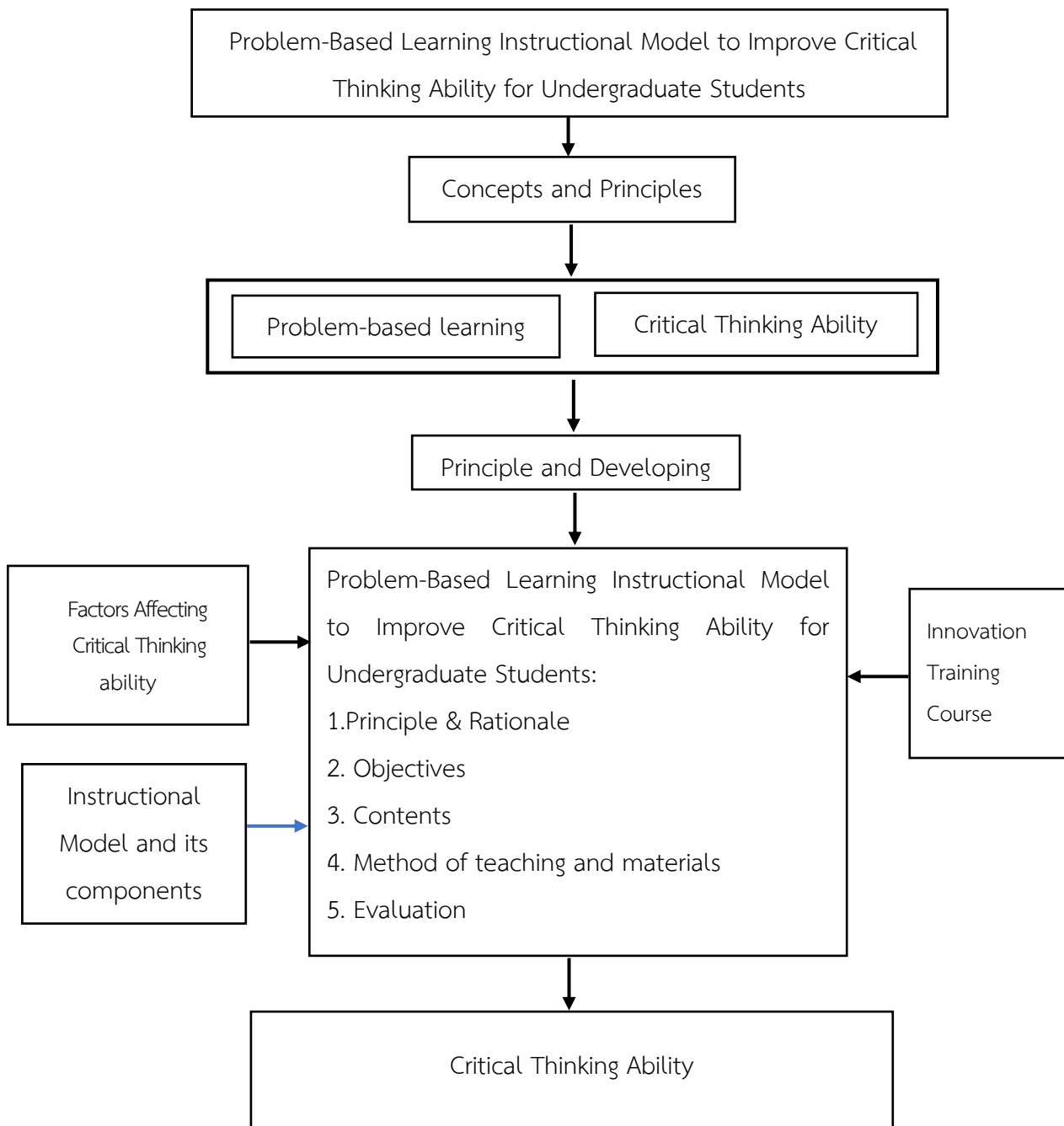


Figure 1.1 Research Framework

## Chapter 2

### Literature Review

In the study of “Development of Problem-Based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students”, the researcher studied the documents concerning the following.

1. Innovation Training Course at Guangxi Minzu University
2. Development of Instructional Model
3. Problem-Based Learning
4. Critical Thinking Ability
5. Related Research

The details are as follows.

#### **Innovation Training Course at Guangxi Minzu University**

##### **Principle**

This course provides the student with a survey and case studies of successful innovations that have led to new ventures, their components, strategies and financial structure. The course combines multiple units such as innovative thinking, entrepreneurship foundation, market research, and college student innovation and entrepreneurship competitions. The main teaching method is group learning and discussion, combined with extracurricular practical activities. It is a compulsory course for innovation and entrepreneurship based on cultivating innovative, compound, and applied talents. The course aims to cultivate innovative, compound and application-oriented talents urgently needed by society. It aims to improve students' ability to apply interdisciplinary knowledge, find and solve problems, and cultivate students' entrepreneurial skills and practical ability as the main measures and important means (Guangxi Minzu University, 2024).

### Objectives of the course

Through the training of full-time undergraduate students in Guangxi Minzu University, the students will become innovative and entrepreneurial talents who have the spirit of innovation and entrepreneurship, master the basic knowledge of innovation and entrepreneurship, and have certain innovation and entrepreneurship capabilities. On this basis, a group of talents with international vision and master the knowledge and skills of innovation and entrepreneurship will be cultivated.

The Innovation Training Course includes 4 units and 32 credit hours:

Creativity stimulation, 2) Team building training, 3) Innovation Principles and Methods, 4) Innovative Design Career. Through the training of full-time undergraduate students in Guangxi Minzu University, the students will become innovative and entrepreneurial talents who have the spirit of innovation and entrepreneurship, master the basic knowledge of innovation and entrepreneurship, and have certain innovation and entrepreneurship capabilities. On this basis, a group of talents with international vision and master the knowledge and skills of innovation and entrepreneurship will be cultivated. Through the teaching of this course, students should acquire the following basic requirements:

Master the basic knowledge required for entrepreneurial activities. Recognize the basic connotation of entrepreneurship and the particularity of entrepreneurial activities, and dialectically recognize and analyze entrepreneurs, entrepreneurial opportunities, entrepreneurial resources, entrepreneurial plans and entrepreneurial projects.

Have the necessary innovation and entrepreneurial ability. Students are able to form teams, integrate entrepreneurial resources, and master the methods of writing business plans. Understand the entrepreneurial process of new enterprises and enhance comprehensive qualities and abilities in innovation and entrepreneurship.

3. Establish a scientific concept of entrepreneurship. Actively adapt to the needs of national economic and social development and people's all-round development, correctly understand the relationship between entrepreneurship and

career development, consciously follow the rules of entrepreneurship, and actively participate in entrepreneurial practice (Guangxi Minzu University, 2024).

### Curriculum Structure

The curriculum structure of Innovation Training Course at Guangxi Minzu University has 4 units and 32 credit hours. This study uses unit 3 of the Market research process as the content of the teaching experiment to critical thinking and problem-solving ability. The curriculum structure of the Innovation Training Course is shown in table 2.1.

**Table 2.1** Chapters and Contents Used in the Present Study

Units	Chapter	Contents	Times 32 hrs.
Unit 1 Creativity stimulation	1.1 Innovation and Entrepreneurship	1.1.1 Entrepreneurship 1.1.2 Entrepreneurship and life development	3 hrs.
	1.2 Innovation and life development	1.2.1 The four major types of innovation 1.2.2 Future personal development plan	
Unit 2 Team building training	2.1 Entrepreneurs	2.11 Entrepreneurs and their awareness, spirit, and motivation 2.1.2 Requirements for the abilities and qualities of entrepreneurs	3 hrs.
	2.2 Entrepreneurial teams	2.2.1 Team building Training 2.2.2 Formation and management of entrepreneurial teams	
Unit 3 Innovation Principles and Methods	3.1 Innovation thinking theory	3.1.1 Innovative thinking and innovative methods 3.1.2 The form of innovative thinking 3.1.3 The main characteristics of innovative thinking	

Table 2.1 (Continued)

Units	Chapter	Contents	Times 32 hrs.
	3.2 Innovative design thinking	3.2.1 Design Thinking Concepts 3.2.2 The connotation of design thinking 3.2.3 The evolution process of design thinking 3.2.4 Design Thinking Model	
	3.3 The Four Major Types of Innovation	3.3.1 The Four Major Types of Innovation 3.3.2 The connotation of innovation 3.3.3 Innovation based entrepreneurship	16 hrs.
	3.4 Innovation and Personal Development	3.4.1 Creating Two Lines in Life 3.4.2 Career Planning vs. Life Creation 3.4.3 Value Creation Tools - Life Value Canvas	
Unit 4 Innovative Design Career	4.1 Recognizing careers 4.2 Career planning 4.3 Career Planning 5-Step Method	4.1.1 Career Concept 4.1.2 Career Choice Theory 4.1.3 career development theory 4.2.1 Career Planning for College Students 4.2.2 Career planning concept based on design thinking 4.3.1 Self-cognition 4.3.2 Career Exploration 4.3.3 Career aspirations 4.3.4 Planning proposal 4.3.5 Career decision	10 hrs.

Unit 3 is chosen by the researcher for implementing the developed model in the present study.



## Development of Instructional Model

### Definition of Instructional Model

There are scholars to define the meaning of definition of Instructional Model as follows:

Joyce (2014) defined a teaching model as a paradigm that refers to a relatively stable, systematic, and theoretical teaching and learning activity based on certain pedagogical ideas and theories of teaching and learning.

Joyce & Weil (1972) defined an instructional model as being a plan or paradigm for setting up a curriculum (a long-term course of study in various disciplines), selecting instructional materials, and directing teaching and learning activities in classrooms and other settings.

Wu (1989) defined an instructional model as the basic structure of various types of instructional activities established in practice for the purpose of designing and organizing instruction under the guidance of a certain pedagogical ideology or theory.

Li (1991) defined a teaching model as a relatively stable, systematic and theoretical teaching paradigm guided by a certain teaching ideology and centered on a certain theme in teaching activities.

He (1997) defined instructional model as a relatively stable framework of teaching activities and the synthesis of activity procedures established under certain teaching ideas and concepts and in a certain teaching environment.

Wu (1989) pointed out that the mode of teaching process, referred to as 'teaching mode', refers to the relatively stable and simplified combination mode and activity procedures designed for the elements of the teaching process to complete the prescribed teaching objectives and contents under the guidance of certain teaching ideas.

From the above definition, it can be concluded that teaching mode refers to a series of teaching paradigms carried out by adopting certain teaching methods and strategies according to specific teaching objectives, teaching contents, teaching objects and teaching environment under the guidance of certain teaching ideas.

### Components of Instructional Model

There are scholars to define the Components of Instructional Model as follows:

Li (1996) contends that instructional model should consist of four components, 1) theoretical basis, 2) functional goal, 3) realization conditions and activity, 4) procedure constitute.

Xu (2012), Joyce (2014) and Ma (2004) contend that instructional model should consist of four components: 1) theoretical basis 2) teaching objectives 3) operating procedures 4) realization conditions or teaching means and strategies and 5) teaching evaluation.

(1) Theoretical basis. It refers to the relevant theories on which the teaching mode depends, which is the "brain" of the whole teaching, determines the direction of the teaching mode, and plays a guiding and leading role for other components.

(2) Teaching objectives. Refers to the expected effect of the teaching mode, but also the teacher in the teaching of students The prediction before the beginning of the movement is the core factor of the teaching mode, which plays a restrictive role in both the operation procedures and the realization conditions and is also the standard and scale of the teaching evaluation.

(3) Operating procedures. Refers to the specific procedures and measures taken by the teaching mode to achieve the results, including How teachers design, how to arrange teaching, how students to carry out learning, and so on, and this is also the most obvious difference between various teaching modes, with significant logic and relative stability.

(4) Implementation conditions. Refers to the teaching mode in order to achieve the teaching objectives, to ensure that the effective play of the function, on It is necessary to optimal combine various conditions, including teachers, students, teaching materials, teaching contents, teaching strategies, teaching methods, teaching management, teaching time and space, and so on.

(5) Teaching evaluation. Refers to the various criteria for judging the teaching mode.

Lou (2018) contends that instructional models consist of six components as follows: 1) teaching object 2) teaching concept 3) teaching objectives 4) selection of teaching materials 5) teaching methods and 6) teaching procedures. The six elements are closely linked and inseparable, and they restrict each other.

From the information above, the instructional model employed in the present study involves 5 components in line with the theories above i.e., principle and rationale, objectives, contents, methods of teaching & materials and evaluation.

### **Confirmatory model**

To ensure the appropriateness of developed instructional model before implementation, the developed instructional model is confirmed depending on program evaluation standards in 4 aspects: 1) Utility standards, 2) Feasibility standards, 3) Propriety standards and 4) Accuracy standards. (Stufflebeam, 2012)

**Utility standards** are intended to ensure that the developed instructional model will serve the information needs of intended users.

**Feasibility standards** are intended to ensure that the developed instructional model will be realistic, prudent, flexible, and frugal.

**Propriety standards** are intended to ensure that the developed instructional model will be conducted in conformity with teaching principles and provide positive results.

**Accuracy standards** are intended to ensure that the developed instructional model shows a measure of closeness to a true value.

## **Problem-Based Learning**

### **Background**

Problem-based learning (PBL) is a learner centered teaching form that encourages students to study and solve problems in a series of real-life situations in order to obtain the best solutions (Kellah, 1996).

The research on Problem-based learning began in 1960 with a group of medical researchers from McMaster University, who used a real problem to drive learning and construct disciplinary knowledge and problem-solving skills (Barrows, 1986).

Problem-based learning is a teaching model based on constructivism. In the field of education, a relatively consistent concept has not yet been determined. However, most scholars agree with the following view: Problem-based learning emphasizes student orientation and should focus on real problem situations throughout the learning process (Mcgrath D, 2003).

### **The definition of Problem-Based Learning**

There are scholars to define the meaning of definition of Problem-Based Learning as follows:

Barrows (1996) defined that problem-based learning can provide students with more opportunities for problem-based collaboration and exploration, rather than simply using problem-based learning as a teaching model. Problem-Based Learning instructional model as six parts, namely: student-centered; guided by teachers; cooperation is the main form of learning; taking problems as the focus of learning and diversified ways of autonomous learning and cooperative learning promote students to obtain more information.

Barbara (1997) defined that problem-based learning is an auxiliary tool that can help teachers guide the classroom. Individuals can help them deal with practical situations through group collaboration and find solutions to cultivate their ability to learn, critical thinking, problem analysis, and information literacy, ultimately facing problems with a critical perspective and attitude.

Colliver (2000) proposed problem-based learning as a teaching approach that organizes students to learn based on actual problem situations. Students need to understand problems, analyze data, and solve problems under the guidance of teachers, and develop individual problem-solving and group collaboration abilities during this stage.

Duch et al. (2001) defined that problem-based learning instructional model as an auxiliary tool that can help teachers guide the classroom. Individuals can help them to deal with practical situations through group cooperation, find solutions, develop the ability to learn to learn, critical thinking, problem analysis and information literacy, and finally face problems with critical eyes and attitudes.

However, researchers hold similar views on the summary and discussion of the characteristics of Problem-Based Learning teaching model.

Zhang (2000) proposed that problem-based learning is a teaching and learning model based on a series of meaningful questions in a learning context. Through a series of real-life questions, individuals can understand the knowledge contained within them. Afterwards, turn them into problem-solving skills one by one.

Liu (2001) defined that the concept of problem-based learning refers to: promoting students to learn around a real and concrete problem, and taking this as the learning background, promoting students to master the necessary thinking skills and strategies, and building knowledge.

Trop and Sage (2002) defined that the problem-based learning model is characterized by: teachers need to prepare in advance, come up with "good" questions, and continue to encourage. In this way, it can individual not be afraid of discussion, and then actively carry out the preset process of identification, analysis and discussion; Teachers should learn to design problem situations in teaching, and guide students to discuss. At the same time, students must have their own position in the preset problem situation.

Silver (2004) defined that problem-based learning is an effective and high-quality teaching method. It revolves around real problems. It is a targeted experiential learning method.

Xie (2007) defined that problem-based learning is a student-centered teaching model based on various real-world problems.

From the definition and views of other scholars above, Problem-Based Learning teaching model in this study refers to: put students in the context of a real problem, carry out daily learning in the way of group cooperation, and analyze, identify and evaluate problems in the process of exploring, so that students can not only understand knowledge-knowledge transfer-knowledge application, and achieve the purpose of forming critical thinking ability and thinking training, and form innovative talents.

## Theory

### Constructivist theory

The constructivist theory was proposed by psychologist Piaget. Piaget studied the process of children's psychological development from the perspectives of cognition and development. He emphasized that children's cognition should be based on their own knowledge reserves and life experiences. Then, by forming relevant things to stimulate the brain, stimulate children to conduct scientific research, and actively try to establish and expand their knowledge framework, improve the existing knowledge system (Zhang, 2021).

After Piaget, many scholars conducted more in-depth exploration and innovation, opening new development content. This is how Vygotsky created the well-known concept of "nearest development zone" from the perspective of social environment. The theories and viewpoints proposed by these scholars have broadened the connotation and extension of constructivist theory, enriched its content, and laid a certain foundation for later and future scholars to conduct teaching experiments (Liang, 2011).

The core of constructivist theory is "student-centered", and the constructivist learning perspective also points out that in daily teaching, students' life experiences and constructed knowledge systems should be taken as prerequisites, and meaning construction and knowledge mastery should be achieved through context, communication, and cooperation. In addition, the most important thing is that individuals must learn to independently construct their own cognitive framework, emphasizing that students should learn on their own and be student-centered in the process of understanding and building knowledge (Zhong & Ye, 2010).

Moreover, the teaching philosophy of constructivist theory once again clarifies the role of teachers in teaching. In the teaching process, the entire classroom, including the teaching section, should be student-centered. Teachers only need to create relevant teaching contexts for students or provide some auxiliary materials or relevant materials and information to help students establish connections with the existing knowledge system, thereby accelerating the speed of students' knowledge construction. At the same time, teachers are also required to make the most of

classroom time, guide students to cooperate and communicate within the classroom, promote students' autonomous learning, and achieve knowledge construction and internalization (He, 1997).

Constructivism also elaborates on four elements in the teaching process, namely: context, cooperation, dialogue, and meaning construction. These four elements are also reflected in the PBL model. The Problem-Based Learning teaching model advocates for learners to analyze and discuss problems through cooperation in actual problem situations, and then gradually acquire new knowledge and build connections between old and new knowledge. In addition, the essence of the development of critical thinking is also the process of meaning construction, and criticism is the foundation of construction (Hu, 2007).

Therefore, this study adopts constructivist learning theory to establish students' dominant position, integrate the process of existing Problem-Based Learning teaching models, inspire students to recall and associate, and utilize existing knowledge and experience to cultivate students' critical thinking abilities. Focus on the development of students' problem-solving thinking processes and thinking abilities to meet the needs of society for the cultivation of critical thinking.

#### **Methods of Teaching Problem-Based Learning (PBL)**

There were academic educators have the step methods of teaching Problem-Based Learning (PBL) as follows:

Barrws (1996) said that there are five steps as follows. First, organize a group; Then, start a new problem - start the problem-solving process - show the results after the solution; finally, reflect. As shown in Table 2.2.

**Table 2.2** Five step model from Barrows

Main processes	Key points
Organize a new group	<ol style="list-style-type: none"> <li>1. Mutual introduction</li> <li>2. Create atmosphere and introduce PBL roles</li> </ol>
Start a new question	<ol style="list-style-type: none"> <li>1. Set questions</li> <li>2. Understand questions</li> <li>3. Describe the product or operation</li> <li>4. Assign tasks</li> <li>5. Deliberate the problem</li> <li>6. Draw up possible results</li> <li>7. Refine and allocate topics</li> <li>8. Determine resources</li> <li>9. Draw up work steps and time limit</li> </ol>
A new round of problem solving	<ol style="list-style-type: none"> <li>1. Discuss the resources used and comment on them.</li> <li>2. Reevaluate the problem.</li> </ol>
Display results	Learners can show their understanding through different forms and tools, such as mathematical analysis, charts, oral reports, drama performances, etc.
Reflect	<ol style="list-style-type: none"> <li>1. Summarize knowledge</li> <li>2. Self-evaluation and group evaluation</li> </ol>

Silver (2004) defined that there are 7 steps as follows:

Step 1: problem scenarios: teachers first need to present meaningful and continuous problem-solving scenarios for students.

Step 2: identifying facts: the students identify the facts in the scene and start analyzing the problem.

Step 3: problem hypotheses: students then set assumptions for the solution.

Step 4: identifying knowledge deficiencies: students enter the most important stage of identifying knowledge deficiencies.



Step 5: applying knowledge: when an individual identifies the gap between the required content and the existing reserves, the process of knowledge construction begins.

Step 6: summarizing: finally summarize after solving the knowledge.

Step 7: evaluating: finally evaluate after solving the knowledge.

Li and Shi (2020) said that there are 3 steps as follows:

Step 1: Before the class preparation stage: The role of a teacher is as an organizer. Reasonable grouping and scientific problem design of teachers are the key for this step. Students analyze problems, widely collect data, prepare for discussion, and make PPT for report and display, to cultivate students' ability of autonomous learning and cooperative learning.

Step 2: In the class presentation stage: The role of teacher is as a guide and a demonstrator. Through pre-class self-directed learning and group discussions, students initially come up with solutions to problems and present their results. Students should explain the problem during the group presentation process. Teachers organize discussions and evaluations, guide critical reading of textbook materials, praise and encourage students to discover their own knowledge deficiencies, continue to learn new knowledge independently, and construct knowledge.

Step 3: After class reflection stage: The role of teacher is as a commentator. Students firstly evaluate and summarize the problems in the class, and write a reflection log, including their own gains and shortcomings, and conduct self-calibration and evaluation in time. Besides, the group members evaluate each other, and the teacher gives written evaluation and feedback.

From above the researcher choose of step of Li and Shi (2020) to teach in this course according to this teaching steps are suitable for the purpose and content of The Innovation Training Course; it is easier to measure students' critical thinking abilities.

## **Roles of Teachers and Students**

### **Roles of teachers**

Compared with the traditional teaching mode, for problem-based learning, teachers are not only the in part of knowledge, but also the promoters, guides and collaborators of students' development.

Teachers are facilitators of student development. In the problem-based learning, teachers need to prepare in advance, come up with questions, and provide continuous encouragement. Only in this way can individuals not be afraid to explore and actively carry out the predetermined activity process of identification, analysis, and discussion (Degama, 2019).

Firstly, teachers design problem scenarios during teaching and guide students to engage in discussions. Teachers need to prepare in advance, come up with a series of related questions, and continuously encourage students. Secondly, teachers encourage students to explore as many solutions as possible and to discuss and collaborate with others to complete problem solutions. Thirdly, when students encounter difficulties in understanding while reading or discussing, teachers should provide teaching materials or lecture notes for the situation. Finally, the teacher checks whether the students are able to achieve the teaching objectives.

### **Roles of students**

In problem-based learning, not only has the role of the teacher changed greatly, but the role of the student has also taken on different meanings. Students are not only learners, but also researchers and collaborators.

Students are collaborators. In problem-based learning, students need to discuss in groups, express their own views and opinions, and exchange ideas and thoughts with other group members. In group discussions and collaborations, students can share their personal professional knowledge and learning experiences, and work together with their team members to solve problems and overcome various difficulties encountered during the process. It is not only beneficial for improving students' learning initiative and self-control, but also promotes the development of good interpersonal relationships among students, enhances their psychological quality, and improves their social skills (Jefriadi et al., 2018).

Firstly, students are grouped according to their learning interests or abilities. In the grouping, each student takes turns reading questions and tries to identify the key points of the questions. Secondly, students discuss and express their respective opinions. Thirdly, students brainstorm and try to connect the knowledge points and learning experiences they have previously learned to find answers to problems. Finally, students share their learning outcomes, explain to each other in the group, record their questions and opinions on others' viewpoints, and report back in the final group presentation.

### **Strengths and weaknesses of problem-based learning**

#### **Strengths of Problem-Based Learning**

The first advantage of Problem Based Learning is that it can enhance students' learning awareness and confidence. The second advantage is that it can improve students' teamwork and communication skills, and the third advantage is that it can help cultivate students' ability to learn independently and solve practical problems. Problem based learning is also beneficial for cultivating students' habit of boldly and confidently presenting personal opinions, which is significantly important in critical thinking ability.

#### **Weaknesses of Problem-Based Learning**

First, the learning community is a narrow sense. Problem Based Learning in the classroom environment, the learning group is mainly limited to students in the classroom, so the thinking of each member of the group is relatively homogenous, and the overall thinking level of the learning group is difficult to reach a higher level, which determines the design of the final problem solution to the innovation level is not high.

Second, Problem Based Learning needs more time for teaching preparation. In the case of students' weak basic knowledge, students need to spend a lot of spare time to prepare materials, which will lead to the increase of learning burden, otherwise, it is difficult to achieve the expected teaching objectives.

## Critical Thinking Ability

### The definition of critical thinking ability

There are scholars to define the meaning of critical thinking ability as follows:

Peter (1990) defined that Dewey, the father of critical thinking teaching, the American Philosophical Association proposed the concept of critical thinking in 1910 includes two parts: emotional tendencies (critical spirit) and cognitive skills (critical skills).

Bailin et al (1999) defined that the process of critical thinking is essentially a problem-solving process, emphasizing the important role of real problem situations in the training process of critical thinking.

Michael (2000) defined that critical thinking is the skillful and dynamic interpretation and evaluation of observations, communication, information, and argumentation.

Wang (2006) defined that critical thinking is a conscious way of evaluating the rationality of a certain belief and behavior.

Gu (2007) explained critical thinking from both broad and narrow perspectives. Essentially, critical thinking is the ability to raise appropriate questions and make reasonable arguments.

Zhu and Lin (2002) defined that critical thinking refers to the intellectual quality of being good at strictly estimating thinking materials and carefully examining the thinking process in thinking activities. It is the degree of independent analysis and criticism in thinking activities, and critical thinking should be a component of problem-solving and creative thinking.

From the definition above, it can be concluded that critical thinking ability is an individual's attitude towards critical thinking, which is a purposeful and self-regulated process of judgment, including interpretation, analysis, evaluation, reasoning, and explanations of evidence, concepts, methods, standards, or all the situations on which judgment is based.

### **The component of critical thinking ability**

Critical Thinking Ability refers to a dynamic development process, which emphasizes that in the process of learning and problem solving, should constantly reflect, revise, evaluate, and constantly correct existing cognition.

There are scholars to define the components of critical thinking ability as follows:

Ennis (1987) defined critical thinking single dimensional structural model, abbreviated called FRISCO for short, the combination of the first letter of 6 English words (Table 2.3). There are six abilities:

**Focus:** refers to the ability of individuals, regardless of their state or the need to solve various problems, to directly address the important points, obtain the important information contained therein, and clarify the reasoning and logical relationships involved.

**Reasons:** refers to describing and explaining one's own argument based on evidence, concepts, methods, standards, and situations, providing evidence and support for the conclusion based on one's own experience or the analysis of others, and proposing a convincing reason.

**Inference:** refers to considering relevant information such as data, statements, principles, and evidence, identifying the reasons for drawing reasonable conclusions, testing whether conclusions and assumptions can be drawn from the given reasons, making the conclusions reliable and guaranteed.

**Situation:** refers to the need to argue or think about a problem in a broad and comprehensive context when conducting critical thinking based on a specific environment. And the entire process includes: first, understanding the information contained in the situation, being able to think about the appropriate level of the problem, and comprehensively considering how individuals with other perspectives benefit and have corresponding advantages.

**Clarity:** refers to understanding and describing the meanings, importance, and roles of professional terms and vocabulary used in various experiences, situations, data, rules, procedures, etc., and then clarifying and expressing the unique meanings of these terms to prevent misunderstandings and confusion.

Overview: refers to examining the various stages of thinking and thinking, and learning to examine and evaluate the logical structure and consistency between each stage, step, and link of the whole, or to verify the truth of what other individuals say in the environment, and to make their own judgment on whether it is feasible.

**Table 2.3** FRISCO single dimension structure model

<b>Six abilities</b>	<b>Description and explanation</b>
Focus	Discover problems, identify key
Reasons	Logical analysis, inspection evidence
Inference	Inspection conclusion
Situation	Consider the problem background, consider different situations
Clarity	Clear terminology, avoid confusion
Overview	Review the process and seek consistency

From Ennis's definition of critical thinking ability and the one-dimensional structural model, it can see that although he affirms that critical thinking has both tendencies and skills, he mainly focuses on skills, and his attention to tendencies is clearly insufficient.

After several rounds of discussion and research, scholars realized that the tendency or temperament of critical thinking also plays a crucial role in a critical thinker and derived the two-dimensional critical thinking structure of Delphi. It is based on two perspectives to consider, measure, and categorize critical thinking, namely cognitive ability and emotional traits (Table 2.4).

**Table 2.4** Two-dimensional structure model

Cognitive skills	Affective dispositions	Affective dispositions
Interpretation	Categorize and understand meaning	Truth-Seeking
Analysis	Analysis and demonstration process	Open-Mindedness
Inference	Challenge and draw conclusions	Analyticity
Explanation	interpretative statement	Systematicity
Evaluation	Evaluation opinions and arguments	Self-Confidence
Self-regulation	Self-assessment	Inquisitiveness

Facione et al (1990) considers, measures, and categorizes critical thinking ability from two dimensions: cognitive ability and emotional traits. In terms of critical thinking cognitive ability, the cognitive dimension of critical thinking is decomposed into six abilities: power: interpretation, analysis, inference, interpretation, evaluation, and self-regulation, with analysis, reasoning, and evaluation as core skills.

Most of the scholars who study critical thinking in China agreed with the two-dimensional structure of critical thinking ability and critical thinking quality. Chinese scholar Liu (2021) believed that critical thinking is composed of critical thinking ability and critical spirit.

Chinese scholar Zhu (2017) summarized that the ability of critical thinking mainly includes the following 6 abilities: 1) Interpretive ability refers to the students understand meaning and clearly define skills, 2) Analytical ability refers to the students analyze and argue issues and opinions, 3) Reasoning ability refers to the students answer the questions and continuously draw conclusions through questioning, 4) Explanatory ability refers to the students explain one's own views clearly and accurately, and to express one's own views when others question them, 5) Evaluation ability refers to the students evaluate, examine, and analyze the opinions and arguments of others, 6) Self-regulation ability refers to the students have a sense of self-reflection throughout the cognitive process and to self-evaluate one's own behavior.

This paper summarizes the definition that critical thinking ability refers to the students can be able to have 6 abilities: 1) Interpretive ability, 2) Analytical ability 3) Reasoning ability 4) Explanatory ability 5) Evaluation ability and 6) Self-regulation ability. We conclude as follow:

1) Interpretive ability refers to the students understanding meaning and clearly defining skills.

2) Analytical ability refers to the students analyzing and arguing issues and opinions.

3) Reasoning ability refers to the students answering the questions and continuously drawing conclusions through questioning.

4) Explanatory ability refers to the students explain one's own views clearly and accurately, and to express one's own views when others question them.

5) Evaluation ability refers to the students evaluate, examine, and analyze the opinions and arguments of others.

6) Self-regulation ability refers to the students having a sense of self-reflection throughout the cognitive process and self-evaluating one's own behavior.

## **Related Research**

### **The assessment tools for critical thinking ability**

Facione and Facione (1990) developed the CCT-DI scale, which measures critical thinking through seven dimensions: truth-seeking, openness, analysis, systematization, self-confidence, thirst for knowledge, and cognitive maturity. This scale, commonly used in research on critical thinking, contains 75 objective questions and is designed to be completed in about 20 minutes using a six-point Likert scale. Evaluation criteria are as follows: a score of 40 or above in any dimension indicates a strong ability in that area, and a total score of 280 or more suggests an overall positive tendency in critical thinking.

Masek (2011) studied a theoretical and empirical review on the impact of problem-based learning on critical thinking skills, including the latest experimental studies from multiple disciplines between 2000 and 2011. The study concluded that, within PBL, students effectively improve their critical thinking skills when engaging



with well-designed questions. However, it also found that experience alone doesn't necessarily indicate whether PBL enhances critical thinking, particularly outside the medical field. Additionally, the research suggests that long-term PBL training is necessary for significant improvement in critical thinking. Factors such as age, gender, academic performance, and educational background may also influence the effectiveness of PBL in developing critical thinking skills.

Nieto (2012) studied *A Study of the Internal Structure of Critical Thinking Dispositions*. The research results the execution of critical thinking depends on a set of skills and dispositions. While skills are widely recognized as the cognitive component of critical thinking, there is less consensus about the nature of dispositions. Most theorists agree that dispositions are a complex construct involving motivations and mental habits, but they provide limited explanations. Nieto's study proposes the "Motivational Genesis of Dispositions" hypothesis, suggesting that dispositions are shaped by both motivation and mental habits, with their relative influence varying based on an individual's practice in critical thinking. Specifically, for those less practiced in critical thinking, motivation plays a larger role, whereas with more practice, mental habits become increasingly influential. Regression analyses in the study support this hypothesis.

Wang et al. (2016) studied about *Research on using problem-solving methods to promote the development of critical thinking - Analysis based on interactive texts and The study found that increased participation in discussions during problem-solving leads to deeper levels of critical thinking*. Internationally recognized methods for cultivating critical thinking include collaborative learning, problem-based learning, questioning, concept maps, and Paul's model. The analysis suggests that well-designed problems, an open and exploratory collaborative learning environment, diverse evaluation feedback, interdisciplinary approaches, and learning scaffolding are effective in promoting students' critical thinking development.

Burris (2017) studied the impact of using problem-based learning in secondary school classrooms on critical thinking and knowledge content learning. This study adopted a quasi-experimental, nonequivalent comparative research method. The study used a quasi-experimental, nonequivalent comparative research method,

involving 140 students divided into two groups: 77 in the PBL experimental group and 63 in the supervised research experimental group. The research involved 12 agricultural teaching teachers selected according to specific standards. The analysis of covariance revealed that the different teaching methods-problem-based learning and supervised learning-significantly influenced both critical thinking abilities and knowledge content learning.

Hussin (2018) studied problem-based learning, which enhances students' critical thinking skills through online tools. The study highlights that critical thinking is a crucial skill for the 21st century, involving a psychological readiness and willingness to critically judge the external world. PBL is regarded as an innovative teaching model that excels in developing students' critical and innovative thinking abilities by placing them in specific problem contexts where they engage in analysis, inference, synthesis, and exploration through both independent and cooperative learning. The research also emphasizes the effectiveness of online tools in teaching and evaluates how these tools can be used to enhance critical thinking within the PBL framework. The study examines previous research on the use of online tools in PBL and identifies the latest trends in using these tools to improve critical thinking skills, underscoring the importance of integrating PBL and online tools for this purpose.

In conclusion, the research studies discussed, particularly those focusing on Problem-Based Learning (PBL). It demonstrates that problem-based learning is an effective way to cultivate students' critical thinking ability. These studies have analyzed various teaching methods and developed online tools to support learning, highlighting the relevance of PBL in the technology era. As a result, researchers have leveraged these findings to design projects that further enhance the effectiveness of teaching and learning.

# Chapter 3

## Research Methodology

This research used Mixed Method of Research. This research is divided into 3 phases.

**Phase 1** was conducted to answer research objective 1: To examine the factors affecting critical thinking ability for undergraduate students.

**Phase 2** was conducted to answer research objective 2: To develop problem-based learning instructional model to improve critical thinking ability for undergraduate students.

**Phase 3** was conducted to answer research objective 3: To study the result of problem-based learning instructional model to improve critical thinking ability for undergraduate students.

The details are as follows.

### **Phase 1: Examination of Factors Affecting Critical Thinking Ability in Undergraduate Students**

#### **Population: Group 1**

The study targeted 150 former students who enrolled in the Innovation Training Course during the first semester of the 2024 academic year. These students were from the English Major of the Foreign Languages Department at Guangxi Minzu University. The population was divided as follows:

Class A: 50 students

Class B: 50 students

Class C: 50 students

#### **Research Instrument**

The primary research instrument was a questionnaire designed specifically for this study.

### Designing the Questionnaire

1. Literature Review: The Innovation Training Course and relevant factors affecting critical thinking ability were studied to inform the questionnaire design.

2. Questionnaire Structure: The questionnaire was designed to assess two main factors: internal factors (5 items) and external factors (5 items) that could improve critical thinking ability. It consisted of three parts:

Part 1: General demographic information of the respondents (N=150).

Part 2: Five items each on internal and external factors affecting critical thinking.

Part 3: Open-ended suggestions for improving critical thinking ability.

3. Expert Review: The draft questionnaire was reviewed by academic advisors for accuracy and completeness.

4. Validity Assessment: The validity of the questionnaire was assessed by three experts (names listed in Appendix A) using the Index of Item-Objective Congruence (IOC) as outlined by Phongsri (2011). The evaluation criteria were:

+1: Content is clearly related to the item.

0: Uncertain if content is related to the item.

-1: Content is not related to the item.

Items with an IOC value of 0.6 or higher were deemed acceptable.

5. Likert Scale Design: A 5-point Likert scale was utilized to measure responses, with the following score criteria:

5: Strongly agree (highest level)

4: Agree (high level)

3: Neutral (medium level)

2: Disagree (low level)

1: Strongly disagree (lowest level)

The mean scores were interpreted using the following criteria from Phongsri (2011):

4.51-5.00: Strongly agree

3.51-4.50: Agree

2.51-3.50: Neutral

1.51-2.50: Disagree

1.00-1.50: Strongly disagree

### **Data Collection**

1. Permission: Official permission was obtained from Guangxi Minzu University to conduct data collection.

2. Survey Administration: Data were collected using Questionnaire Star from 150 students to assess the factors affecting their critical thinking ability.

### **Data Analysis**

Descriptive statistics, including frequency, mean ( $\mu$ ), and standard deviation ( $\sigma$ ), were used to analyze the collected data.

### **Key Informants: Group 2**

#### **Participants**

The study included three lecturers teaching Innovation Training courses at three different colleges within Guangxi Minzu University:

1. Foreign Languages College: 1 lecturer
2. Economics College: 1 lecturer
3. Innovation and Entrepreneurship College: 1 lecturer

### **Research Instrument**

The primary research instrument for this group was an open-ended interview form.

#### **Designing the Interview Instrument**

1. Literature Review: A thorough review of both domestic and international literature was conducted to understand methods of improving critical thinking ability and the factors influencing it for students at Guangxi Minzu University.

2. Drafting the Interview: A draft of 10 open-ended questions was designed, focusing on both internal and external factors affecting critical thinking ability. The interview form was structured as follows:

Part 1: General demographic information of the respondents (N=3).

Part 2: Five questions addressing internal factors and five questions addressing external factors affecting critical thinking.

Part 3: Open-ended section for suggestions.

3. Expert Review: The draft interview questions were reviewed by academic advisors to ensure accuracy and completeness.

4. Validity Assessment: The validity of the open-ended interview questions was evaluated by three experts (names listed in Appendix A) using the Index of Item-Objective Congruence (IOC) as described by Phongsri (2011). The evaluation criteria were:

+1: The content is clearly related to the question.

0: Uncertain if the content is related to the question.

-1: The content is not related to the question.

Questions with an IOC value of 0.6 or higher were considered acceptable.

5. Interview Implementation: The open-ended interviews were conducted with lecturers from the three designated colleges at Guangxi Minzu University. These interviews were designed to elicit in-depth responses and could only be answered by the lecturers.

### **Data Collection**

1. Permission: Official permission was obtained from Guangxi Minzu University to conduct the interviews.

2. Interview Administration: Data were collected from the designated lecturers through video calls, WeChat voice messages, and email, using the developed interview questions.

### **Data Analysis**

The data collected from the interviews were analyzed using qualitative content analysis. Descriptive statistics were used to summarize the findings.

### **Output Phase 1**

Factors affecting internal and external factors to enhance critical thinking ability for undergraduate students in Guangxi Minzu University by table 3.1.

**Table 3.1** Summary how to conduct research from Phase 1

Topics	Details
Research process	Analyzed the internal and external influencing factors from students and lecturers.
Research objective 1	To examine the factors affecting critical thinking ability for undergraduate students.
Conduct research	Designing instrument 1 (The questionnaire for students) Designing instrument 2 (The interview for the lecturers) Assess the validity by 3 experts (List name from Appendix A)
Target group	1. The 150 students of Innovation Training course in the semester 1 academic year 2024 from 3 classes of English Major of Foreign Languages College in Guangxi Minzu University. 2. The lecturers who are teaching Innovation Training course from 3 colleges in Guangxi Minzu University.
Instrument	1. Questionnaire for students Part 1: Common data of the respondent overall. (N=150) Part 2: About internal and External Factors. 5 items of internal factors 5 items of external factors Part 3: Suggestion 2. Interview for the lecturers. Part 1: Common data of the respondent overall. (N=3) Part 2: 10 questions. 5 questions for internal factors. 5 questions for external factors. Part 3: Suggestions
Data analysis	1. Descriptive Statistics, Frequency, Mean ( $\mu$ ), Standard Deviation ( $\sigma$ ) for questionnaires. 2. Content analysis for interview.
Output	The result of the factors to enhance critical thinking ability of undergraduate students. The internal factors consist of students' positive emotions, positive learning behavior, positive teaching behavior, attitude, and physical health. The external factors consist of method of teaching, time, teaching environment and materials.

## **Phase 2: Development of a Problem-Based Learning Instructional Model to Improve Critical Thinking Ability in Undergraduate Students**

### **Research Instrument**

The primary research instrument used was a conformity assessment form designed to evaluate the PBL instructional model in terms of four key standards: accuracy, propriety, feasibility, and utility.

### **Designing the Instrument**

1. Literature Review: The design process began with an in-depth study of related concepts, principles, and processes for developing instructional models. This included analyzing the factors affecting critical thinking ability identified in Phase 1.

2. Instructional Model Development: A comprehensive PBL instructional model was developed, which included stable teaching activities and procedures. The model was structured around five key components:

- Principle & Rationale
- Objectives
- Content
- Methods of Teaching & Materials
- Evaluation

These components were aligned with four evaluation standards:

- Utility Standards
- Feasibility Standards
- Propriety Standards
- Accuracy Standards

3. Questionnaire Design: A questionnaire was developed to confirm the appropriateness of the instructional model, focusing on the four standards mentioned above (accuracy, propriety, feasibility, and utility).

4. Expert Review: The draft questionnaire and the instructional model were presented to academic advisors for review and validation.

5. Validity Assessment: The validity of the questionnaire was assessed by three experts (names listed in Appendix A) using the Index of Item-Objective Congruence (IOC), following the criteria outlined by Phongsri (2011):



+1: Confident that the content measures its objectives

0: Uncertain if the content is related to its objectives

-1: Certain that the content does not measure the objectives

Items with an IOC value of 0.6 or higher were deemed acceptable.

6. Conformity Assessment Form: A conformity assessment form was designed to evaluate the developed PBL instructional model according to the four key standards.

#### **Data Collection**

1. Permission: Permission was obtained to conduct data collection.

2. Data Collection: The appropriateness of the instructional model was assessed by three experts (two from Thailand and one from China; names listed in Appendix A) using the developed conformity assessment form. The evaluation focused on the model's accuracy, propriety, feasibility, and utility standards.

#### **Data Analysis**

Descriptive analysis was conducted using frequency and percentage to summarize the experts' evaluations. Items were considered acceptable if they met a standard of 100% agreement among the experts.

#### **Output Phase 2**

Problem-based learning instructional model the appropriateness of which is confirmed by experts for further implementation shown in table 3.2.

**Table 3.2** Summary how to conduct research from Phase 2

Topics	Details
<b>Research process</b>	Develop problem-based learning instructional model in terms of accuracy standards, propriety standards, feasibility standards, and utility standards.
<b>Research objective 2</b>	To develop problem-based learning instructional model to improve critical thinking ability for undergraduate students.
<b>Research instrument</b>	Designing instrument (the questionnaire for IOC). Designing instrument about the questionnaire on confirming the instructional. Assess the validity by 3 experts (List name in Appendix A).
<b>Target group</b>	3 experts through Item-Objective Congruence (IOC) according to the criteria.
<b>Instrument</b>	Questionnaires The handout for 3 experts through Item-Objective Congruence (IOC)
<b>Data analysis</b>	Descriptive analysis frequency and percentage. The acceptable items must not be less than 100%.
<b>Output</b>	The problem-based learning Instructional model the appropriateness of which is confirmed by experts for further implementation.

**Phase 3 was conducted to answer research objective 3: To study the result of problem-based learning instructional model to improve critical thinking ability for undergraduate students.**

#### **Population**

A total of 150 Sophomore students from 3 classes of students with different levels of learning achievement who enroll in Innovation Training Course at Guangxi Minzu University in semester 1 academic year 2024. Those sections involve the following.

50 students in class A

50 students in class B

50 students in class C

### The Sample Group

The 50 students who enrolled in Innovation Training Course from class section B are obtained by cluster random sampling.

### Research Design

**Table 3.3** Posttest Only Experimental Design

Group	X	T1
Sample Group	Problem-based learning instructional model	Critical thinking ability

X -- Problem-based learning instructional model

T1 -- Critical thinking ability

### Research instruments

1. Lesson plans using Problem-based learning instructional model
2. Rubric scoring form.

### Designing instrument 1 (Lesson plans)

1. Study and design lesson plans with the following components: contents, objectives, methods of teaching, materials and evaluation.

2. Design lesson plans by format given.

3. Present the lesson plan to the advisors for checking correctness, completion and improvement.

4. Assess the validity of the designed lesson plans by 3 experts (List name from Appendix A) through Item-Objective Congruence (IOC) according to the criteria as shown below. (Phongsri, 2011)

+1 = Sure that the contents are related to the topics

0 = Not sure that the contents are related to the topics

-1 = The contents are not related to the topics

The acceptable items must have IOC values not less than 0.6. The IOC calculated from the validation measures 1.00.

5. Conduct a try-out of the developed lessons plans with another group of samples for further improvements and implementation with the sample group.

### **Designing instrument 2 (Rubric scoring form)**

#### **Rubric scoring form**

1. Study the rubric scoring criteria aligned with critical thinking ability.
2. Design 5-point range rubric scoring criteria. (From Appendix D).
3. Present the developed rubric scoring criteria to the advisors for checking correctness, completion and improvement.
4. Assess the validity of the designed rubric scoring criteria by 3 experts (List name from Appendix A) through Item-Objective Congruence (IOC) according to the criteria as shown below. (Phongsri, 2011)

+1 = Sure that the descriptors are related to the issue of assessment

0 = Not sure that the descriptors are related to the issue of assessment

-1 = Sure that the descriptors are not related to the issue of assessment

The acceptable items must have IOC values not less than 0.6. The IOC calculated from the validation measures 1.00.

#### **Data Collection**

1. Ask for permission of data collection from Guangxi Minzu University.
2. Collect students' performance of critical thinking ability by using rubric scoring before assessment by external raters.

#### **Data Analysis**

Categorize students' performance according to rubric scoring criteria into their levels descriptor.

**Table 3.4** Criteria to evaluate 1 Interpretive ability and Analytical ability

Score	Grade
9-10	Excellent
7-8	Good
5-6	Fair
3-4	Poor
Less than 3	Very poor

**Table 3.5** Criteria to evaluate 2 Reasoning ability

Score	Grade
9-10	Excellent
7-8	Good
5-6	Fair
3-4	Poor
Less than 3	Very poor

**Table 3.6** Criteria to evaluate 3 Explanatory abilities

Score	Grade
9-10	Excellent
7-8	Good
5-6	Fair
3-4	Poor
Less than 3	Very poor

**Table 3.7** Criteria to evaluate 4 Evaluation ability and Self-regulation ability

Score	Grade
9-10	Excellent
7-8	Good
5-6	Fair
3-4	Poor
Less than 3	Very poor

**Table 3.8** Criteria to evaluate critical thinking ability

Score	Grade
33-40	Excellent
25-32	Good
17-24	Fair
9-16	Poor
Less than 9	Very poor

### Output Phase 3

The results of implementing problem-based learning instructional model will enhance critical thinking ability of undergraduate students at a level good  $\geq 80\%$  according to rubric scoring criteria into their levels descriptor by table 3.11.

Table 3.9 Summary the process to do in Phase 3

Topics	Details
<b>Research process</b>	Conformity assessment form of lesson plans and rubric scoring in terms.
<b>Research objective 3</b>	To study the results of problem-based learning instructional model to improve critical thinking ability of undergraduate students.
<b>Conduct research</b>	Design handouts and implement teaching in accordance with the principles and steps, goals and contents, teaching methods and evaluation of teaching based on problem-based learning instructional model
<b>The sample group</b>	<ol style="list-style-type: none"> <li>1. The 50 students who enrolled in Innovation Training Course from class section B are obtained by cluster sampling.</li> <li>2. By 3 experts through Item-Objective Congruence (IOC) according to the criteria.</li> </ol>
<b>Instrument</b>	<ol style="list-style-type: none"> <li>1. Lesson plan for 3 experts through Item-Objective Congruence (IOC)</li> <li>2. Rubric score form for 3 experts through Item-Objective Congruence (IOC)</li> </ol>
<b>Data collection</b>	<ol style="list-style-type: none"> <li>1. Ask for permission of data collection.</li> <li>2. Collect students' performance by using rubric scoring before assessment by external raters.</li> </ol>
<b>Data analysis</b>	<p>Categorize students' performance according to rubric scoring criteria into their levels descriptor.</p> <p>Descriptive analysis i.e. frequency and percentage. The critical thinking ability of undergraduate students at a level good <math>\geq 80\%</math>.</p>

# Chapter 4

## Results of Analysis

The purpose of this chapter is to present the results of the study. In the study of “Development of Problem-Based Learning Instructional Model to Improve Critical Thinking Ability of Undergraduate Students”, the researcher studied the documents concerning the following.

**Objective 1:** To examine the factors affecting critical thinking ability of undergraduate students.

**Objective 2:** To develop problem-based learning instructional model to improve critical thinking ability for undergraduate students.

**Objective 3:** To study the result of problem-based learning instructional model to improve critical thinking ability for undergraduate students.

The results of the data analysis will be represented with symbols and meanings, as follows:

N - The population

$\mu$  - Mean

$\sigma$  - Standard Deviation

### Data Analysis Results

**Part 1: Analysis results serving objective 1: To examine the factors affecting critical thinking ability of undergraduate students.**

The common data of the respondents is shown in table 4.1



**Table 4.1** Common data of the respondent in overall (N=150)

Data	Frequency	Percentage
<b>Gender</b>		
A. Male	43	29.00
B. Female	107	71.00
<b>Total</b>	<b>150</b>	<b>100</b>
<b>Age</b>		
A. below 18 yrs.	0	0.00
B. 18-20 yrs.	132	88.00
C. 21-23yrs.	18	12.00
D. over 23 yrs.	0	0.00
<b>Total</b>	<b>150</b>	<b>100</b>

Table 4.1 shows the results of the common data on gender and age for the respondents overall. It shows that the overall gender is mostly female, female accounting for 71% of the total. Male respondents accounted for 29% of the total. This is very consistent with the characteristics of more woman in English Major of Guangxi Minzu University. The age distribution of students is highest in the 18–20-year-old age group at 88%, while the age of students in the 21-23 years old at only 12%. This is also very much in line with the age characteristics of second-year undergraduate students.

**Table 4.2** The result of questionnaire from students in overview (N=150)

Factors	$\mu$	$\sigma$	Level	Ranking
<b>Internal Factor (Students' positive emotion, Positive learning behavior, Positive teaching behavior, Attitude, Students' health)</b>				
1. Do you think if you joy or satisfaction or caring or eagerness in innovation training course can improve your critical thinking ability?	4.27	0.88	High	4
2. Do you think building a trusting relationship between lecturers' students and families in innovation training course can improve your critical thinking ability?	4.11	0.89	High	5
3. Do you think if the lecturers have skills in communication, collaboration, adaptability, empathy and patience make you like to study in innovation training course and can improve your critical thinking ability?	4.43	0.80	High	3
4. Do you think if you have a positive attitude that make you are successful in studying in innovation training course and having good critical thinking ability?	4.60	0.82	The highest	2
5. Do you think if you are well – being, brain, a good health to study in innovation training course, make you improve critical thinking ability?	4.63	0.7	The highest	1
<b>Total Average of Internal factors</b>	<b>4.41</b>	<b>0.82</b>	<b>High</b>	

Table 4.2 (Continued)

Factors	$\mu$	$\sigma$	Level	Ranking
<b>External Factor (Method of teaching, Time, Environment, facilities, infrastructure, Materials)</b>				
6. Do you think if the lecturers have the difference instructional model and verity evaluation to teach in innovation training course can improve students' critical thinking ability?	4.41	0.69	High	3
7. Do you think if the lecturers finish education by major or have the high or experience to teach in innovation training course can improve students' critical thinking ability?	4.39	0.81	High	4
8. Do you think if the students manage the time to study innovation training course both inside and outside the classroom can improve students' critical thinking ability?	4.39	0.82	High	4
9. Do you think that the teaching environment (including class size, classroom environment, facilities, teacher-student interaction, relatively fixed and quiet teaching place) of the innovation training course affects students' critical thinking ability?	4.59	0.63	The highest	1
10. Do you think the good materials that modern and verity to teach in innovation training course have the affecting students' critical thinking ability?	4.55	0.83	The highest	2
<b>Total Average of External Factors</b>	<b>4.47</b>	<b>0.76</b>	<b>High</b>	

The results of table 4.2 indicate that internal factors affecting the students' critical thinking ability for Guangxi Minzu University are found to be at a high level overall ( $\mu=4.41$ ). Considering each item individually, it was found that No.5 has the highest mean ( $\mu=4.63$ ), followed by No.4 ( $\mu=4.60$ ). and the lowest mean is No.2 ( $\mu=4.11$ ).

For external factors affecting critical thinking, the overall level is also found to be at a high level ( $\mu=4.47$ ). Considering each item individually, it was found that No.4 has the highest mean ( $\mu=4.59$ ), followed by No.5 ( $\mu=4.55$ ) and the lowest mean are No.2 and No.3 ( $\mu=4.39$ ).

**Table 4.3** Common data of the respondent in class A. (N=50)

Data	Frequency	Percentage
<b>Gender</b>		
A. Male	12	24.00
B. Female	38	76.00
<b>Total</b>	<b>50</b>	<b>100</b>
<b>Age</b>		
A. below 18 yrs.	0	0.00
B. 18-20 yrs.	41	82.00
C. 21-23yrs.	9	18.00
E. over 23 yrs.	0	0.00
<b>Total</b>	<b>50</b>	<b>100</b>

From table 4.3 the common data of the respondent in overall shows that the most gender is female, accounting for 76.00%. The age distribution of students is highest in the 18-20 years old age, accounting for 82.00%, consistent with the distribution of overall statistics.

**Table 4.4** The result of questionnaire from students in class A. (N=50)

Factors	$\mu$	$\sigma$	Level	Ranking
<b>Internal Factor (Students' positive emotion, Positive learning behavior, Positive teaching behavior, Attitude, Students' health)</b>				
1. Do you think if you joy or satisfaction or caring or eagerness in innovation training course can improve your critical thinking ability?	4.26	0.84	High	4
2. Do you think building a trusting relationship between lecturers' students and families in innovation training course can improve your critical thinking ability?	4.00	0.87	High	5
3. Do you think if the lecturers have skills in communication, collaboration, adaptability, empathy and patience make you like to study in innovation training course and can improve your critical thinking ability?	4.42	0.80	High	3
4. Do you think if you have a positive attitude that make you are successful in studying in innovation training course and having good critical thinking ability?	4.50	0.85	High	2
5. Do you think if you are well – being, brain, a good health to study in innovation training course, make you improve critical thinking ability?	4.56	0.73	The highest	1
<b>Total Average of Internal factors</b>	<b>4.35</b>	<b>0.82</b>	<b>High</b>	
<b>External Factor (Method of teaching, Time, Environment, facilities, infrastructure, Materials)</b>				
6. Do you think if the lecturers have the difference instructional model and verity evaluation to teach in innovation training	4.30	0.70	High	4

Table 4.4 (Continued)

Factors	$\mu$	$\sigma$	Level	Ranking
course can improve students' critical thinking ability?				
7. Do you think if the lecturers finish education by major or have the high or experience to teach in innovation training course can improve students' critical thinking ability?	4.34	0.79	High	3
8. Do you think if the students manage the time to study innovation training course both inside and outside the classroom can improve students' critical thinking ability?	4.26	0.93	High	5
9. Do you think that the teaching environment (including class size, classroom environment, facilities, teacher-student interaction, relatively fixed and quiet teaching place) of the innovation training course affects students' critical thinking ability?	4.60	0.63	The highest	1
10. Do you think the good materials that modern and verity to teach in innovation training course have the affecting students' critical thinking ability?	4.56	0.80	The highest	2
<b>Total Average of External Factors</b>	<b>4.41</b>	<b>0.77</b>	<b>High</b>	

The results of table 4.4 indicates that internal factors affecting the students' critical thinking ability are found to be at a high level overall ( $\mu=4.35$ ). Considering each item individually, it was found that No.5 have the highest mean ( $\mu=4.56$ ), followed by No.4 ( $\mu=4.50$ ). and the lowest mean is No.2 ( $\mu=4.00$ ).

For external factors affecting the critical thinking ability, the overall level is also found to be at a high level ( $\mu=4.41$ ). Considering each item individually, it was found that No.4 has the highest mean ( $\mu=4.60$ ), followed by No.5 ( $\mu=4.56$ ) and the lowest mean is No.3 ( $\mu=4.26$ ).

This data is basically consistent with the results of the total data survey.

**Table 4.5** Common data of the respondent in class B. (N=50)

Data	Frequency	Percentage
<b>Gender</b>		
A. Male	20	40.00
B. Female	30	60.00
<b>Total</b>	<b>50</b>	<b>100</b>
<b>Age</b>		
A. below 18 yrs.	0	0.00
B. 18-20 yrs.	48	96.00
C. 21-23yrs.	2	4.00
E. over 23 yrs.	0	0.00
<b>Total</b>	<b>50</b>	<b>100</b>

From table 4.5 the common data of the respondent in overall shows that females outnumber males, accounting for 60.00%, and male accounting for 40.00%. The age distribution of students is highest in the 18-20 years old age, accounting for 96.00%, consistent with the distribution of overall statistics.

**Table 4.6** The result of questionnaire from students in class B. (N=50)

Factors	$\mu$	$\sigma$	Level	Ranking
<b>Internal Factor (Students' positive emotion, Positive learning behavior, Positive teaching behavior, Attitude, Students' health)</b>				
1. Do you think if you joy or satisfaction or caring or eagerness in innovation training course can improve your critical thinking ability?	4.20	0.89	High	4
2. Do you think building a trusting relationship between lecturers students and families in innovation training course can improve your critical thinking ability?	4.08	0.89	High	5
3. Do you think if the lecturers have skills in communication, collaboration, adaptability, empathy and patience make you like to study in innovation training course and can improve your critical thinking ability?	4.40	0.80	High	3
4. Do you think if you have a positive attitude that make you are successful in studying in innovation training course and having good critical thinking ability?	4.60	0.82	The highest	2
5. Do you think if you are well – being, brain, a good health to study in innovation training course, make you improve critical thinking ability?	4.64	0.69	The highest	1
<b>Total Average of Internal factors</b>	<b>4.38</b>	<b>0.82</b>	<b>High</b>	
<b>External Factor (Method of teaching, Time, Environment, facilities, infrastructure, Materials)</b>				
6. Do you think if the lecturers have the difference instructional model and verity	4.40	0.69	High	3



Table 4.6 (Continued)

Factors	$\mu$	$\sigma$	Level	Ranking
evaluation to teach in innovation training course can improve students' critical thinking ability?				
7. Do you think if the lecturers finish education by major or have the high or experience to teach in innovation training course can improve students' critical thinking ability?	4.36	0.82	High	5
8. Do you think if the students manage the time to study innovation training course both inside and outside the classroom can improve students' critical thinking ability?	4.38	0.82	High	4
9. Do you think that the teaching environment (including class size, classroom environment, facilities, teacher-student interaction, relatively fixed and quiet teaching place) of the innovation training course affects students' critical thinking ability?	4.56	0.64	The highest	1
10. Do you think the good materials that modern and verity to teach in innovation training course have the affecting students' critical thinking ability?	4.52	0.83	The highest	2
<b>Total Average of External Factors</b>	<b>4.44</b>	<b>0.76</b>	<b>High</b>	

The results of table 4.6 indicates that internal factors affecting the critical thinking ability are found to be at a high level overall ( $\mu=4.38$ ). Considering each item individually, it was found that No.5 have the highest mean ( $\mu=4.64$ ), followed by No.4 ( $\mu=4.60$ ), while the lowest mean is No.2 ( $\mu=4.08$ ).

For external factors affecting the critical thinking ability, the overall level is also found to be at a high level ( $\mu=4.44$ ). Considering each item individually, it was found that No.4 has the highest mean ( $\mu=4.56$ ), followed by No.2 ( $\mu=4.52$ ), while the lowest mean is No.2 ( $\mu=4.36$ ). This data is basically consistent with the results of the total data survey.

**Table 4.7** Common data of the respondent in class C. (N=50)

Data	Frequency	Percentage
<b>Gender</b>		
A. Male	11	22.00
B. Female	39	78.00
<b>Total</b>	<b>50</b>	<b>100</b>
<b>Age</b>		
A. below 18 yrs.	0	0.00
B. 18-20 yrs.	43	86.00
C. 21-23yrs.	7	14.00
E. over 23 yrs.	0	0.00
<b>Total</b>	<b>50</b>	<b>100</b>

From table 4.7 the common data of the respondent in overall shows that there were 39 females students, accounting for 78.00%, and 11 male students, accounting for 22.00%. The age distribution of students is highest in the 21-23 years old age, accounting for 86.00%, consistent with the distribution of overall statistics.

**Table 4.8** The result of questionnaire from students in class C. (N=50)

Factors	$\mu$	$\sigma$	Level	Ranking
<b>Internal Factor (Students' positive emotion, Positive learning behavior, Positive teaching behavior, Attitude, Students' health)</b>				
1. Do you think if you joy or satisfaction or caring or eagerness in innovation training course can improve your critical thinking ability?	4.34	0.91	High	4
2. Do you think building a trusting relationship between lecturers students and families in innovation training course can improve your critical thinking ability?	4.26	0.89	High	5
3. Do you think if the lecturers have skills in communication, collaboration, adaptability, empathy and patience make you like to study in innovation training course and can improve your critical thinking ability?	4.48	0.81	High	3
4. Do you think if you have a positive attitude that make you are successful in studying in innovation training course and having good critical thinking ability?	4.70	0.75	The highest	1
5. Do you think if you are well – being, brain , a good health to study in innovation training course , make you improve critical thinking ability?	4.68	0.68	The highest	2
<b>Total Average of Internal factors</b>	<b>4.49</b>	<b>0.80</b>	<b>High</b>	
<b>External Factor (Method of teaching, Time, Environment, facilities, infrastructure, Materials)</b>				
6. Do you think if the lecturers have the difference instructional model and verity	4.52	0.67	The highest	4

Table 4.8 (Continued)

Factors	$\mu$	$\sigma$	Level	Ranking
evaluation to teach in innovation training course can improve students' critical thinking ability?				
7. Do you think if the lecturers finish education by major or have the high or experience to teach in innovation training course can improve students' critical thinking ability?	4.48	0.81	High	5
8. Do you think if the students manage the time to study innovation training course both inside and outside the classroom can improve students' critical thinking ability?	4.54	0.67	The highest	3
9. Do you think that the teaching environment (including class size, classroom environment, facilities, teacher-student interaction, relatively fixed and quiet teaching place) of the innovation training course affects students' critical thinking ability?	4.60	0.63	The highest	1
10. Do you think the good materials that modern and verity to teach in innovation training course have the affecting students' critical thinking ability?	4.58	0.85	The highest	2
<b>Total Average of External Factors</b>	<b>4.54</b>	<b>0.73</b>	<b>The highest</b>	

The results of table 4.8 indicates that internal factors affecting critical thinking ability are found to be at a high level overall ( $\mu=4.49$ ). Considering each item individually, it was found that No.4 have the highest mean ( $\mu=4.70$ ), followed by No.5 ( $\mu=4.68$ ), while the lowest mean is No.2 ( $\mu=4.26$ ).

For external factors affecting the students' critical thinking ability for Guangxi Minzu University, the overall level is also found to be at a high level ( $\mu=4.54$ ). Considering each item individually, it was found that No.4 has the highest mean ( $\mu=4.60$ ) followed by No.5 ( $\mu=4.58$ ), while the lowest mean is No.2 ( $\mu=4.48$ ). This data is basically consistent with the results of the total data survey.

The Lecturers Interview analysis results

The interviews include three lecturers who taught the Innovation Training Course in Guangxi Minzu University in 1st semester of 2024 academic year. One lecturer is from **Foreign Languages** in Guangxi Minzu University, one lecturer is from **Economics** college in Guangxi Minzu University, one lecturer is from Innovation and Entrepreneurship College in Guangxi Minzu University. The common data of the respondents are shown in table 4.9.

**Table 4.9** Common data of the respondent in Guangxi Minzu University. (N=3)

Data	Frequency	Percentage
<b>Gender</b>		
A. Male	1	33.30
B. Female	2	66.70
<b>Total</b>	<b>3</b>	<b>100</b>
<b>Teaching experience</b>		
A. Below 3 yrs.	0	0.00
B. 3-6 yrs.	0	0.00
C.7- 9 yrs.	1	33.30
D. Over 9 yrs.	2	66.70
<b>Total</b>	<b>3</b>	<b>100</b>
<b>Age</b>		
A. below 25yrs	0	0.00
B. 25-35yrs	1	33.30
C. 35 -49yrs	2	66.70
D. Over 49 yrs.	0	0.00
<b>Total</b>	<b>3</b>	<b>100</b>

Table 4.9 (Continued)

Data	Frequency	Percentage
<b>Professional title</b>		
A. Professor	0	0.00
B. Associate Professor	2	66.70
C. Assistant Professor	0	0.00
D. Lecturer	1	33.30
<b>Total</b>	<b>3</b>	<b>100</b>

From table 4.9, the common data of the lecturers shows that the most common gender is female, accounting for 66.70% of the respondents, while male accounting for 33.30%.

In terms of teaching experience, the most teaching experience falls in the range of above 9 years, making up 66.70%. In terms of the age of teachers, the most age is in the range of 35 -49 years old, making up 66.7%. In terms of professional title, associate professor accounting for 66.70% and lecturer accounting for 33.30%. It can also be seen that the interviewees are experienced and representative.

#### **Interview Lecturers Results**

After interviews with three lecturers, the factors that affect critical thinking ability of undergraduate students are summarized as follows.

#### **Internal Factors**

##### **Students' positive emotion**

Students' positive emotion factors include students' joy and eagerness for the course, and their ability to feel happy, satisfied, or eager during the course learning. The lecturers believe that positive emotions among students include their love and expectations for the course, and that they can feel happy, satisfied, or eager during course learning, which can stimulate their interest and motivation and have a positive impact on the improvement of their critical thinking.

Secondly, positive emotions of students also include their confidence in themselves. Students have confidence in their abilities and knowledge, believing that

they can overcome difficulties and achieve good grades. This kind of confidence can help students overcome setbacks and maintain a positive state. Moreover, confident students are more willing to express their opinions and stimulate their creativity.

Thirdly, positive emotions of students also can control their emotions and behaviors, preventing themselves from being affected by emotional fluctuations. Students can control their energy and attention, actively participate in classroom discussions and independent thinking, and avoid distractions and wasting time.

#### **Positive learning behavior**

The lecturers believe that positive learning behavior includes establishing trust relationships between lecturers, students, and families, as well as the positive thinking patterns. First of all, building trust with teachers and family during the learning process can make students feel confident. At the same time, maintaining good relationships with others enables students to respect others, be willing to help others, and cooperate with others. This kind of good interpersonal relationship can help students establish trust and common goals, and improve learning and work efficiency. Moreover, students adopt a positive mindset to learn the course, focusing on the benefits rather than the drawbacks of the problem, and seeking ways to solve it. Students will not fall into negative thinking patterns, but take positive actions.

#### **Positive teaching behavior**

The lecturers believe that when teachers have skills in communication, collaboration, adaptability, empathy, and patience, they will guide students to actively participate in classroom activities, actively engage in group discussions, and enable students to proactively identify and solve problems encountered in learning, thereby improving their critical thinking abilities. Secondly, teachers encourage interaction and cooperation among students, as well as exploring and challenging innovative thinking together, in order to find the best solutions. The lecturers stated that when teachers demonstrate skills in communication, collaboration, adaptability, empathy, and patience, students will also be more interested in learning the course and propose updated and more comprehensive perspectives, which will help improve their critical thinking abilities.

### **Attitude**

Attitude includes two aspects, one is the positive attitude of students for learning course. The other one is the positive attitude of teachers for course teaching.

The lecturers believe that students have a positive attitude and interests for course learning, can make them willing to learn new knowledge, actively participate in group discussions, think actively, and solve problems. Students are not only willing to accept new knowledge and skills, but also adept at applying these knowledge to solve problems.

On the other hand, when teachers demonstrate positive personal enthusiasm and enthusiasm for teaching in the curriculum, they will guide students to pay attention to multiple aspects of the problem in a more vivid and interesting way, and propose deeper and more comprehensive perspectives, which will help improve students' critical thinking ability.

### **Physical health**

Physical health includes students have well-being, brain and good health to study in course. Healthy students are better able to concentrate and maintain energy to study and think about problems. The lecturers said that when students have a good physical, mental, and health condition, they can better cope with challenges and fully unleash their potential. Students can improve their learning motivation and efficiency, actively learn and think about problems, which helps to enhance their critical thinking abilities.

### **External Factor**

#### **Method of teaching**

In the interview, the lecturer mentioned that there have been continuous reforms in the teaching methods of Innovation Training Courses in recent years. Teachers pay attention to using various forms of teaching methods and begin to focus on student participation and teacher-student interaction. Using multimedia technology, they apply various interactive teaching methods such as case sharing, group discussion, case analysis, brainstorming, role-playing, and game experience to innovative training courses.



The lecturers mentioned that most teachers still adopt the traditional classroom teaching form, with the teacher as the center and self directing and self performing teaching content. Students passively receive theoretical knowledge, which is difficult to stimulate their enthusiasm and interest in course learning, and also difficult to improve their critical thinking and innovative thinking abilities.

### **Time**

The lecturers consistently agreed that time is a key factor affecting students' critical thinking ability. If the students manage the time to study Innovation Training course both inside and outside the classroom can improve students' critical thinking ability. The lecturers believed that sufficient time is significantly important for the course of innovation training methods because it requires more time to practice which applying critical thinking to solve practical problems. Students need spend more time on practice and enhance critical thinking ability.

### **Teaching environment**

In the Innovation Training course, a open, positive and interactive teaching environment is essential to improve students' critical thinking skills. In terms of class size, small class teaching should be adopted, with no more than 30 students in each class, to ensure that each student has more opportunities to participate in classroom discussions, and teachers can provide personalized teaching for students. At the same time, the classroom should have modern teaching equipment that can provide students with online learning and interaction with teachers, allowing teachers to receive timely teaching feedback and evaluations. A good classroom atmosphere can stimulate students' interest in learning, encourage them to think independently and actively.

### **Materials**

In the interview, the lecturer mentioned that teachers tend to increase and optimize online course teaching resources, select some high-quality course online resources as part of theoretical teaching content, improve course learning effectiveness, and enrich students' learning experience. In addition to optimizing the current offline teaching content, teachers should increase online teaching content

and students' online self-learning class hours, with offline teacher teaching as the main focus and online student self-learning as a supplement for teaching activities.

The teaching materials commonly used by teachers, such as textbooks, corporate report, online innovation and entrepreneurship competitions, and entrepreneurship training simulations, help students apply critical thinking skills to conduct market research and analysis, write market research reports and business plans, and teach students how to discover, analyze, and solve problems, preparing them for future employment.

After analyzing data collected from both groups of informants, the researcher synthesizes those factors dividing them into 2 main types - internal and external factors as shown in table 4.10 below.

**Table 4.10** Summary of factors affecting critical thinking ability for undergraduate students

Students' opinion		Lecturers' opinion		Synthesized opinion	
Internal Factors	External Factors	Internal Factors	External Factors	Internal Factors	External Factors
1) Students believe that critical thinking ability is useful for personal development and future challenges. Students' positive emotion and positive learning behavior affect students' learning motivation and learning effect.	1) Students believe that the use of various teaching methods such as case analysis, role playing, competition simulation and group discussion can stimulate students' interest in learning and promote the development of students' critical thinking ability.	1) Lecturers believe that students' positive emotions can stimulate their enthusiasm for learning, and good emotions have a positive effect on cultivating critical thinking abilities.	1) Lecturers believe when teaching innovative thinking methods, we can draw on the latest achievements of innovation education in developed countries and add innovative teaching methods such as mind maps, "5W2H method", "Six Thinking Hats", and "TRIZ".	1) Students' positive emotion: Both teachers and students agree that students' joy and eagerness for the course, and their ability to feel happy, satisfied, or eager during the course learning.	1) Method of teaching: Both teachers and students agree that using various forms of teaching methods which can improve student participation and improve their critical thinking and innovative thinking abilities.

Table 4.10 (Continued)

Students' opinion		Lecturers' opinion		Synthesized opinion	
Internal Factors	External Factors	Internal Factors	External Factors	Internal Factors	External Factors
2)Students believe that participating in group discussions and creating mind maps in the classroom can help them better understand and master new knowledge, thereby improving their critical thinking abilities.	2)Students believe that learning innovation training courses requires spending more time practicing and practicing. In addition to classroom learning time, they also need more time for group discussions, simulation training, and social practice.	2)Maintaining a good relationship between students and teachers can make students confident, respect others, be willing to help others, and cooperate with others.	2) The lecturers believe that encouraging students to spend time participating in extracurricular practical activities, including organizing them to study in entrepreneurial enterprises and conducting social research activities during winter and summer vacations,	2)Positive learning behavior: Both teachers and students agree that building trust with teachers and family during the learning process can make students feel confident, and help students to respect others, be willing to help others, and cooperate with others.	2)Time: Both teachers and students agree that the students manage the time to study Innovation Training course both inside and outside the classroom can improve students' critical thinking ability. Students need spend more time on practice and enhance critical

Table 4.10 (Continued)

Students' opinion		Lecturers' opinion		Synthesized opinion	
Internal Factors	External Factors	Internal Factors	External Factors	Internal Factors	External Factors
			can help exercise students' critical thinking abilities.		thinking ability.
3) Students believe that if the lectures possesses skills in communication, collaboration, adaptability, empathy, and patience, it can make students enjoy participating in course learning.	3)Students believe that an appropriate class size, relaxed classroom atmosphere, and well-equipped digital teaching equipment can help students participate in classroom discussions and express their own	3)The positive emotions of teachers and their reserve of professional knowledge and theory can also affect the learning enthusiasm and effectiveness of students.	3)The lecturers believe that a good teaching environment such as small class teaching and multimedia classrooms can enable students to actively participate in group discussions and express personal opinions,	3)Positive teaching behavior: Both teachers and students agree that teachers have skills in communication, collaboration, adaptability, empathy, and patience, they will guide students to actively participate	3)Teaching environment: Both teachers and students agree that a open, positive and interactive teaching environment is essential to improve students' critical thinking skills. a good teaching environment such as

Table 4.10 (Continued)

Students' opinion		Lecturers' opinion		Synthesized opinion	
Internal Factors	External Factors	Internal Factors	External Factors	Internal Factors	External Factors
	opinions.		which is helpful for exercising their thinking patterns.	in classroom activities, actively engage in group discussions, and enable students to proactively identify and solve problems encountered in learning.	small class teaching and multimedia classrooms can enable students to actively participate in group discussions and express personal opinions, which is helpful for exercising their thinking patterns.
4)Students believe that participating in group discussions and creating mind	4)Students believe that teachers use rich teaching resources, such as	4)The lecturers believe that the cultivation and application of critical	4)The lecturers believe that integrating online and offline	4)Attitude: Both teachers and students agree that attitude includes	4)Materials: Both teachers and students agree that diversified teaching

Table 4.10 (Continued)

Students' opinion		Lecturers' opinion		Synthesized opinion	
Internal Factors	External Factors	Internal Factors	External Factors	Internal Factors	External Factors
maps in the classroom can help them better understand and master new knowledge, thereby improving their critical thinking abilities.	digital teaching platforms and online teaching videos, to enable students to learn diverse courses and improve their critical thinking abilities.	thinking skills are of great help to the personal qualities and abilities of students, as well as their future employment development.	innovation and entrepreneurship course resources, as well as utilizing educational resources both on and off campus, to build a batch of school enterprise cooperation practice platforms, can help improve students' critical thinking ability and enable	two aspects, one is the positive attitude of students for learning course. The other one is the positive attitude of teachers for course teaching.	resources can meet the diverse learning needs of students, make their learning content more diverse, help improve course learning effectiveness, and enrich their learning experience.

Table 4.10 (Continued)

Students' opinion		Lecturers' opinion		Synthesized opinion	
Internal Factors	External Factors	Internal Factors	External Factors	Internal Factors	External Factors
			them to participate in practical training activities.		
5)Students believe that having good physical fitness can help them concentrate better on learning and use critical thinking clearly to think critically about problems.		5)Physical fitness is an important factor affecting the learning curriculum. Without good physical conditions and flexible thinking patterns, it is impossible to complete innovative training.		5)Physical health: Both teachers and students agree that students have well-being, brain and good health to study in course which can concentrate and maintain energy to study and think about problems.	



From table 4.10 shows that the both student and teacher respondents unanimously agree that internal and external factors together influence the development of critical thinking ability for undergraduate students. Internal factors include students' positive emotion factors, positive learning behavior factors, positive teacher behavior factors, attitude factors, physical health factors. Students' positive emotion factors include students' joy and eagerness for the course, and their ability to feel happy, satisfied, or eager during the course learning. Positive learning behavior includes building a trusting relationship between lecturers, students and families. Positive teaching behavior includes the lecturers have skills in communication, collaboration, adaptability, empathy and patience make you like to study and enjoy participating in course learning. Positive teaching behavior includes instructors possessing skills in communication, collaboration, adaptability, empathy, and patience, making students enjoy participating in course learning. Attitude includes students have a positive attitude and interests for course learning, and students are enthusiastic about learning new knowledge, actively participating in group discussions, actively thinking and solving problems. Physical health includes students have well-being, brain and good health to study in course.

External factors include method of teaching, time, teaching environment and materials. Method of teaching include the difference instructional model, a variety of appropriate teaching methods and verity evaluation to teach in course, such as role play, issue oriented, team cooperation, situational simulation, participate in practical activities. Time include students manage the time to study innovation training both inside and outside the classroom. Teaching environment includes class size, classroom environment, facilities, teacher-student interaction, relatively fixed and quiet teaching place. A good teaching environment can effectively improve students' learning results. Materials include textbooks, teaching materials, teaching reports, learning platform, innovation and entrepreneurship competition, innovation training plans, network resources and library resources.

From the result of objective 1 about internal factor and external factor from the students and lecturers, the researcher took the result about internal factor: 1) Students' positive emotion and positive learning behavior are the factor to

motivate students' learning, 2) Positive teaching behavior and attitude are the factor to have interaction between students and lecturers, 3) Physical health to help students better understand and study new knowledge.

About external factor: 1) Method of teaching, the teachers used a variety technique to stimulate the students' learning, 2) Time, students manage the time to study innovation training both inside and outside the classroom, 3) Teaching environment, the lecturers provided various equipment and relaxed and atmosphere classroom for students. 4) Materials, the teachers used a variety materials to enrich students' learning experience. From above the lecturers took the result to do the handout in part 2 included lesson plan and scoring rubric form.

**Part 2: Analysis results serving objective 2: To develop problem-based learning instructional model to improve critical thinking ability for undergraduate students.**

To serve objective 2, the collected data of confirming the appropriateness of 5 components of instructional model are analyzed in 4 areas, i.e., utility, feasibility, propriety, and accuracy, and presented by frequency and percentage of the experts as shown in table and description below.

**Table 4.11** Frequency and percentage of confirmability of utility, feasibility, propriety, and accuracy of the instructional model components in 3 areas by experts

Components of problem-based learning instructional model		Opinion of the experts															
		utility				feasibility				propriety				accuracy			
		Agree		Disagree		Agree		Disagree		Agree		Disagree		Agree		Disagree	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1	Principle and Rationale	3	100.00	0	0.00	3	100.00	0	0.00	3	100.00	0	0.00	3	100.00	0	0.00
2	Objectives	3	100.00	0	0.00	3	100.00	0	0.00	3	100.00	0	0.00	3	100.00	0	0.00
3	Contents	3	100.00	0	0.00	3	100.00	0	0.00	3	100.00	0	0.00	3	100.00	0	0.00
4	Methods of Teaching & Materials	3	100.00	0	0.00	3	100.00	0	0.00	3	100.00	0	0.00	3	100.00	0	0.00
5	Evaluation	3	100.00	0	0.00	3	100.00	0	0.00	3	100.00	0	0.00	3	100.00	0	0.00

From table 4.11 the confirmability of each component of the instructional model by 3 experts 100 % all utility, feasibility, propriety, and accuracy.

#### **Principle and Rationale**

The principle and rationale of the instructional model is confirmed to be appropriate by 3 experts 100% of all experts; utility 100%; feasibility 100%; propriety 100%; and accuracy 100%.

#### **Objectives**

The objectives of the instructional model is confirmed to be appropriate by 3 experts 100% of all experts; utility 100%; feasibility 100%; propriety 100%; and accuracy 100%.

#### **Contents**

The contents of the instructional model is confirmed to be appropriate by 3 experts 100% of all experts; utility 100%; feasibility 100%; propriety 100%; and accuracy 100%.

#### **Methods of Teaching & Materials**

The methods of teaching & materials of the instructional model is confirmed to be appropriate by 3 experts 100% of all experts; utility 100%; feasibility 100%; propriety 100%; and accuracy 100%.

#### **Evaluation**

The evaluation of the instructional model is confirmed to be appropriate by 3 experts 100% of all experts; ;utility 100%; feasibility 100%; propriety 100%; and accuracy 100%.

### **Part 3: Analysis results serving objective 3: To study the results of problem-based learning instructional model to enhance critical thinking ability of undergraduate students.**

This section provides the results of implementing problem-based learning instructional model to enhance critical thinking ability of undergraduate students. The analysis results are presented by reporting undergraduate students' performance according to rubric score-based assessment criteria and satisfaction of critical thinking

ability through problem-based learning instructional model as specified in chapter 3 with tables and descriptive analysis.

### Critical thinking over all 8 standards

**Table 4.12** Relative developmental score of students' critical thinking ability  
(Summary the level: Critical thinking ability over all 8 standards)  
enhancement through problem-based learning instructional model.

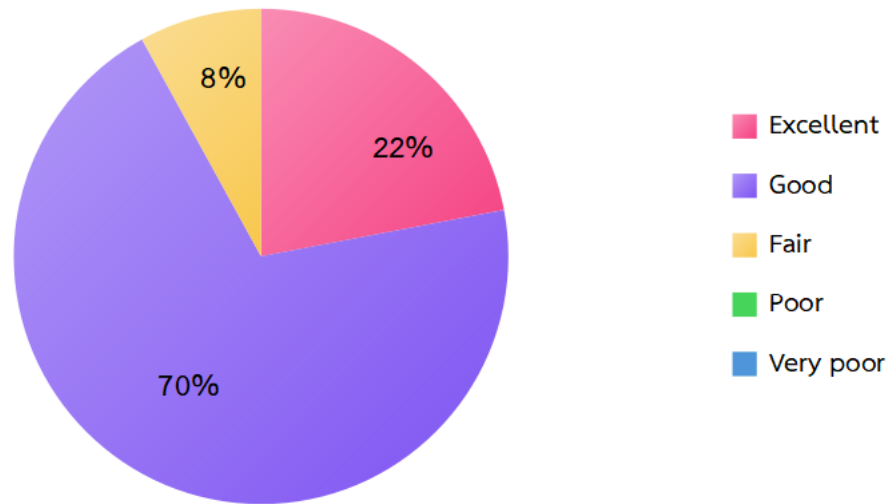
Score	Grade
33-40	Excellent
25-32	Good
17-24	Fair
9-16	Poor
Less than 9	Very poor

**Table 4.13** Summary the level: Critical thinking ability over all 8 standards

Development level	Frequency	Percentage
Excellent	11	22.00
Good	35	70.00
Medium	4	8.00
Pass	0	0.00
Poor	0	0.00

Summary the level of students' critical thinking ability through problem-based learning instructional model in figure 4.1.

### Summary the level: Critical thinking ability over all 8 standards



**Figure 4.1** Relative the level of students' critical thinking ability (Summary the level: Critical thinking ability over all 8 standards) through problem-based learning instructional model

Table 4.13 shows that after implementing the problem-based learning instructional model, most of the students (92%) showed a good or excellent level of critical thinking ability. Among them, 11 were excellent (22%), 35 were good (70%), 4 were fair (8%), there were no student at a poor or very poor development level of critical thinking ability.

Overall, as can be seen from figure 4.1, after implementing the problem-based learning instructional model, the critical thinking ability of most students (92%) has been improved. This result is consistent with the research hypothesis that after implementing the problem-based learning instructional model, students' critical thinking ability will increase by 80% overall (Good level or higher). Therefore, we can conclude that the problem-based learning instructional model is effective for enhancing undergraduate students' critical thinking ability.

### Interpretive ability and Analytical ability

**Table 4.14** Relative developmental score of students' critical thinking ability (Criteria to evaluate 1: Interpretive ability and Analytical ability) enhancement through problem-based learning instructional model.

**Criteria to evaluate 1:** Interpretive ability and Analytical ability

**Standard 1:** Be able to discover the innovation thinking theory

**Standard 2:** Identify the forms and characteristics of innovative thinking

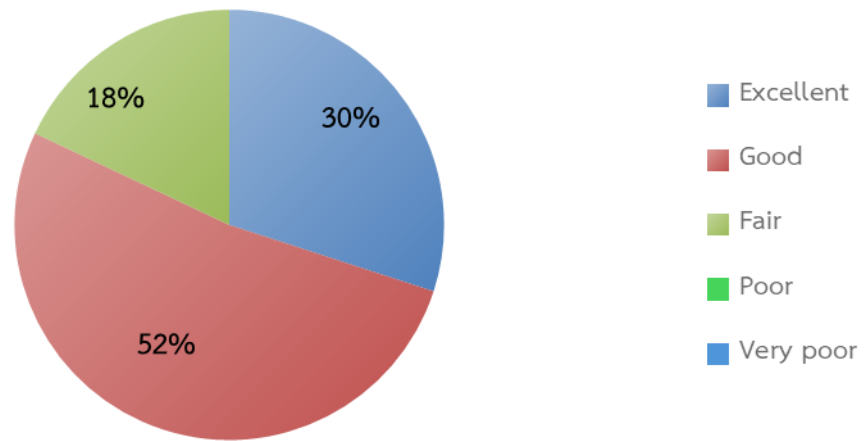
Score	Grade
9 - 10	Excellent
7 - 8	Good
5 - 6	Fair
3 - 4	Poor
Less than 3	Very poor

**Summary the level item 1:** Interpretive ability and Analytical ability

Development level	Frequency	Percentage
Excellent	15	30.00
Good	26	52.00
Fair	9	18.00
Poor	0	0.00
Very poor	0	0.00

Summary the level item 1 Interpretive ability and Analytical ability through problem-based learning instructional model in figure 4.2.

Summary the level item 1 Interpretive ability and Analytical ability



**Figure 4.2** Relative the level of students' critical thinking ability (Summary the level item 1 Interpretive ability and Analytical ability) through problem-based learning instructional model

From table 4.14 and figure 4.2, it can be seen that most of the students (82%) showed a good or excellent level of interpretive ability and analytical ability, exceeding the expected 80% in the research hypothesis. Among them, 15 were excellent (30%), 26 were good (52%), 9 were fair (18%), there were no student at a poor or very poor development level of interpretive ability and analytical ability. This indicates that the problem-based learning instructional model has a significant positive impact on students' critical thinking ability.



### Reasoning ability

**Table 4.15** Relative developmental score of students' critical thinking ability (Criteria to evaluate 2: Reasoning ability) enhancement through problem-based learning instructional model.

#### Criteria to evaluate 2: Reasoning ability

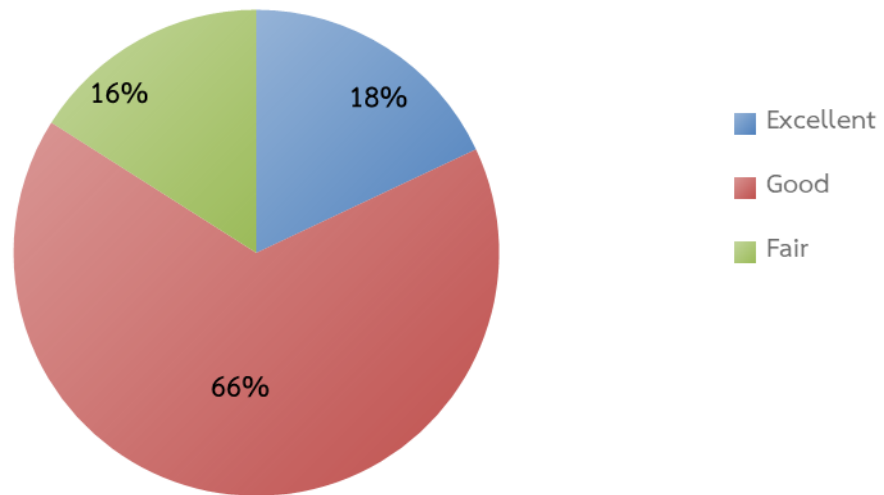
Standard 1: Be able to using innovative design thinking to design a life development plan that you enjoy	
Standard 2: Using the process of design thinking, design a jewelry that can be carried with you	
Score	Grade
9- 10	Excellent
7 - 8	Good
5 -6	Fair
3 – 4	Poor
Less than 3	Very poor

#### Summary the level item 2: Reasoning ability

Development level	Frequency	Percentage
Excellent	9	18.00
Good	33	66.00
Fair	8	16.00
Poor	0	0.00
Very poor	0	0.00

Summary the level item 2 Reasoning ability through problem-based learning instructional model in figure 4.3.

Summary the level item 2 Reasoning ability



**Figure 4.3** Relative the level of students' critical thinking ability (Summary the level item 2 Reasoning ability) through problem-based learning instructional model

From table 4.15 and figure 4.3, it can be seen that most of the students (84%) showed a good or excellent level of reasoning ability, exceeding the expected 80% in the research hypothesis. Among them, 9 were excellent (18%), 33 were good (66%), 8 were fair (16%), there were no student at a poor or very poor development level of reasoning ability. This indicates that the problem-based learning instructional model has a significant positive impact on students' critical thinking ability.

### Explanatory ability

**Table 4.16** Relative developmental score of students' critical thinking ability (Criteria to evaluate 3: Explanatory ability) enhancement through problem-based learning instructional model.

#### Criteria to evaluate 3: Explanatory ability

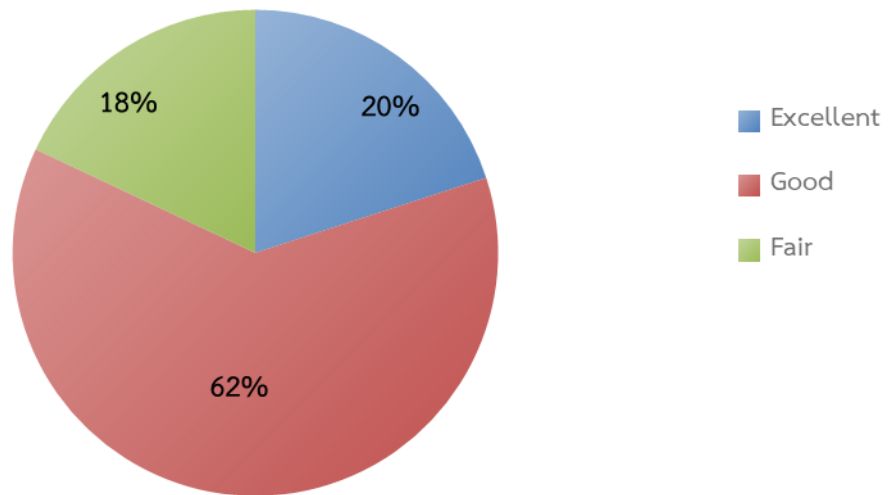
Standard 1: Ability to describe and define the innovation and entrepreneurship	
Standard 2: Display the process of mobile phone innovation through text or graphics	
Score	Grade
9- 10	Excellent
7 - 8	Good
5 -6	Fair
3 – 4	Poor
Less than 3	Very poor

#### Summary the level item 3: Explanatory ability

Development level	Frequency	Percentage
Excellent	10	20.00
Good	31	62.00
Fair	9	18.00
Poor	0	0.00
Very poor	0	0.00

Summary the level item 3 Explanatory ability through problem-based learning instructional model in figure 4.4.

Summary the level item 3 Explanatory ability



**Figure 4.4** Relative the level of students' critical thinking ability (Summary the level item 3 Explanatory ability) through problem-based learning instructional model

From table 4.16 and figure 4.4, it can be seen that most of the students (82%) showed a good or excellent level of explanatory ability, exceeding the expected 80% in the research hypothesis. Among them, 10 were excellent (20%), 31 were good (62%), 9 were fair (18%), there were no student at a poor or very poor development level of explanatory ability. This indicates that the problem-based learning instructional model has a significant positive impact on students' critical thinking ability.

#### Evaluation ability and Self regulation ability

**Table 4.17** Relative developmental score of students' critical thinking ability (Criteria to evaluate 4: Evaluation ability and Self regulation ability) enhancement through problem-based learning instructional model.

**Criteria to evaluate 4:** Evaluation ability and Self regulation ability

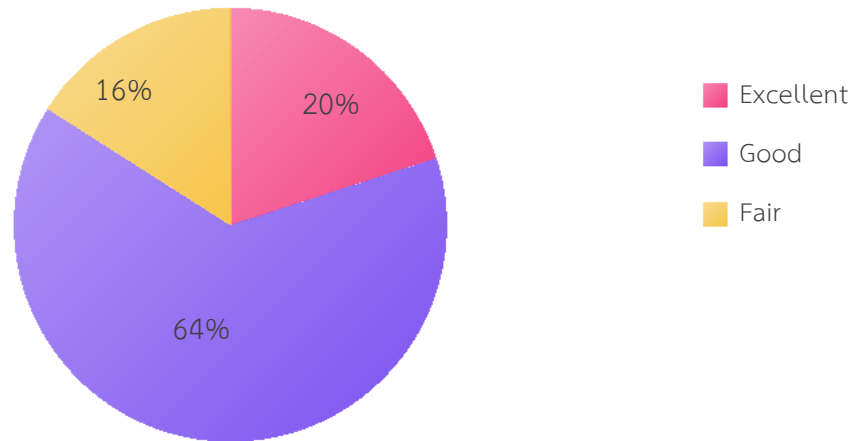
<b>Standard 1: Be able to find personal value of life by using value creation canvas</b>	
<b>Standard 2: Be able to evaluate the life value canvas of other members in the group</b>	
Score	Grade
9- 10	Excellent
7 - 8	Good
5 -6	Fair
3 – 4	Poor
Less than 3	Very poor

**Summary the level item 4:** Evaluation ability and Self regulation ability

Development level	Frequency	Percentage
Excellent	10	20.00
Good	32	64.00
Fair	8	16.00
Poor	0	0.00
Very poor	0	0.00

Summary the level item 4 Evaluation ability and Self regulation ability through problem-based learning instructional model in figure 4.5.

Summary the level item 4 Evaluation ability and Self regulation ability



**Figure 4.5** Relative the level of students' critical thinking ability (Summary the level item 4 Evaluation ability and Self regulation ability) through problem-based learning instructional mode

From table 4.17 and figure 4.5, it can be seen that most of the students (84%) showed a good or excellent level of evaluation ability and self regulation ability, exceeding the expected 80% in the research hypothesis. Among them, 10 were excellent (20%), 32 were good (64%), 8 were fair (16%), there were no student at a poor or very poor development level of evaluation ability and self regulation ability. This indicates that the problem-based learning instructional model has a significant positive impact on students' critical thinking ability.

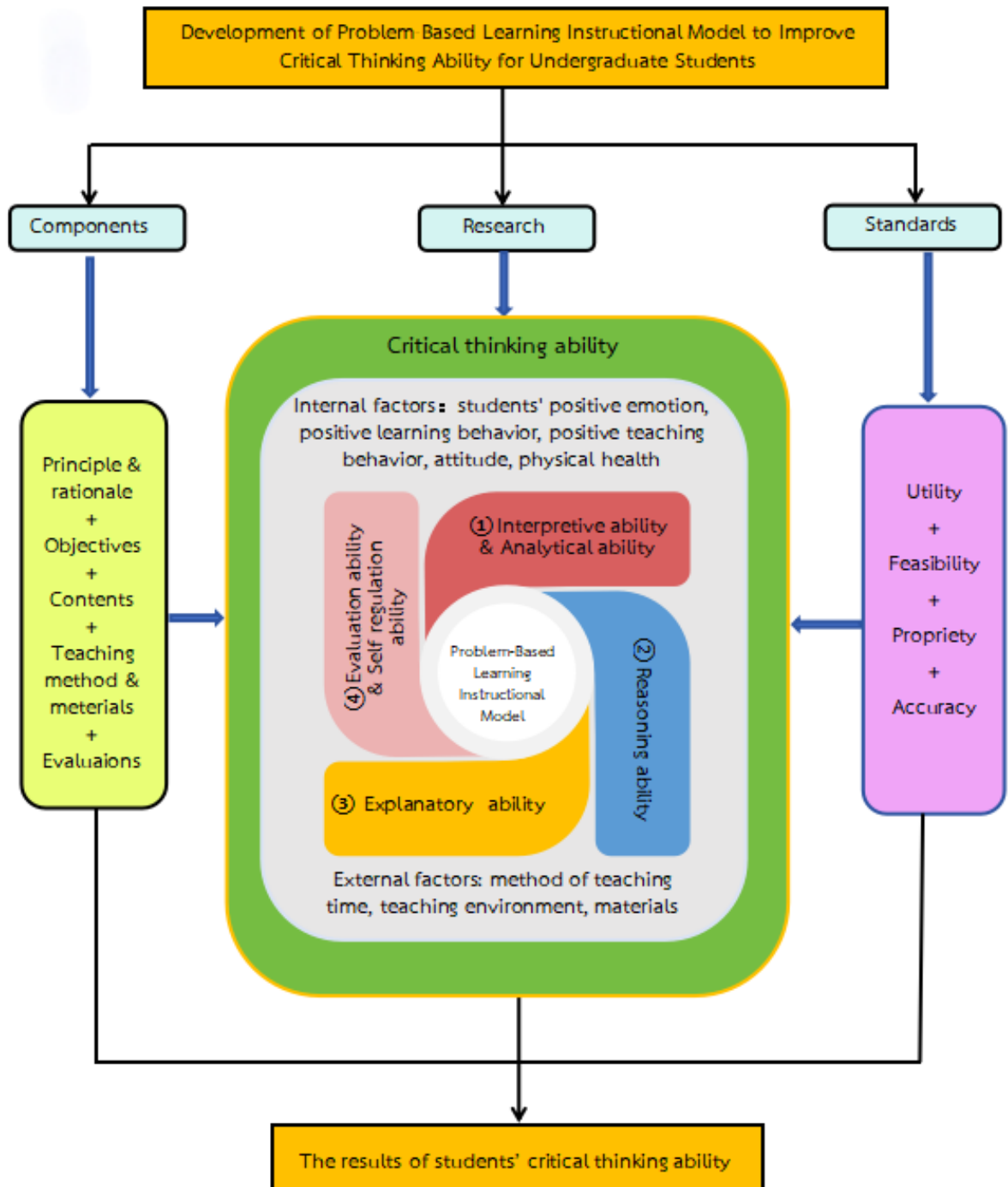


Figure 4.6 Development the problem-based learning (PBL) instructional model after implementation

## Chapter 5

### Conclusion Discussions and Recommendations

This chapter explains the conclusion, discussions and recommendations for further study on “Development of Problem-Based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students”. It can be concluded and discussed as follows. Further, some approaches are recommended on basis of the findings.

The research objectives were:

1. To examine the factors enhancing critical thinking ability for undergraduate students.
2. To develop problem-based learning instructional model to improve critical thinking ability for undergraduate students.
3. To study the result of problem-based learning instructional model to improve critical thinking ability for undergraduate students.

#### Conclusion

1. There were two factors to enhancing critical thinking ability for undergraduate students which were internal factors and external factors. The internal factors involved students' positive emotion, positive learning behavior, positive teacher behavior, attitude and physical health. As for external factors referred to method of teaching, time, teaching environment and materials.

2. Problem-based learning instructional model to improve critical thinking ability for undergraduate students was 100% as assessed by three specialists conformed to utility, feasibility, propriety, and accuracy standards. The model developed by five components: 1) Principle and rationale, study the course and students' critical thinking ability and take the result from objective 1 to do model, 2) Objectives, take from objective 2 in research, 3) Contents, take from the structure of course to experiment, 4) Method of teaching & materials, take from the steps to



teach by problem-based learning instructional model and 5) Evaluation, by scoring rubric form to undergraduate students' critical thinking ability.

3. After the experiment, it was found that 22% of 50 students were at excellent, 70% of 50 students were at good level in critical thinking ability and another 8% were at a fair level. The result is consistent with the research hypothesis that 80% upwards of the participants would have critical thinking ability at a good level after learning through problem-based learning instructional model.

## Discussions

In the study of "Development of Problem-Based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students", the factors affecting critical thinking ability for undergraduate students are discussed as follows:

1. The data obtained through the questionnaire surveys of students and interviews with lecturers indicate that both internal and external factors jointly affect the improvement of critical thinking ability for undergraduate students.

The internal factors involved students' positive emotion, positive learning behavior, positive teacher behavior, attitude and physical health for enhancing critical thinking ability for undergraduate students. The survey shows that students' attention to the course and the importance of critical thinking ability for undergraduate students have a great influence on the development of their own critical thinking skills, and students' positive emotion, positive learning behavior, positive attitude and physical health will affect their learning effect. Fitrianti and Nur's (2018) perspective on internal factors as the driving force that motivates individuals to achieve goals and promotes independent learning of knowledge or skills is an important one. Internal factors refer to the personal characteristics, motivations, and beliefs that influence a person's actions and behaviors. These factors can play a significant role in motivating individuals to seek out new information, engage in self-directed learning, and strive to achieve their personal and professional goals. Internal factors are conducive to the use and promotion of problem-based learning methods and effectively improve learners' critical thinking ability. The reason is learners' motivation and interest are one of the most important driving forces for learning,

helping learners to improve their interpretive ability, analytical ability, reasoning ability, etc.

The external factors to critical thinking ability for undergraduate students include method of teaching, time, teaching environment and materials. Yang & Wang (2016) considered that there are many factors that affect students' learning, and method of teaching is the external factor that has the greatest impact on students' classroom learning. It is the most important direct factor that affects students' effective learning, controlling other factors. Liu (2023) believed that problem-based learning (PBL) teaching method to achieve the more significant teaching effects for students' mastery of theoretical knowledge, practical skills, and critical thinking ability compared with traditional teaching methods. In this research practice, students use more learning resources in cooperative learning, which can better cultivate innovation and self-learning abilities. Teachers adopt diverse teaching activities and methods to promote the occurrence of high-level cognitive activities in students, thus effectively improving their critical thinking abilities (Li & Shi, 2020).

In conclusion, the interaction between internal and external factors integrally affects the teaching achievement of "Innovation Training Course" and the development of critical thinking ability for undergraduate students. In teaching practice, both internal and external factors can jointly affect students' learning outcomes, including enhancing their critical thinking ability, innovative thinking ability, and problem-solving ability. Therefore, studying the influencing factors of critical thinking ability is of great significance for improving the critical thinking ability of undergraduate students.

Problem-based learning instructional model to enhance critical thinking ability of undergraduate students was 100% as assessed by 3 experts conformed to utility, feasibility, propriety, and accuracy standards. The model developed by 5 components: 1) Principle and rationale, study the course and students' critical thinking ability and take the result from objective 1 to do model, 2) Objectives, take from objective 2 in research, 3) Contents, take from the structure of course to experiment, 4) Method of teaching & materials, take from the steps to teach by

problem-based learning instructional model and 5) Evaluation, by scoring rubric form to undergraduate students' critical thinking ability.

In terms of principle & rationale, the practicability, feasibility, appropriateness and accuracy of the principle and basis of this mode have been unanimously recognized by experts. The problem-based learning instructional model is based on Constructivist theory that focuses on develop critical thinking ability and problem-solving ability for students.

In terms of teaching objectives, the teaching objectives under this mode were unanimously recognized by the three experts. It is obvious that establishment of effective teaching objectives serves as a fundamental prerequisite for conducting teaching activities. The teaching objectives are closely related to the teaching content and set around the development of students' ability.

In terms of contents, the three experts agreed that the content is reasonable and appropriate. The teaching content embodies the main characteristics of problem-based teaching mode, including problem-based, situational, autonomous, exploratory, and cooperative. It can effectively enhance the students' critical thinking ability.

In terms of teaching methods and textbooks, the three experts believe that well-designed teaching activities and interesting learning situations can make the teaching mode highly adaptable and effectively stimulate students' interest in learning by this model.

In the evaluation section, experts acknowledge the effectiveness and applicability of evaluation and feedback mechanisms in improving student performance, and can provide effective feedback on enhancing students' critical thinking abilities.

Therefore, the experts unanimously agree that the problem-based learning teaching model is practical, feasible, appropriate, and accurate. The robustness and adaptability of this teaching model can effectively improve the critical thinking ability of undergraduate students. Consequently, experts believed that this model can be implemented in teaching.

3. After the experiment, it was found that 32% of 50 students were at excellent, 60% of 50 students were at good level in critical thinking ability as follows:

Firstly, the development of thinking is driven by individual problems which is the process from discovering problems to solving them is a process of active, divergent, progressive, and improved thinking. Interpret problem and analyzing information is the beginning of the process of thinking development. Interpreting problems and analyzing information is also a crucial first step in improving critical thinking skills (Zhang, 2021). Through the implementation of problem-based learning instructional model, most of the students (82%) showed good perception ability, exceeding the expected 80% in the research hypothesis. Among the results, 15 were excellent (30%), 26 were good (52%), 9 were fair (18%). This indicates that the problem-based learning instructional model has a significant positive impact on interpretive ability and analytical ability.

Secondly, the reasoning ability is the ability to question and continuously draw conclusions through questioning, and is an indispensable part of critical thinking ability. It plays an important role in the implementation of problem-based learning instructional model and can effectively promote students' critical thinking ability (Li & Shi, 2020). Through implementing problem-based learning instructional model, students' reasoning ability level has been enhanced. Most of the students (84%) showed good reasoning ability, exceeding the expected 80% in the research hypothesis. Among them, 9 were excellent (18%), 33 were good (66%), 8 were fair (16%). This indicates that problem-based learning instructional model have the significant positive impacts on students' reasoning ability.

Thirdly, explanatory ability refers to the ability to clearly and accurately explain one's own viewpoints, and to articulate one's own views clearly when others question them (Zhang, 2021). During the process of learning and innovation training, students express their views through problem situations and become the main body of learning, which has a positive impact on critical thinking ability. Most of the students (82%) showed good explanatory ability, exceeding the expected 80% in the research hypothesis. Among the results, 10 were excellent (20%), 31 were good

(62%), 9 were fair (18%). This indicates that through problem-based learning instructional model, students' explanatory ability has been significantly enhanced.

Fourthly, evaluation ability and self regulation ability are essential components of critical thinking ability. The experimental teaching of problem-based learning instructional model emphasizes the cultivation of students' exploratory spirit and research awareness, and advocates questioning problems. Student learning begins with identifying and defining problems, followed by analyzing and solving them. This process will enable students to face their own shortcomings and deficiencies, and can also self calibrate, self evaluate, and peer evaluate their learning based on the course content, which plays a positive role in improving students' critical thinking (Li & Shi, 2020). Most of the students (84%) showed good evaluation ability and self regulation ability, exceeding the expected 80% in the research hypothesis. Among them, 10 were excellent (20%), 32 were good (64%), 8 were fair (16%). This indicates that through problem-based learning instructional model, students' evaluation ability and self regulation ability have been significantly improved.

In summary, interpretive ability, analytical ability, reasoning ability, explanatory ability, evaluation ability and self regulation ability are essential sections which contribute significantly to the development of students' critical thinking ability. The problem-based learning instructional model used in this experiment emphasizes the scientific nature of problem posing, making students the main body of learning in problem situations, and sufficiently stimulating their creative thinking and critical thinking ability. Through teaching experiments, the majority of students have achieved good or excellent critical thinking skills and greatly improved their enthusiasm for learning.

## **Recommendations**

In the study of “Development of Problem-Based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students”, the researcher put forward the following recommendations to students, lecturers and university administrators. The details as follows:

**To the students:**

1. The problem-based learning instructional model is based on posing a question to students, requiring them to solve the problem in a group collaboration, review old knowledge, and construct new knowledge from it. This teaching mode requires students to transition from passive reception mode to active discovery mode, enhancing their learning motivation. Students should solve problems in real situations of autonomy and cooperation, and construct new knowledge.

2. On the one hand, students need to have their own tasks to complete, evaluate and reflect on the content and learning process they have learned, and actively construct their own knowledge. On the other hand, students also need to discuss and debate with their team members to enhance their awareness of cooperative learning.

3. In the experimental process of problem-based learning instructional model, students use their own intelligence and teamwork to analyze and solve problems together. The ultimate result is the reconstruction of knowledge. Students should actively demonstrate their problem awareness in the classroom, improve their learning initiative, enhance their ability to learn independently and collaboratively.

**To the lecturers:**

The problem-based learning instructional model emphasizes the problem-based and situational aspects of teaching. It can adequately stimulate students' thinking, implement student independent activities around problems, collect and organize information in specific situations, analyze different perspectives and solutions. Therefore, in order to improve students' critical thinking ability, lecturers are required to pay attention to problem posing and situational design in teaching design.

2. In order to enhance students' critical thinking ability, enable them to comprehensively use evaluation methods, and effectively improve their evaluation ability in critical thinking, lecturers need to attach importance to the use of teaching evaluation. In various stages of teaching, lecturers should flexibly use teacher evaluation, peer evaluation, and self-evaluation, and adopt different levels and multi subject teaching evaluation activities.

3. In the process of problem-based learning teaching, the discussion questions designed and proposed by the lecturers are the key to guiding group discussions and cultivating students' critical thinking abilities. How to design and propose questions with appropriate difficulty is the prerequisite and foundation for implementing problem-based learning instructional model. In addition to systematically learning instructional design knowledge, lecturers also need to enhance their teaching abilities beyond their professional field, as well as their theoretical knowledge and critical thinking skills.

**To the university:**

The university can select and determine a series of innovation and entrepreneurship online course resources through national quality course online learning platforms, China University MOOCs, People's MOOCs, and other online platforms, allowing students to engage in independent online learning. Students are required to complete some post class innovation training or read articles, cases, and stories related to innovation and entrepreneurship. Internet information platform can be used to complete the after-school learning tasks. With the help of mobile app, cloud class, superstar learning app, rain class and other WeChat small programs, students can easily and happily complete the after-school learning tasks by completing tasks and clocking in, cultivate students' interest in innovative learning, and stimulate students' critical thinking.

The university requires students to participate in in class project practice activities, mainly using teaching methods such as student student participation and teacher-student interaction, applying case sharing, group discussion, brainstorming, case analysis, role-playing, game experience, etc. to in class project practice activities. For example, when teaching innovative methods, students independently learn the theoretical knowledge of innovative methods through online course resources, and have a preliminary abstract understanding of innovative methods. Through interactive and experiential innovation exercises in offline classrooms, students can more flexibly comprehend the knowledge they have learned and solve learning difficulties in the process of teacher-student interaction, ultimately achieving better learning outcomes.

The university should attach great importance to the professional development of teachers, increase opportunities for teacher training, build experience exchange platforms, purchase necessary teaching facilities and learning materials, and serve to improve the professional level of teachers from a perspective, developing teachers' theoretical knowledge and critical thinking abilities. Only in this way can teachers have the ability to actively and effectively evaluate and guide students in the process of collecting and screening information, thinking, and solving problems, and improve students' critical thinking skills.

### **Future Research**

Looking forward to the future, the follow-up research of problem-based instructional model can also be carried out from the following aspects:

1. In future research, the author plan to have a more comprehensive understanding of the studied population, conduct more detailed observations of the studied population, keep good tracking records and investigations, in order to reduce the impact of these unknown factors on the experimental results.

2. In future research, the author will further increase the sample size and improve the accuracy of the experiment. Due to the significant difference in the gender ratio of the subjects in this study, it is hoped that in future research, a reasonable ratio can be formed among the study population in different grades, genders, and disciplines, and more precise studies can be conducted.

3. In the future, the author will conduct similar project implementation research based on this study. With mature research experience and expanded research strength, further research can be conducted on the impact and long-term effects of PBL teaching mode on students' critical thinking ability at different stages, and applied to other professional practical courses.

4. The author will develop the problem-based learning teaching model to study and improve the teamwork ability of undergraduate students. At the same time, the author will develop another teaching model to enhance the critical thinking ability of undergraduate students.



In conclusion, the application of problem-based learning instructional model is of great significance to the future research of Innovation Training course teaching in colleges and universities. Therefore, future research can focus on exploring how to design more detailed teaching plans and refine teaching processes to enhance students' critical thinking skills and learning outcomes.

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## Appendices



## Appendix A

List of Specialists and Letters of Specialists Invitation  
for IOC Verification

### List of experts to validate research instruments

1. Assistant Professor Dr. Sarayuth  
Sethakajorn Administration Program  
Bansomdejchaopraya Rajabhat University
2. Professor Dr. Liu Yinmei Education Program  
Guangxi Minzu University
3. Professor Dr. Gao Bin Educational Management Program  
Guangxi Minzu University

### List of experts to evaluate the format Instructional Model

1. Assistant Professor Dr. Wanida Ploysangwal English Program University of the Thai Chamber of Commerce
2. Dr. Panas Jansritong Administration Program Burapa University
3. Professor Dr. Shi Tianfei Education Program Guangxi Minzu University

Appendix B

Official Letter



Ref.No. MHESI 0643.14/590

Graduate School  
Bansomdejchaopraya Rajabhat University  
1061 Itsaraparb 15 Hirunrujee  
Thonburi Bangkok 10600

29 March 2024

**Subject** Invitation to be the expertise for research instruments' quality

**Dear** Assistant Professor Dr.Sarayuth Sethakajorn

**Attachment** Questionnaire 1 set

Regarding the thesis entitled "Development of Problem-based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students" of Mrs. Ye Tianru, a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103201, Thailand under the supervision of Associate Professor Dr. Areewan Iamsa-ard as major advisor, The Assistant Professor Dr. Tanaput Chanchaoren and Assistant Professor Dr.Wapee Kong-In as co-advisor.

The Curriculum Management Committee considered that you are an expertise who has the knowledge and ability to provide useful advice on constructing research instruments for students.

Please be respected as an expert to examine such research instruments. Thank you very much for your concern.

Sincerely,

(Assistant Professor Akaranun Asavarutpokin)  
Vice Dean Acting for Dean of Graduate School

Graduate School  
Tel.+662-473-7000 ext. 1814



Ref.No. MHESI 0643.14/591

Graduate School  
Bansomdejchaopraya Rajabhat University  
1061 Itsaraparb 15 Hirunrujee  
Thonburi Bangkok 10600

29 March 2024

**Subject** Invitation to be the expertise for research instruments' quality

**Dear** Professor Dr.Liu Yinmei

**Attachment** Questionnaire 1 set

Regarding the thesis entitled "Development of Problem-based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students" of Mrs. Ye Tianru, a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103201, Thailand under the supervision of Associate Professor Dr. Areewan Iamsa-ard as major advisor, The Associate Professor. Dr.Sarayuth Sethakajorn and Assistant Professor Dr.Wapee Kong -In as co-advisor.

The Curriculum Management Committee considered that you are an expertise who has the knowledge and ability to provide useful advice on constructing research instruments for students.

Please be respected as an expert to examine such research instruments. Thank you very much for your concern.

Sincerely,

(Assistant Professor Akaranun Asavarutpokin)  
Vice Dean Acting for Dean of Graduate School

Graduate School  
Tel.+662-473-7000 ext. 1814



Ref.No. MHESI 0643.14/592

Graduate School  
Bansomdejchaopraya Rajabhat University  
1061 Itsaraparb 15 Hirunrujee  
Thonburi Bangkok 10600

29 March 2024

**Subject** Invitation to be the expertise for research instruments' quality

**Dear** Professor Dr.Gao Bin

**Attachment** Questionnaire 1 set

Regarding the thesis entitled "Development of Problem-based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students" of Mrs. Ye Tianru, a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103201, Thailand under the supervision of Associate Professor Dr. Areewan Iamsa-ard as major advisor, The Associate Professor. Dr.Sarayuth Sethakajorn and Assistant Professor Dr.Wapee Kong-In as co-advisor.

The Curriculum Management Committee considered that you are an expertise who has the knowledge and ability to provide useful advice on constructing research instruments for students.

Please be respected as an expert to examine such research instruments. Thank you very much for your concern.

Sincerely,

(Assistant Professor Akaranun Asavarutpokin)  
Vice Dean Acting for Dean of Graduate School

Graduate School  
Tel.+662-473-7000 ext. 1814



Ref.No. MHESI 0643.14/593

Graduate School  
Bansomdejchaopraya Rajabhat University  
1061 Itsaraparb 15 Hirunrujee  
Thonburi Bangkok 10600

29 March 2024

**Subject** Invitation to be the expertise for instructional model's quality

**Dear** Assistant Professor Dr. Wanida Ploysangwal

**Attachment** Evaluation sheets

Regarding the thesis entitled "Development of Problem-based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students" of Mrs. Ye Tianru, a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103201, Thailand under the supervision of Associate Professor Dr. Areewan Iamsa-ard as major advisor, The Associate Professor. Dr.Sarayuth Sethakajorn and Assistant Professor Dr.Wapee Kong -In as co-advisor.

The Curriculum Management Committee considered that you are an expertise who has the knowledge and ability to provide useful advice on constructing instructional model for students.

Please be respected as an expert to examine such research instruments. Thank you very much for your concern.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Akaranun'.

(Assistant Professor Akaranun Asavarutpokin)  
Vice Dean Acting for Dean of Graduate School

Graduate School  
Tel.+662-473-7000 ext. 1814





Ref.No. MHESI 0643.14/594

Graduate School  
 Bansomdejchaopraya Rajabhat University  
 1061 Itsaraparb 15 Hirunrujee  
 Thonburi Bangkok 10600

29 March 2024

**Subject** Invitation to be the expertise for instructional model's quality

**Dear** Dr. Panas Jansritong

**Attachment** Evaluation sheets

Regarding the thesis entitled "Development of Problem-based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students" of Mrs. Ye Tianru, a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103201, Thailand under the supervision of Associate Professor Dr. Areewan Iamsa-ard as major advisor, The Associate Professor. Dr.Sarayuth Sethakajorn and Assistant Professor Dr.Wapee Kong -In as co-advisor.

The Curriculum Management Committee considered that you are an expertise who has the knowledge and ability to provide useful advice on constructing instructional model for students.

Please be respected as an expert to examine such research instruments. Thank you very much for your concern.

Sincerely,

(Assistant Professor Akaranun Asavarutpokin)  
 Vice Dean Acting for Dean of Graduate School

Graduate School  
 Tel.+662-473-7000 ext. 1814



Ref.No. MHESI 0643.14/595

Graduate School  
 Bansomdejchaopraya Rajabhat University  
 1061 Itsaraparb 15 Hirunrujee  
 Thonburi Bangkok 10600

29 March 2024

**Subject** Invitation to be the expertise for instructional model's quality

**Dear** Professor. Dr. Shi Tianfei

**Attachment** Evaluation sheets

Regarding the thesis entitled "Development of Problem-based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students" of Mrs. Ye Tianru, a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103201, Thailand under the supervision of Associate Professor Dr. Areewan Iamsa-ard as major advisor, The Associate Professor. Dr.Sarayuth Sethakajorn and Assistant Professor Dr.Wapee Kong -In as co-advisor.

The Curriculum Management Committee considered that you are an expertise who has the knowledge and ability to provide useful advice on constructing instructional model for students.

Please be respected as an expert to examine such research instruments. Thank you very much for your concern.

Sincerely,

(Assistant Professor Akaranun Asavarutpokin)  
 Vice Dean Acting for Dean of Graduate School

Graduate School  
 Tel.+662-473-7000 ext. 1814



Ref.No. MHESI 0643.14/596

Graduate School  
 Bansomdejchaopraya Rajabhat University  
 1061 Itsaraparb 15 Hirunrujee  
 Thonburi Bangkok 10600

29 March 2024

**Subject** Request for data collection  
**Dear** President of Guangxi Minzu University  
**Attachment** 200 copy of questionnaires

Regarding the thesis entitled “Development of Problem-based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students” of Mrs. Ye Tianru, a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103201, Thailand under the supervision of Associate Professor Dr. Areewan Iamsa-ard as major advisor, The Associate Professor. Dr.Sarayuth Sethakajorn and Assistant Professor Dr.Wapee Kong -In as co-advisor.

The researcher needs to collect data using questionnaire in terms of factors undergraduate student's Critical Thinking Ability from 200 students with different levels of learning achievements at Guangxi Minzu University, I'm formally requesting your assistance in distributing the attached questionnaire to the informants as referred above and please send the completed ones back to the researcher via email to 978342115@qq.com.

The researcher plans to use this data for her thesis completion and further necessary publication as required by the Ph.D. course.

I am grateful for your consideration of my request. I pledge to adhere to any stipulations you deem fit. You may reach me at the phone number or email address provided below in case of any related questions. I look forward to your response.

Sincerely,

(Assistant Professor Akaranun Asavarutpokin)  
 Vice Dean Acting for Dean of Graduate School

Graduate School  
 Tel.+662-473-7000 ext. 1814



Ref.No. MHESI 0643.14/597

Graduate School  
Bansomdejchaopraya Rajabhat University  
1061 Itsaraparb 15 Hirunrujee  
Thonburi Bangkok 10600

29 March 2024

**Subject** Request for permission to implement experiment

**Dear** President of Guangxi Minzu University

Regarding the thesis entitled “Development of Problem-based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students” of Mrs. Ye Tianru, a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103201, Thailand under the supervision of Associate Professor Dr. Areewan Iamsa-ard as major advisor, The Associate Professor. Dr.Sarayuth Sethakajom and Assistant Professor Dr.Wapee Kong -In as co-advisor.

The researcher needs to implement an experiment in compliance with approved methodology and collect data in terms of undergraduate student's Critical Thinking Ability from 4 classes of students with different levels of learning achievements , who enrolled in Innovation Training Course at Guangxi Minzu University during the 1st semester of academic year 2024. Hence, I'm formally requesting permission to implement the experiment and access the aforementioned data. The researcher plans to use this data for her thesis completion and further necessary publication as required by the Ph.D. course.

The researcher plans to use this data for his thesis completion and further necessary publication as required by the Ph.D. course. I am grateful for your consideration of my request. I pledge to adhere to any stipulations you deem fit. You may reach me at the phone number or email address provided below in case of any related questions. I look forward to your response.

Sincerely,

(Assistant Professor Akaranun Asavarutpokin)  
Vice Dean Acting for Dean of Graduate School

Graduate School  
Tel.+662-473-7000 ext. 1814

# Appendix C

## Research Instrument

### Results of Validity Verificatio

- Questionnaire for students (Objective 1)
- Interview for lecturers (Objective 1)
- Questionnaire for experts (Objective 2)
- Lesson Plan (Objective 3)
- Scoring rubric form (Objective 3)

## Questionnaire For Students(Objective 1)

### Directions:

These questionnaires are the instruments for collecting data in 1st phase of the research entitled “Development of problem-based learning instructional model to improve critical thinking ability for undergraduate students” conducted by Ye Tianru, a Ph.D. student in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University under the supervision of Associate Professor Dr. Areewan Iamsa-ard Associate majoring advisor, and Assistant Professor Dr. Tanaput Chanchaoren & Assistant Professor Dr. Wapee Kong-In co-advisor.

This questionnaire is divided into 3 sections i.e.

**Section 1** Common data of the respondent.

**Section 2** The information on the factors critical thinking ability of undergraduate students.

The questionnaire type is the Closed-ended questions that can only be answered by selecting from provided number to summated rating scale, 5 scales.

The important issues of the items consist of two groups of the factors: Internal factors (respondents) and External factors (teachers, circumstances, etc.)

**Section 3** Further suggestions

Data obtained from this questionnaire are only used for the purpose of conducting aforementioned research and remain confidential. Individual or personal data presentation will be avoided.

**Answer the questionnaire:**

*Directions: Please put ✓ into the  according to your own personal data.*

**Section 1** Common data of the respondent.

1. Gender

 Male             Female

2. Students from

 A. Class A in English Major B. Class B in English Major C. Class C in English Major

3. Age

 A. below 18 yrs.             B. 18-20 yrs. C. 21-23yrs.                 D. over 23 yrs.

**Section 2** The information on factors affecting critical thinking ability of undergraduate students

*Directions: Please rate the following factors affecting the problem-based learning instructional model by putting ✓ into the attitude level column based on the criteria given below. Each question can select only one answer.*

5 means you STRONGLY agree with the contents.

4 means you QUITE agree with the contents.

3 means you remain NEUTRAL. with the contents

2 means you DO NOT QUITE agree with the contents

1 means you DO NOT STRONGLY agree with the contents

**Table 1** Questionnaire on factors affecting critical thinking ability of undergraduate students

Questions	Answers				
	5	4	3	2	1
<b>Internal Factors No.1 Students' positive emotion, No.2 Positive learning behavior, No.3 Positive teacher behavior, No.4 Attitude, No.5 Students' health.</b>					
1. Do you think if you joy or satisfaction or caring or eagerness in innovation training course can improve your critical thinking ability?					
2. Do you think building a trusting relationship between lecturers students and families in innovation training course can improve your critical thinking ability?					
3. Do you think if the lecturers have skills in communication, collaboration, adaptability , empathy and patience make you like to study in innovation training course and can improve your critical thinking ability?					
4. Do you think if you have a positive attitude that make you are successful in studying in innovation training course and having good critical thinking ability?					
5. Do you think if you are well – being, brain , a good health to study in innovation training course , make you improve critical thinking ability?					
<b>External factors (No. 1-2 Method of teaching No.3 Time No. 4 Environment , facilities , infrastructure and No.5 Materials</b>					
1. Do you think if the lecturers have the difference instructional model and verity evaluation to teach in innovation training course can improve students' critical thinking ability?					
2. Do you think if the lecturers finish education by major or have the high or experience to teach in innovation training course can improve students' critical thinking ability?					
3.Do you think if the students manage the time to study innovation training course both inside and outside the classroom can improve students' critical thinking ability?					



Questions	Answers				
	5	4	3	2	1
4. Do you think that the teaching environment (including class size, classroom environment, facilities, teacher-student interaction, relatively fixed and quiet teaching place) of the innovation training course affects students' critical thinking ability?					
5. Do you think the good materials that modern and verity to teach in innovation training course have the affecting students' critical thinking ability?					

### Section 3 Suggestions for improving the better instruction

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Thank you for your kind cooperation for completing the questionnaire!

Researcher

Ye Tianru

## Interview for Lecturers (Objective 1)

### Directions:

These questionnaires are the instruments for collecting data in 1st phase of the research entitled “Development of problem-based learning instructional model to improve critical thinking ability for undergraduate students” conducted by Ye Tianru, a Ph.D. student in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University under the supervision of Associate Professor Dr. Areewan Iamsa-ard Associate majoring advisor, and Assistant Professor Dr. Tanaput Chanchaen & Assistant Professor Dr. Wapee Kong-In co-advisor.

This interview is divided into 3 sections i.e.

Section 1 Common data of the respondent

Section 2 Interview on factors to enhance critical thinking ability of undergraduate students

Section 3 Comment and recommendation for improving the better instruction

Data obtained from this interview are only used for the purpose of conducting aforementioned research and remain confidential. Individual or personal data presentation will be avoided.

**Answer the questionnaire:****Section 1** Common data of the respondent

*Directions:* Please put  $\checkmark$  into the  according to your own personal data.

## 1. Gender

- A. Male                       B. Female

## 2. Lecturers from

- A. Foreign Languages in Guangxi Minzu University  
 B. Economics college in Guangxi Minzu University  
 C. Innovation and Entrepreneurship College in Guangxi Minzu University

## 3. Experience teaching

- A. Below 3 yrs.                       B. 3-6 yrs.  
 C. 7- 9 yrs.                           D. Over 9 yrs.

## 4. Age

- A. Below 25 yrs.                       B. 25-35yrs  
 C. 36-49yrs.                           D. Over 49 yrs.

**Section 2** Interview on factors to enhance critical thinking ability of undergraduate students

*Directions: The type of question is open-ended questions; you can answer according to your actual situation. Your answers will only be used in this research and will not be disclosed individually.*

1. When you teach in innovation training course, how do you know your students joy or satisfaction or like to study in this course? Please give the reason.

2. Do you think building a trusting relationship between lecturers students and families in innovation training course can improve your students' critical thinking ability? Please give the reason.

3. Do you have a good skills , communication, collaboration, adaptability , empathy and patience to teach students in innovation training course? Please give the reason

4. Do you think if you have a positive attitude for students that make you are successful to teach in innovation training course and having your students' good critical thinking ability? Please give the reason.

5. Do you think if you are well – being, brain, a good health to teach in innovation training course, make your students' improve critical thinking ability? If you agree, please give the reason.

6. What do use instructional model and verity evaluation to teach in innovation training course and what do you think about problem-based learning instructional model to can improve students' critical thinking ability?

7. What do you finish your education , what your major and how many year of your experiences to teach in innovation training course ?

8. What do you prepare the time to discuss with the students , have the participating together inside and outside the classroom to improve students' critical thinking ability?

9. Do you think that the teaching environment (including class size, classroom environment, facilities, teacher-student interaction, relatively fixed and quiet teaching place) of the innovation training course affects students' critical thinking ability? Please

give the reason

10. What materials to teach in innovation training course? Do you think its a good materials , modern and verity to teach in innovation training course and have the affecting students' critical thinking ability?

**Section 3:** Comment and recommendation for improving the better instruction.

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Thank you for your kind cooperation for completing the interview!

Researcher

Ye Tianru

## Questionnaire for experts (Objective 2)

### Development of Problem-Based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students

Dear assessors,

The present study is conducted by Ye Tianru, a Ph.D. student in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University, Thailand, under the supervision of the following advisors.

1. **Major Advisor:** Associate Professor Dr.Areewan Iamsa-ard
2. **Co-advisor:** Assistant Professor Dr. Tanaput Chanchaoren
3. **Co-advisor:** Assistant Professor Dr.Wapee Kong -In

The attached open questions are the instrument for collecting data in phase 2 of the research, the objective of which is to confirm instructional model. Please write down your own opinion for each question. Data obtained from this questionnaire are only used for the purpose of conducting aforementioned research and remain confidential. Individual or personal data presentation will be avoided.

These questions involve 3 parts as follows.

Part 1: Assessor's information

Part 2: Assessment of the quality of instructional model on 5-point rating scale basis in 4 aspects 1) Utility Standard 2) Feasibility Standard 3) Propriety Standard and 4) Accuracy Standard.

Part 3: Suggestion

The researcher certifies that all information obtained from this questionnaire will be used for academic purposes and to generate maximum benefit meeting objectives.

Thank you very much for dedicating your valuable time and providing useful information to this research for the benefit of further research and development.

Ph.D. student name: Ye Tianru  
Curriculum and Instruction Program  
Bansomdejchaopraya Rajabhat University

## Assessment of confirm the quality of Problem-Based Learning Instructional Model

**Assessor:** Dr.Panas Jansritong

**Position:** Admistration Program

**Workplace:** Burapa University

**Direction:** Assessment of confirm the quality of instructional model

Please answer all questions by making ✓ in the answer box that corresponds to your opinion or the truth using the following criteria.

Assessment Items	Rating Result		
	Agree	Disagree	Remarks
<b>Utility Standard</b>			
1. Problem-based learning instructional model is useful to lecturers to enhance learning achievement.			
2. Problem-based learning instructional model is useful to students to enhance learning achievement.			
3. Problem-based learning instructional model includes necessary and enough contents.			
4. Problem-based learning instructional model promotes to enhance learning achievement more compared to traditional teaching.			
5. Problem-based learning instructional model increases the learning achievement of students.			

Table (Continued)

Assessment Items	Rating Result		
	Agree	Disagree	Remarks
<b>Feasibility Standard</b>			
1.The lecturer can apply problem-based learning instructional model to enhance learning achievement to their work and it is worth the time for actual use.			
2. The lecturer can develop the students to problem-based learning instructional model.			
3. problem-based learning instructional model to lecturer is easy to use.			
4. The students always develop their learning all time by problem-based learning instructional model to promote adversity quotient.			
5. The students are comfortable in learning by themselves with problem-based learning instructional model to promote adversity quotient.			
<b>Propriety Standard</b>			
1. Problem-based learning instructional model to enhance learning achievement is appropriate for lecturers to use assessment results to improve the students.			
2. Problem-based learning instructional model to enhance learning achievement is appropriateness for students to create knowledge by themselves.			
3. Problem-based learning instructional model to enhance learning achievement is convenient to use.			
4. Problem-based learning instructional model to enhance learning achievement is a systematic process to use.			



Table (Continued)

Assessment Items	Rating Result		
	Agree	Disagree	Remarks
5. Problem-based learning instructional model to enhance learning achievement is clear and suitable for use in learning and students' development.			
<b>Accuracy Standard</b>			
1. Problem-based learning instructional model to enhance learning achievement is comprehensively analyzed from different contexts and sufficient for the synthesis of patterns.			
2. Problem-based learning instructional model to enhance learning achievement has a clear process.			
3. Problem-based learning instructional model to enhance learning achievement are described and the acquisition is clear.			
4. Problem-based learning instructional model to enhance learning achievement use techniques and tools which acquires accurate information and communication.			
5. Problem-based learning instructional model to enhance learning achievement is a correct and comprehensive learning system.			

### Suggestions

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Sign.....Assessor

(Dr.Panas Jansritong)

Date...../...../.....

## Lesson Plan (Objectives 3)

### Learning objectives

**Item 1 :** Interpretive ability, Analytical ability

Mastering the innovative thinking and innovative methods (Standard 1: Be able to discover the innovating thinking theory.)

Being able to summarize the forms and characteristics of innovative thinking. (Standard 2: Identify the forms and characteristics of innovative thinking.)

### Contents

Innovation theory

### Method of teaching

Teaching problem-based learning instructional model refers to an integrated teaching model that is taught in 4 steps in the classroom.

#### **Step 1: Design problem scenarios and design questions (0.5 hours)**

The role of a teacher is as an organizer. Teachers organize students and design questions related to innovative thinking and methods to help students clarify problem based learning tasks. According to learning objectives and contents, the teachers provide teaching materials (teaching videos, PPTs, learning websites, and related case studies) based on learning objectives and content, and publishes a list of self-directed learning tasks to students. The questions as follow:

- 1.1 How do you define innovative thinking?
- 1.2 What are the types of innovative thinking?
- 1.3 What are the characteristics of innovative thinking?
- 1.4 How do you use mind map to summarize innovative thinking?

#### **Step 2: Group discussion and problem analysis (1.5 hours)**

Students need to complete the questions and tasks carefully designed by the teacher. The process of analyzing problems, collecting extensive information, preparing for discussions, and completing assignments has cultivated students' abilities in self-directed and cooperative learning. Through problem scenarios, students have gained a preliminary understanding of the basic principles of innovative thinking, including its definition, types, and characteristics. The specific steps are as follows:

(1) Students engage in group discussions on the questions designed by the teacher.

(2) After group discussions, engage in teamwork and utilize students' critical thinking skills.

(3) Students attempt to analyze problems through independent thinking and group discussions.

### **Step 3: Tasks implementation and problem-solving (1.5 hours)**

**Teacher's task:** In order to help students clarify their problems and quickly sort out and summarize innovative principles, teachers provide students with some learning courseware and videos as references, providing some inspiration for their assignments.

**Student's task:** After using critical thinking to analyze problems, students begin to complete the teacher's assignments and tasks, and independently use mind maps to solve the problems raised by the teacher.

First of all, each member of the group needs to consult and filter information according to their own division of labor. Group members provide their own opinions and evidence, form a brainstorming session, and initiate a collision of thoughts. When other members of the group come up with different ideas and suggestions, students can think and analyze, and critically learn from others' opinions. Finally, students should think about the production of mind maps based on their life experience and learning materials.

### **Step 4: Results display and evaluation (0.5 hours)**

#### **Teacher's task:**

(1) Teacher listen to the students' presentations and sharing their assignments.

(2) Teacher record the questions raised during group cooperation and communication, and stimulate students to think and discuss.

(3) Teacher evaluate and summarize groups assignments based on their presentations, enabling students to improve their abilities and critical thinking in an equal and relaxed learning atmosphere.

### Students Activities

(1) Students summarize and organize the content of the classroom collaboration stage and discussion process.

(2) Students summarize the concepts and precautions for creating a mind map about innovative thinking principles.

(3) Students conduct self-evaluation and peer evaluation of their own and other group assignments during learning, evaluate the strengths and weaknesses of each group, and provide suggestions for revision.

### Learning materials

(1) Textbook:



(2) PPT:



(3) Online learning:

中国大学MOOC 课程 学校 学校云 慕课堂 下载APP 期末考试

首页 > 管理学

## 创新创业思维与实践

Mindset and Innovation and Entrepreneurship (P-IE)

张 斌 教授

播放

第1次开课  
 开课时间: 2019年10月08日 ~ 2020年06月30日  
 学时安排: 1-2小时每周  
 当前开课已结束

[立即自学](#)

往期不提供结课证书, 想参加下学期课程。

Innovation Training Course PPT pictures:

<h2>第二章 创新思维与创新方法</h2>	<h3>第一节 创新思维</h3> <ol style="list-style-type: none"> <li>1. 创新思维的概念</li> <li>2. 创新思维的形式</li> <li>3. 创新思维的主要特点</li> <li>4. 创新思维的障碍</li> <li>5. 突破创新思维障碍的方法</li> </ol>	<h3>第一节 创新思维</h3> <p>在英文中“创新”(Innovation)这个词起源于拉丁语,它原意有三层含义:一是更新;二是创造;三是改变。</p> <p>创新思维是人类在探索未知领域过程中,发挥人的主观能动性,以超越常规的眼光观察问题,提出与众不同且能经得起检验的全新观点、思路和方案并解决问题的思维活动。</p>
<h4>一、创新思维的概念</h4> <p>01 广义理解的创新思维包括在发明创造中直接或间接使用的一切思维形式,包括逻辑的、非逻辑的思维。</p> <p>02 狭义理解的创新思维专指在发明创造中提出创新思想的思维活动形式。</p>	<h4>二、创新思维的形式</h4> <h5>五种常见的创新思维</h5> <ul style="list-style-type: none"> <li><b>正向思维</b>: 顺过来思维,即沿着与一般习惯或成规的方向进行思考,分析解决问题的方式。</li> <li><b>联想思维</b>: 通过已知事物之间的联系,从而推导出未知事物的思维方式。</li> <li><b>发散思维</b>: 从一点出发,向各个方向、各个层次、各个侧面进行思考,寻求多种解决问题的可能性。</li> <li><b>逆向思维</b>: 从反面或相反的方向进行思考,寻求解决问题的新方法。</li> <li><b>收敛思维</b>: 将各种分散的思维成果,集中起来,寻求最佳解决问题的方案。</li> </ul>	<h4>二、创新思维的形式</h4> <h5>(一) 逆向思维</h5> <p>逆向思维也叫求异思维,它是对司空见惯的似曾相识的事物或观点反过来思考的一种思维方式。</p> <ul style="list-style-type: none"> <li>逆向思维打破常规,敢于向权威挑战,敢于向传统观念挑战,敢于向陈规旧习挑战,敢于向大众观念挑战。</li> <li>逆向思维打破常规,敢于向权威挑战,敢于向传统观念挑战,敢于向陈规旧习挑战,敢于向大众观念挑战。</li> </ul>
<h4>二、创新思维的形式</h4> <h5>(二) 发散思维</h5> <p>发散思维又称辐射思维、放射思维、扩散思维或求异思维,是指在事物或对问题的研究中,保持思想活跃和开放状态,保持思想活跃和开放状态。</p> <p>如果说创新是一个民族兴盛的基石,那么发散思维便是创新的基石。</p>	<h4>二、创新思维的形式</h4> <h5>(二) 发散思维</h5> <p>在解决具体问题的过程中,如何运用发散思维并没有固定不变的模式。对于不同的条件,运用这种思维的方式也是不同的。一般来说,发散思维的方法有以下几种:</p> <ul style="list-style-type: none"> <li><b>多向思维</b>: 从多个角度、多个侧面、多个层次进行思考,寻求多种解决问题的方法。</li> <li><b>多端思维</b>: 从多个起点、多个方向、多个层次进行思考,寻求多种解决问题的方法。</li> <li><b>多途思维</b>: 从多个途径、多个渠道、多个侧面进行思考,寻求多种解决问题的方法。</li> </ul>	<h4>二、创新思维的形式</h4> <h5>(二) 发散思维</h5> <p><b>纵向发散法</b>: 沿着事物的纵向进行思考,寻求多种解决问题的方法。</p> <p><b>交叉发散法</b>: 从多个角度、多个侧面、多个层次进行思考,寻求多种解决问题的方法。</p>
<h4>二、创新思维的形式</h4> <h5>(三) 联想思维</h5> <p>联想思维是在原先并不相关的事物之间建立起一种认识的联系,将两者联系起来,从而产生新的认识。</p> <p><b>纵向联想</b>: 沿着事物的纵向进行思考,寻求多种解决问题的方法。</p> <p><b>横向联想</b>: 从多个角度、多个侧面、多个层次进行思考,寻求多种解决问题的方法。</p> <p><b>逆向联想</b>: 从反面或相反的方向进行思考,寻求多种解决问题的方法。</p>	<h4>二、创新思维的形式</h4> <h5>(四) 非逻辑思维: 灵感思维</h5> <p>灵感思维,是指在事物的接触及思考中,因受到某种启发而产生的创新思维方式。它同逻辑思维一样,是在科学研究和文学艺术创作中经常出现和运用的一种创新思维方式。</p> <p>idea</p> <p>由于这种创新思维方式具有非逻辑的高效率,所以,要善于抓住这种非逻辑的灵感思维,对其进行深入思考和研究,以取得解决具体问题的最佳或创造性的解决方案。</p>	<h4>二、创新思维的形式</h4> <h5>(四) 非逻辑思维: 求异思维</h5> <p>所谓求异思维,是指思维主体对某一研究问题求解时,不满足于以往思维的常规,从不同方向、不同角度去寻求解决问题的不同答案的一种思维方式。</p> <p>求异思维方法的内核是:积极求异,灵感迸发,多点创异,最后形成异彩纷呈的新思路、新见解。</p> <p>可以说,求异思维方法是一种创造性的思维,科学史上许多重大发现和发明都是通过这种方法实现的。</p>
<h4>二、创新思维的形式</h4> <h5>求异思维 → 2. 转换求异思维</h5> <p>转换求异思维是指思维主体在问题求解时,通过变换或改变原有思维的视角、方向、方法或依据,从而获取不同答案的一种思维方式。</p> <ul style="list-style-type: none"> <li>▶ 思维视角转换法。</li> <li>▶ 思维方向转换法。</li> <li>▶ 思维方法转换法。</li> <li>▶ 思维依据转换法。</li> </ul> <p>转换求异思维的方法: (1)转换思维视角; (2)转换思维方向; (3)转换思维方法; (4)转换思维依据。</p>	<h4>视频1: 论批判性思维 Critical Thinking</h4> <p>Go The Distance</p>	<h4>视频2: 提高批判性思维的5个小贴士</h4> <p>CRITICAL THINKING</p> <p>It's necessary to apply knowledge and practice critical thinking skills to solve problems.</p>

<p><b>三、创新思维的主要特点</b></p>  <ul style="list-style-type: none"> <li>(一) 独创性或新颖性</li> <li>(二) 极大的灵活性</li> <li>(三) 艺术性和非拟化</li> <li>(四) 对象的潜在性</li> <li>(五) 风险性</li> </ul>	<p><b>视频3: 思维模式对你的人生来说有多重要?</b> 这就是你和别人的区别!</p> 	<p><b>第三节 创新思维的训练方法</b></p> <p><b>(一) 发散思维</b></p> <ol style="list-style-type: none"> <li>请在5分钟内尽可能多地写出带有数字一至十的词汇,如一心一意等,与邻桌比比,写得最多又无错误的为胜。</li> <li>用5个关键词编故事,看谁的思维最发散。规则:所编故事一定要用到所有的相关词汇,无先后次序,长短不限,看谁编得最好。</li> </ol> <p>关键词: 古语 台风 一棵树 杂货店 天使</p>
<p><b>(二) 收敛思维</b></p> <ol style="list-style-type: none"> <li>下列各词,哪一个与众不同? A: 房屋 冰棍 平房 办公室 茅舍 B: 沙丁鱼 鲑鱼 鳊鱼 鳙鱼 鲤鱼</li> <li>假如你是一个钟表商店的经理,门前要挂两个大的钟表模型,你认为时针和分针摆在什么位置上最好?</li> </ol>	<p><b>(三) 逆向思维</b></p> <ul style="list-style-type: none"> <li>· 1 买卖链接       <ul style="list-style-type: none"> <li>· 游戏目的: 在迅速反应中发展思维的逆向性和灵活性。</li> <li>· 游戏玩法: 一起玩“石头、剪刀、布”。不过,这次要增加小小的改动,每一次胜利者都要做“买”的动作,输的一方则要像“卖”的动作,谁先做够谁就能淘汰。</li> </ul> </li> <li>· 2 反口令       <ul style="list-style-type: none"> <li>· 游戏目的: 根据“口令”做相反的动作,训练思维的逆向性及思维的敏捷性。</li> <li>· 游戏玩法: 你说“站立”,对方就要坐着不动你说“举左手”,对方就要举右手;你说“向前走”,对方就要往后退——总而言之,对方要和你说“反着来”才行,如果他做错了就算输。</li> </ul> </li> </ul>	<p><b>二、实操联系——思维导图</b></p> <ul style="list-style-type: none"> <li>· 思维导图又叫心智图是表达发散性思维的有效图形思维工具,它简单却又很有效,是一种革命性的思维工具。</li> <li>· 思维导图是一种将思维形象化的方法,简单来说,思维导图就是用图表的形式来描述我们的思考。</li> </ul>
<p><b>思维导图</b></p> 	<p><b>思维导图</b></p> 	<p><b>课后作业</b></p> <p>以小组为单位(6-8人一组),采用头脑风暴法,进行思维发散,绘制一张以“文化”为主题的思维导图。</p> <p><b>要求: 1. A4纸, 下周上课文</b> <b>2. 小组团队合作</b></p> <p><b>思维导图绘制</b></p> 

### Online learning:

[https://www.bilibili.com/video/BV1nt4y1C7j3/?spm\\_id\\_from=333.999.0.0&vd\\_source=6059c9d05b535875c9a3f5f7c8833896](https://www.bilibili.com/video/BV1nt4y1C7j3/?spm_id_from=333.999.0.0&vd_source=6059c9d05b535875c9a3f5f7c8833896)

[https://www.bilibili.com/video/BV1at411o7Co/?spm\\_id\\_from=333.999.0.0](https://www.bilibili.com/video/BV1at411o7Co/?spm_id_from=333.999.0.0)

[https://www.bilibili.com/video/BV1ZJ411b7tx/?spm\\_id\\_from=333.999.0.0](https://www.bilibili.com/video/BV1ZJ411b7tx/?spm_id_from=333.999.0.0)

[https://www.bilibili.com/video/BV1G4411M7nP/?spm\\_id\\_from=333.999.0.0](https://www.bilibili.com/video/BV1G4411M7nP/?spm_id_from=333.999.0.0)

### Team work and Discussion:

1. What are the inspirations of innovative thinking for your personal development?

2. What are the opportunities for innovation in your life?

## Evaluation

**Table 4** The scoring of interpretive ability and analytical ability

Item	5	4	3	2	1
<b>Item 1 : interpretive ability and analytical ability</b>					
Standard 1: Be able to discover the innovation thinking theory	Be able to accurately summarize and organize the relevant definitions of innovative thinking principles when creating mind map	Be able to use mind map to clearly outline the relevant definitions of innovative thinking principles	Possess basic interpretive and analytical skills, and organize definitions of innovative thinking principles	Having basic explanatory and analytical abilities, but unable to summarize and organize the definition of innovative thinking principles	Lack of basic explanatory and analytical skills, unable to organize the definition of innovative thinking principles
Standard 2: Identify the forms and characteristics of innovative thinking	Be able to accurately identify and summarize various forms and different characteristics of innovative thinking	Be able to clearly outline the forms and characteristics of innovative thinking	Having basic explanatory and analytical skills, able to roughly outline the forms and characteristics of innovative thinking	Having basic interpretive and analytical abilities, but unable to summarize the forms and characteristics of innovative thinking	Lack of basic explanatory and analytical skills, unable to summarize the forms and characteristics of innovative thinking

**Table 5** Criteria to evaluate Item 1

Standard 1: Be able to discover the innovation thinking theory	
Standard 2: Identify the forms and characteristics of innovative thinking	
Score	Grade
9- 10	Excellent
7 - 8	Good
5 -6	Moderate
3 – 4	Pass
Less than 3	Poor



### Scoring rubric for form (Objective 3)

#### Assessment form for Validity of Rubric

**Research Title:** Development of Problem-Based Learning Instructional Model to Improve Critical Thinking Ability for Undergraduate Students

**Research Objectives:** 3. To study the result of problem-based learning instructional model to improve critical thinking ability for undergraduate students.

**Assessor:** Assistant Professor Dr. SarayuthSethakajorn

**Position:** Educational management and Learning Management Innovation Program

**Workplace:** Bansomdejchaopraya Rajabhat University

**Directions:** Please assess the validity of the attached lesson plans regarding the given issues by putting ✓ in the box according to the following criteria.

- +1 if you think the issues CAN measure the appropriateness of the instructional model
- 0 if you are NOT SURE the issues can measure the appropriateness of the instructional model
- 1 if you think the issues CANNOT measure the appropriateness of the instructional model

5 means the highest

4 means high

3 means moderate

2 means few

1 means the fewest

Table 1 Scoring rubric form

Item	5	4	3	2	1
<b>Item 1: Interpretive ability, Analytical ability</b>					
<b>Standard 1:</b> Be able to discover the innovation thinking theory	Be able to accurately summarize and organize the relevant definitions of innovative thinking principles when creating mind map	Be able to use mind map to clearly outline the relevant definitions of innovative thinking principles	Possess basic interpretive and analytical skills, and organize definitions of innovative thinking principles	Having basic explanatory and analytical abilities, but unable to summarize and organize the definition of innovative thinking principles	Lack of basic explanatory and analytical skills, unable to organize the definition of innovative thinking principles
<b>Standard 2:</b> Identify the forms and characteristics of innovative thinking	Be able to accurately identify and summarize various forms and different characteristics of innovative thinking	Be able to clearly outline the forms and characteristics of innovative thinking	Having basic explanatory and analytical skills, able to roughly outline the forms and characteristics of innovative thinking	Having basic interpretive and analytical abilities, but unable to summarize the forms and characteristics of innovative thinking	Lack of basic explanatory and analytical skills, unable to summarize the forms and characteristics of innovative thinking

Table 1 (Continued)

Item	5	4	3	2	1
<b>Item 2: Reasoning ability</b>					
Standard 1: Be able to using innovative design thinking to design a personal life development plan that you enjoy	Be able to accurately apply innovative design thinking to design personal life development plan	Be able to apply innovative design thinking to design personal life development plan	Can roughly apply innovative design thinking to design personal life development plan	Can understand innovative design thinking, but unable to design personal life development plan	Unable to understand innovative design thinking and design personal life development plan
Standard 2: Using the process of design thinking, design a jewelry that can be carried with you	Be able to accurately apply design thinking steps to design a jewelry	Be able to apply design thinking steps to design a jewelry	Can use most of the steps of design thinking to design a jewelry	Can partially use design thinking steps, but cannot design a jewelry	Unable to use design thinking steps to design a jewelry

Table 1 (Continued)

Item	5	4	3	2	1
<b>Item 3: Explanatory ability</b>					
Standard 1: Ability to describe and define the innovation and entrepreneurship	Accurately describe and define the innovation and entrepreneurship	Be able to better describe and define the innovation and entrepreneurship	Could describe and define the innovation and entrepreneurship	It is more difficult to describe and define the innovation and entrepreneurship	It is impossible to describe and define the innovation and entrepreneurship
Standard 2: Display the process of mobile phone innovation through text or graphics	Accurately show the process of mobile phone innovation through text or graphics	Be able to better show the process of mobile phone innovation through text or graphics	Could display the process of mobile phone innovation through text or graphics	It is more difficult to display the process of mobile phone innovation through text or graphics	It is impossible to display the process of mobile phone innovation through text or graphics

Table 1 (Continued)

Item	5	4	3	2	1
<b>Item 4: Evaluation ability and Self regulation ability</b>					
Standard 1: Be able to find personal value of life by using value creation canvas	Accurately find personal value of life by using value creation canvas	Be able to better find personal value of life by using value creation canvas	Could find personal value of life by using value creation canvas	It is more difficult to find personal value of life by using value creation canvas	It is impossible to find personal value of life by using value creation canvas
Standard 2: Be able to evaluate the life value canvas of other members in the group	Accurately evaluate the life value canvas of other members in the group	Be able to better evaluate the life value canvas of other members in the group	Could evaluate the life value canvas of other members in the group	It is more difficult to evaluate the life value canvas of other members in the group	It is impossible to evaluate the life value canvas of other members in the group

Table 2 Assessment form

Item	Assessment			Remarks
	Results			
	+1	0	-1	
<b>1</b>	<b>Item 1: Interpretive ability and Analytical ability</b>			
	<p><b>Standard 1:</b> Be able to discover the innovation thinking theory</p> <p><b>Standard 2:</b> Identify the forms and characteristics of innovative thinking</p>			
<b>2</b>	<b>Item 2: Reasoning ability</b>			
	<p><b>Standard 1:</b> Be able to using innovative design thinking to design a life development plan that you enjoy</p> <p><b>Standard 2:</b> Using the process of design thinking, design a jewelry that can be carried with you</p>			
<b>3</b>	<b>Item 3: Explanatory ability</b>			
	<p><b>Standard 1:</b> Ability to describe and define the innovation and entrepreneurship</p> <p><b>Standard 2:</b> Display the process of mobile phone innovation through text or graphics</p>			
<b>4</b>	<b>Item 4: Evaluation ability and Self regulation ability</b>			
	<p><b>Standard 1:</b> Be able to find personal value of life by using value creation canvas</p> <p><b>Standard 2:</b> Be able to evaluate the life value canvas of other members in the group</p>			

Criteria to evaluate Item 1 Interpretive ability and Analytical ability 2 Standards

Score	Grade
9-10	Excellent
7-8	Good
5-6	Fair
3-4	Poor
Less than 3	Very poor

Criteria to evaluate Item 2 Reasoning ability 2 Standards

Score	Grade
9-10	Excellent
7-8	Good
5-6	Fair
3-4	Poor
Less than 3	Very poor

Criteria to evaluate Item 3 Explanatory ability 2 Standards

Score	Grade
9-10	Excellent
7-8	Good
5-6	Fair
3-4	Poor
Less than 3	Very poor

Criteria to evaluate Item 4 Evaluation ability and Self regulation ability 2  
Standards

Score	Grade
9-10	Excellent
7-8	Good
5-6	Fair
3-4	Poor
Less than 3	Very poor

Criteria to evaluate critical thinking ability over all

Score	Grade
33-40	Excellent
25-32	Good
17-24	Fair
9-16	Poor
Less than 9	Very poor



## Appendix D

### The Results of the Quality Analysis of Research Instruments

- IOC Questionnaire for students
- IOC Interview for lecturers
- IOC Lesson Plan
- IOC Scoring rubric form

### Evaluation Results of IOC for Questionnaire for Students

NO	Item	Experts' rating			Total	IOC	Results
		1	2	3			
<b>Internal factors</b>							
1	Do you think if you joy or satisfaction or caring or eagerness in innovation training course can improve your critical thinking ability?	+1	+1	+1	3	1	Valid
2	Do you think building a trusting relationship between lecturers students and families in innovation training course can improve your critical thinking ability?	+1	+1	+1	3	1	Valid
3	Do you think if the lecturers have skills in communication, collaboration, adaptability , empathy and patience make you like to study in innovation training course and can improve your critical thinking ability?	+1	+1	+1	3	1	Valid
4	Do you think if you have a positive attitude that make you are successful in studying in innovation training course and having good critical thinking ability?	+1	+1	+1	3	1	Valid
5	Do you think if you are well – being, brain , a good health to study in innovation training course , make you improve critical thinking ability?	+1	+1	+1	3	1	Valid
<b>External factors</b>							
6	Do you think if the lecturers have the difference instructional model and verity evaluation to teach in innovation training course can improve students' critical thinking ability?	+1	+1	+1	3	1	Valid
7	Do you think if the lecturers finish education by major or have the high or experience to teach in innovation training course can improve students' critical thinking ability?	+1	+1	+1	3	1	Valid

NO	Item	Experts' rating			Total	IOC	Results
		1	2	3			
<b>External factors</b>							
8	Do you think if the students manage the time to study innovation training course both inside and outside the classroom can improve students' critical thinking ability?	+1	+1	+1	3	1	Valid
9	Do you think that the teaching environment (including class size, classroom environment, facilities, teacher-student interaction, relatively fixed and quiet teaching place) of the innovation training course affects students' critical thinking ability?	+1	+1	+1	3	1	Valid
10	Do you think the good materials that modern and verity to teach in innovation training course have the affecting students' critical thinking ability?	+1	+1	+1	3	1	Valid
<b>Total (In Overview)</b>					30	1	Valid

Note: Valid when  $\geq 0.60$

### Evaluation Results of IOC for Interview for Lectures

NO	Item	Experts' rating			Total	IOC	Results
		1	2	3			
<b>Internal factors</b>							
1	When you teach in innovation training course, how do you know your students joy or satisfaction or like to study in this course? Please give the reason.	+1	+1	+1	3	1	Valid
2	Do you think building a trusting relationship between lecturers students and families in innovation training course can improve your students' critical thinking ability? Please give the reason.	+1	+1	+1	3	1	Valid
3	Do you have a good skills , communication, collaboration, adaptability , empathy and patience to teach students in innovation training course? Please give the reason.	+1	+1	+1	3	1	Valid
4	Do you think if you have a positive attitude for students that make you are successful to teach in innovation training course and having your students' good critical thinking ability? Please give the reason.	+1	+1	+1	3	1	Valid
5	Do you think if you are well – being, brain, a good health to teach in innovation training course, make your students' improve critical thinking ability? If you agree, please give the reason.	+1	+1	+1	3	1	Valid
<b>External factors</b>							
6	What do use instructional model and verity evaluation to teach in innovation training course and what do you think about problem-based learning instructional model to can improve students' critical thinking ability?	+1	+1	+1	3	1	Valid
7	What do you finish your education , what your major and how many year of your experiences to teach in innovation training course ?	+1	+1	+1	3	1	Valid
8	What do you prepare the time to discuss with the students , have the participating together inside and outside the classroom to improve students' critical thinking ability?	+1	+1	+1	3	1	Valid

NO	Item	Experts' rating			Total	IOC	Results
		1	2	3			
9	Do you think that the teaching environment (including class size, classroom environment, facilities, teacher-student interaction, relatively fixed and quiet teaching place) of the innovation training course affects students' critical thinking ability? Please give the reason.	+1	+1	+1	3	1	Valid
10	What materials to teach in innovation training course? Do you think its a good materials , modern and verity to teach in innovation training course and have the affecting students' critical thinking ability?	+1	+1	+1	3	1	Valid
<b>Total (In Overview)</b>					30	1	Valid

Note: Valid when  $\geq 0.60$

### Evaluation Results of Instructional Model Appropriateness Evaluation

NO	Components of flipped classroom teaching model	Opinion of the Specialists															
		Utility				Feasibility				Propriety				Accuracy			
		Agree		Disagree		Agree		Disagree		Agree		Disagree		Agree		Disagree	
		F	P	F	P	F	P	F	P	F	P	F	P	F	P	F	P
1	Principle and Rationale	3	100	3	0	3	100	3	0	3	100	3	0	3	100	3	0
2	Objectives	3	100	3	0	3	100	3	0	3	100	3	0	3	100	3	0
3	Contents	3	100	3	0	3	100	3	0	3	100	3	0	3	100	3	0
4	Methods of Teaching &Materials	3	100	3	0	3	100	3	0	3	100	3	0	3	100	3	0
5	Evaluation	3	100	3	0	3	100	3	0	3	100	3	0	3	100	3	0

F is frequency, P is percent.

Evaluation Results of IOC for Lesson Plans by 3 experts

NO	Item	Experts'			Total	IOC	Results
		rating					
		1	2	3			
<b>Learning Objective</b>							
1	Complying with content of the course	+1	+1	+1	3	1	Valid
2	Covering knowledge, process, and attitude	+1	+1	+1	3	1	Valid
3	Being measurable in knowledge, process, and attitude	+1	+1	+1	3	1	Valid
<b>Contents</b>							
4	Complying with learning objective	+1	+1	+1	3	1	Valid
5	Being appropriate in terms of time management	+1	+1	+1	3	1	Valid
6	Problem-based Learning instructional models	+1	+1	+1	3	1	Valid
7	Complying with the designed instructional model	+1	+1	+1	3	1	Valid
8	Supporting students' learning	+1	+1	+1	3	1	Valid
9	Including various activities	+1	+1	+1	3	1	Valid
<b>Learning materials</b>							
10	Complying with the learning objectives	+1	+1	+1	3	1	Valid
11	Complying with the contents	+1	+1	+1	3	1	Valid
<b>Evaluation and Assessment</b>							
12	Complying with the learning objectives	+1	+1	+1	3	1	Valid
13	Including various methods and instruments	+1	+1	+1	3	1	Valid
<b>Total (In Overview)</b>					<b>39</b>	<b>1</b>	<b>Valid</b>

Note: Valid when  $\geq 0.60$

## Evaluation Results of IOC for Validity of Scoring Rubric

NO	Item	Experts' rating			Total	IOC	Results
		1	2	3			
<b>Interpretive ability, Analytical ability</b>							
1	Standard 1: Be able to discover the innovation thinking theory	+1	+1	+1	3	1	Valid
2	Standard 2: Identify the forms and characteristics of innovative thinking	+1	+1	+1	3	1	Valid
<b>Reasoning ability</b>							
3	Standard 1: Be able to using innovative design thinking to design a personal life development plan that you enjoy	+1	+1	+1	3	1	Valid
4	Standard 2: Using the process of design thinking, design a jewelry that can be carried with you	+1	+1	+1	3	1	Valid
<b>Explanatory ability</b>							
5	Standard 1: Ability to describe and define the innovation and entrepreneurship	+1	+1	+1	3	1	Valid
6	Standard 2: Display the process of mobile phone innovation through text or graphics	+1	+1	+1	3	1	Valid
<b>Evaluation ability, Self regulation ability</b>							
7	Standard 1: Be able to find personal value of life by using value creation canvas	+1	+1	+1	3	1	Valid
8	Standard 2: Be able to evaluate the life value canvas of other members in the group	+1	+1	+1	3	1	Valid
<b>Total (In Overview)</b>					<b>24</b>	<b>1</b>	<b>Valid</b>

Note: Valid when  $\geq 0.60$



Appendix E  
Certificate of English

**BS** BANSOMDEJCHAOPRAYA  
**RU** RAJABHAT UNIVERSITY

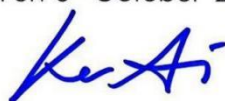
This is to certify that

***Miss Tianru Ye***

Achieved BSRU English Proficiency Test (BSRU-TEP) level

**C2**

Given on 3<sup>rd</sup> October 2020



(Assistant Professor Dr Kulsirin Aphiratvoradej)

Director

## Appendix F

The Document for Acceptance Research

MHESI 8038.1/05



**JOURNAL OF MCU UBON REVIEW**  
Mahachulalongkornrajavidyalaya  
University, Ubon Ratchathani Campus

### RESPONSE FOR PUBLICATION OF THE ARTICLE

8<sup>th</sup> July, 2024

The Editorial Department of the Journal of MCU Ubon Review (TCI) of MCU, Ubon Ratchathani Campus has considered the article.

**Title :** DEVELOPMENT OF PROBLEM-BASED LEARNING INSTRUCTIONAL MODEL TO IMPROVE CRITICAL THINKING ABILITY FOR UNDERGRADUATE STUDENTS

**Writer :** Ye Tianru, Areewan Iamsa-ard, Tanaput Chancharoen and Wapee Kong-In

**Publication Approval:** The Journal of MCU Ubon Review (ISSN : 2697-4150 (Online)) Mahachulalongkornrajavidyalaya University, Ubon Ratchathani Campus

**Period of Publication :** 9<sup>th</sup> Year, Volume III (September-December 2024)

Your article has been sent to 3 experts for peer review and found that its quality is at a "Good" level and academically useful.

Please be informed accordingly.

(Assoc.Prof, Dr.Phrakhruwutthidhampanit)

Editor of the Journal of MCU Ubon Review (TCI)  
Mahachulalongkornrajavidyalaya University, Ubon Ratchathani Campus

The Editorial Department of the Journal of MCU Ubon Review (TCI)  
Mahachulalongkornrajavidyalaya University, Ubon Ratchathani Campus  
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The Editor: Tel.081-7908464, Coordinator: Tel. 081-5474704  
E-mail : journal.of.mcu.ubon.review@gmail.com, Website: <https://so06.tci-thaijo.org/index.php/mcejou>

## Researcher Profile

**Name-Surname:** Ye Tianru  
**Birthday:** 02, July, 1989  
**Address:** No. 100, Mingxiu West Road, Xixiang Tang District, Nanning City, Guangxi, China

**Educational background:** Master of Commerce, The University of Adelaide, in 2015  
Bachelor of Tourism Management, Guangxi Normal University, in 2013

**Working experience:** 2016.05- Now Working in Guangxi Minzu University

**Office Location:** Guangxi Minzu University

**Current Contact Location:** No. 180, University East Road, Xixiang Tang District, Nanning City, Guangxi, China