

DEVELOPMENT OF PROJECT BASED LEARNING INSTRUCTIONAL
MODEL FOR ENHANCING CRITICAL THINKING ABILITY OF
UNDERGRADUATE STUDENTS

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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 Project Based Learning Instructional Model for
Enhancing Critical Thinking Ability of Undergraduate Students

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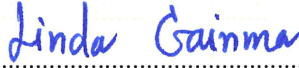

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ABSTRACT

The objectives of this research are 1) To examine the factors to enhance critical thinking ability of undergraduate students. 2) To develop project-based learning instructional model for enhancing critical thinking ability of undergraduate students. 3) To study the results of implementing project-based learning instructional model for enhancing critical thinking ability of undergraduate students. Population in Phase 1, there are 200 former students at Yulin Normal University enrolled Web Design and Production Course in semester 1 academic year 2022 and 3 lecturers teach Web Design and Production Course at Yulin Normal University. There are 5 experts to confirm instructional model in Phase 2. The sample groups of this research were 63 students from Yulin Normal University in Phase 3. The research instruments were 1) a set of questionnaires for students and interview for lecturers, 2) a set of questionnaires for confirming instructional model, 3) lesson plan and 4) scoring rubric. Data were statistically analyzed by percentage, mean, standard deviation and content analysis, data analytics statistics for confirmation of instructional model and scoring rubric.

The results were found that:

1. The factors which enhancing critical thinking ability of undergraduate students include 2 factors: Internal factors and external factors. Data analysis results from students' data reveal that that learning interest, learning effort, and learning motivation are the most influential internal factors. The attitude of the instructor towards innovative teaching models, the emphasis placed on cultivating critical thinking abilities, the course objectives set by the instructor, and the teaching methods adopted by the instructor are external

factors that have a significant impact. Lecturers' opinion reflect also both internal and external factors. In terms of internal factors, students' cognition, knowledge level, and experience can affect their critical thinking ability. Researcher summarize these internal factors into two aspects: students' knowledge and experience (participation in classroom activities and practices) and students' psychology (promoting self-directed learning, making learners interested in web design and production courses). Regarding external factors, including social environment (creating a classroom atmosphere to achieve teaching objectives), materials (preparing teaching aids, learning resources, and other necessary equipment to promote learning, interest, and broaden knowledge), teaching methods (integrating various teaching methods), and evaluation (analyzing the effectiveness of course teaching).

2. Project based learning instructional model for enhancing critical thinking ability of undergraduate students include 5 components: 1) Principle and rationale, 2) Objectives, 3) Contents, 4) Method of teaching & materials and 5) Evaluation. The steps of Project based learning instructional model involve step 1: Introduction of scenarios and clarification of tasks; step 2: Collect data and formulate plans; step 3: Group discussion, specific implementation; step 4: Instruction and process inspection; step 5: Display the results, revise and improve; step 6: Evaluate and test, expand and sublimate. The model is 100% conformed to utility standards, feasibility standards, propriety standards, and accuracy standards as assessed by 5 specialists.

3. It was found that 14.29% of 63 students whose critical thinking ability is at excellent level while another 79.36% of them are assessed to be at a good level. A total of 93.65% are above the good level. The result is consistent with the research hypothesis that 80% upwards of the participants will have critical thinking ability at good level after learning through project-based learning instructional model.

Keywords: Project-based learning instructional model, critical thinking ability

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Sharp sword from the sharpening out, plum blossom incense from the cold weather. The study at the doctoral stage gave me a deeper understanding of curriculum and teaching theory, and also gave me a new understanding of myself. As my dissertation work draws to a close, my study abroad career as a doctoral student in Thailand is coming to an end. Now looking back on these three years of study and life, I have received support and help from many people. It is precisely because of your help and support that I was able to successfully complete my studies. Thank you from the bottom of my heart.

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During the long process from the thesis filing to the mid-term defense, and then to the graduation defense, the teacher carefully annotated my questions from the overall framework to the content details, from theoretical design to practical application, from structural layout to standardized format, analyzed and elaborated. The teacher's suggestion is like a wake-up call, helping me to clarify the direction of the thesis revision, so that my thesis writing can proceed smoothly and be completed on time. I would also like to thank Yulin Normal University and related teachers and students, who gave me a lot of help in the research of influencing factors, the implementation of teaching models and the design of teaching activities during the teaching experiment of my thesis. At the same time, I would like to sincerely thank my family. It is precisely because of their strong support and understanding that I have enough time to devote myself to my doctoral studies and successfully complete my studies. I would also like to thank my PhD classmates for helping me answer my questions in my studies.

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Qin Lizhong

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Chapter 1

Introduction

Rationale

The course "Web Design and Production" is a backbone professional course for undergraduate e-commerce, journalism and other application majors (Yulin Normal University, 2022). Through the study of this course, students are required to master the basic concepts of web design, learn to use commonly used web design tools, be able to design and create common static and dynamic web pages, and have the ability to establish and maintain websites. At the same time, through the study of this course, students' critical thinking ability and innovative spirit will be cultivated. The design idea of this course is employment oriented, creating work scenarios, and focusing on the cultivation of practical skills through the teaching of book knowledge, in order to strengthen the cultivation of students' practical skills. The knowledge objectives of this course mainly include: being able to write HTML code, being able to display basic graphic and textual information, and being able to design multimedia pages. The skill objectives include: being able to independently collect and organize data, and having the ability to understand user needs; Ability to design and implement project pages based on project requirements; Able to achieve page beautification and layout based on static page design principles and CSS technical specifications. The quality objectives include: cultivating a good habit of self-directed learning that is good at thinking and conducting in-depth research; Through teaching, students' ability to analyze problems and critical thinking ability can be cultivated. (Yulin Normal University, 2022)

Critical thinking ability are a must-have skill for the 21st century. However, undergraduates in Guangxi have generally low critical thinking skills (Chen, 2018). First of all, colleges and universities do not measure and evaluate the development of students' critical thinking as an important output of the quality of talent training from the perspective of school-running philosophy (Li, 2015). Second, there is a lack of courses or educational teaching activities that specifically cultivate students' critical thinking (Zhang, 2016). In the teaching of computer courses, teachers tend to follow the teaching tradition of knowledge memory and neglect the cultivation of students'

critical thinking, especially the cultivation of skills in analysis, evaluation and creativity in critical thinking ability (Yang, 2017). Through investigation, it was found that our school did not pay enough attention to the cultivation of critical thinking ability, did not offer special critical thinking courses, and the lecturers failed to master the methods of cultivating critical thinking. For the students of web design and production courses, there are problems such as lack of analysis of user needs, lack of evaluation of layout, and lack of design innovation. These are the manifestations of students' lack of critical thinking ability. Therefore, it is imminent to strengthen the relevant research and practice of critical thinking of college students. (Yulin Normal University, 2022)

Project-based learning instructional model is a kind of learning that can stimulate learners' learning motivation and interest, cultivate students' ability to analyze and solve problems, and critical thinking ability. way (Yang, 2017). Project learning with curriculum standards as the core is a process of exploring complex and real issues, as well as a process of carefully designing project works, planning and implementing project tasks. In this process, students can master the required knowledge and skills (Building, 2008). The acquisition of learners' knowledge is not through simple memorization or rote memorization, but throughout the entire project task, allowing learners to actively participate in, explore and practice in the process of communicating and interacting with teachers and classmates, and their evaluation Adopting diversified evaluation methods such as teacher-student mutual evaluation and process evaluation can enable learners to acquire knowledge and skills during the completion of project tasks and enrich emotional experience (Li, 2008). Therefore, we believe that project learning can help improve students' problem-solving ability, practical ability, innovative thinking ability and critical thinking ability.

Mei (2022) Research on high school physics project-based learning for the cultivation of higher-order thinking ability. It expounds how to design high-school physics project-based learning for the cultivation of higher-order thinking ability through lesson examples. Li (2022). Pointing to the high school information technology project-based teaching design and practice for the cultivation of higher-order thinking, it explores how to carry out high school information technology project-based teaching design on the basis of cultivating students' higher-order

thinking ability. Guo (2012). An empirical study on the impact of project learning on the critical thinking ability of English majors. After analyzing the experimental data, it is concluded that project learning can improve students' critical thinking ability. Su (2019). Research on the influence of project-based learning in elementary school Chinese on students' critical thinking in a mixed learning environment, verifying the effect of project-based learning on the cultivation of students' critical thinking from two aspects: critical thinking tendency and critical thinking skills. Finally, the conclusion of the research is that the critical thinking of the class carrying out project-based learning is significantly stronger than that of the traditional teaching class. Therefore, we can see that the project teaching method can effectively improve students' critical thinking ability. However, through literature collection and statistics, it is found that the current model is mainly concentrated in the stage of compulsory education and vocational education or language subjects, and there are relatively few studies on the application of computer courses in the stage of higher education.

As the rationale shown above, the author realizes the importance of studying “Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students”.

Research Questions

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

Research Objectives

1. To examine the factors to enhance critical thinking ability of undergraduate students.
2. To develop project-based learning instructional model for enhancing critical thinking ability of undergraduate students.
3. To study the results of implementing project-based learning instructional model for enhancing critical thinking ability of undergraduate students.

Research Hypothesis

After implementing project-based learning model, students' critical thinking ability will be overall improved at 80% (Good Level).

Scope of the Research

Population and the sample group

Population

The total of 280 sophomore from 5 classes of students with different levels of proficiency-beginner, intermediate, and advanced, who enroll in Web Design and Production Course at Yulin Normal University in semester 1 academic year 2023. Those sections involve the following.

Class A 50 students

Class B 47 students

Class C 63 students

Class D 65 students

Class E 55 students

The sample group

The 63 students who enroll in Web Design and Production Course from class section C are obtained by cluster random sampling.

Independent variable

Project based learning instructional model

Dependent variable

Students' critical thinking ability

Contents

According to critical thinking ability in this study, the researcher chooses Unit 6 for the experiment. The content is shown below:

Chapter 1: Web page planning and design (6 hours)

Chapter 2: Web design and production (6 hours)

Chapter 3: Web application and optimization (4 hours)

Time

Semester 1 of academic year 2023 (August,2023 - October,2023)

Advantages

1. To the students: The learners' critical thinking is developed, and they can solve more complicated problems in their future studies or employment
2. To the lecturers: The other related teachers can apply the developed instruction model to other different courses.
3. To the institute: The university has alternatives of teaching model to develop its students for better outcomes.

Definition of Terms

The factors affecting critical thinking ability of undergraduate students refers to the internal and external factors collected from students using questionnaire and interviews for lecturers designed by the researcher. The internal factors involve the information about students while external factors consist of information about the teacher and circumstances. In addition, the factors will be obtained by structured interviews with the lecturers.

Development of project-based learning instructional model refers to a new teaching framework composed of stable teaching activities and teaching procedures. Experts confirmed such a 5-part teaching model from 4 aspects: 1. Principles and principles, 2. Objectives, 3. Content, 4. Teaching and material methods, 5. Evaluation: 1) Utility standards, 2) Feasibility standards, 3) Propriety standards and 4) Accuracy standards (Stufflebeam and Social Impact, 2012), as follows:

Utility Standards aims to ensure that the pedagogical models developed meet the information needs of the intended users.

Feasibility Standards aims to ensure that the teaching models developed are realistic, careful, flexible and frugal.

Propriety Standards aims to ensure that the pedagogical model developed will follow the pedagogical principles and deliver positive outcomes

Accuracy Standards aims to ensure that the developed teaching model shows how close to the true value.

Project based learning instructional model refers to a learning mode that takes students as the main body, starts with problems, takes project work as an

important link, and combines knowledge acquisition and knowledge application. Through literature research, it is found that project-based learning focuses on the creation of situations, task design, program formulation, project implementation, achievement sharing and evaluation. The teaching mode is subdivided into the following 6 steps (Kovalyova, 2016; Luo, 2015; Qi, 2020; Yin 2014; Wang, 2010):

Step 1: Introduction of scenarios and clarification of tasks.

Step 2: Collect data and formulate plans.

Step 3: Group discussion, specific implementation.

Step 4: Instruction and process inspection.

Step 5: Display the results, revise and improve.

Step 6: Evaluate and test, expand and sublimate.

Critical thinking ability refers to a tendency or skill to engage in activities with a deliberate attitude (Peter, 1990). It skillfully and actively interprets and evaluates observations, communications, information, and arguments (Michael, 2000). The critical thinking ability in this research refers to having a good judgment on the needs of users in the process of web design and production, using appropriate evaluation criteria to judge and think about the true value of web information content, and creating something after thinking A way of thinking and skills. There are three main dimensions of critical thinking ability, which include: 1) analysis, 2) evaluation, and 3) creativity. (Dong, 2012; Guo, 2014; Zhu, 2016; Yang, 2017; Paul, 2022)

Item 1: Analysis.

Standard 1: Group Positioning

Standard 2: Content Selection

Standard 3: Functional Settings

Item2: Evaluation.

Standard 1: Layout Design

Standard 2: Web Navigation

Standard 3: Web Security

Item 3: Creativity.

Standard 1: Design Highlights

Standard 2: User Experience

Standard 3: Updating and Optimizing

Undergraduate students refers to the students who enroll in Web Design and Production Course from Yulin Normal University.

Yulin Normal University refers to a government university located in the South of Guangxi for undergraduate students.

Research framework

Based on the research objectives, relevant theories are compiled and studied i.e, project-based learning instructional model and critical thinking ability. The steps of project-based learning instructional model Includes 6 steps. Step 1: Introduction of scenarios and clarification of tasks. Step 2: Collect data and formulate plans. Step 3: Group discussion, specific implementation. Step 4: Instruction and process inspection. Step 5: Display the results, revise and improve. Step 6: Evaluate and test, expand and sublimate (Kovalyova, 2016; Luo, 2015; Qi, 2020; Yin 2014; Wang, 2010). The students' critical thinking ability aremeasured through rubric score which consists of 3 items. Item1: Analysis. Item2: Evaluation. Item 3: Creativity (Peter, 1990;

Michael, 2000; Dong, 2012; Guo, 2014; Zhu, 2016; Yang, 2017; Paul, 2022). These thoughts and principles are employed as the foundation of the following research framework as shown in figure 1.1

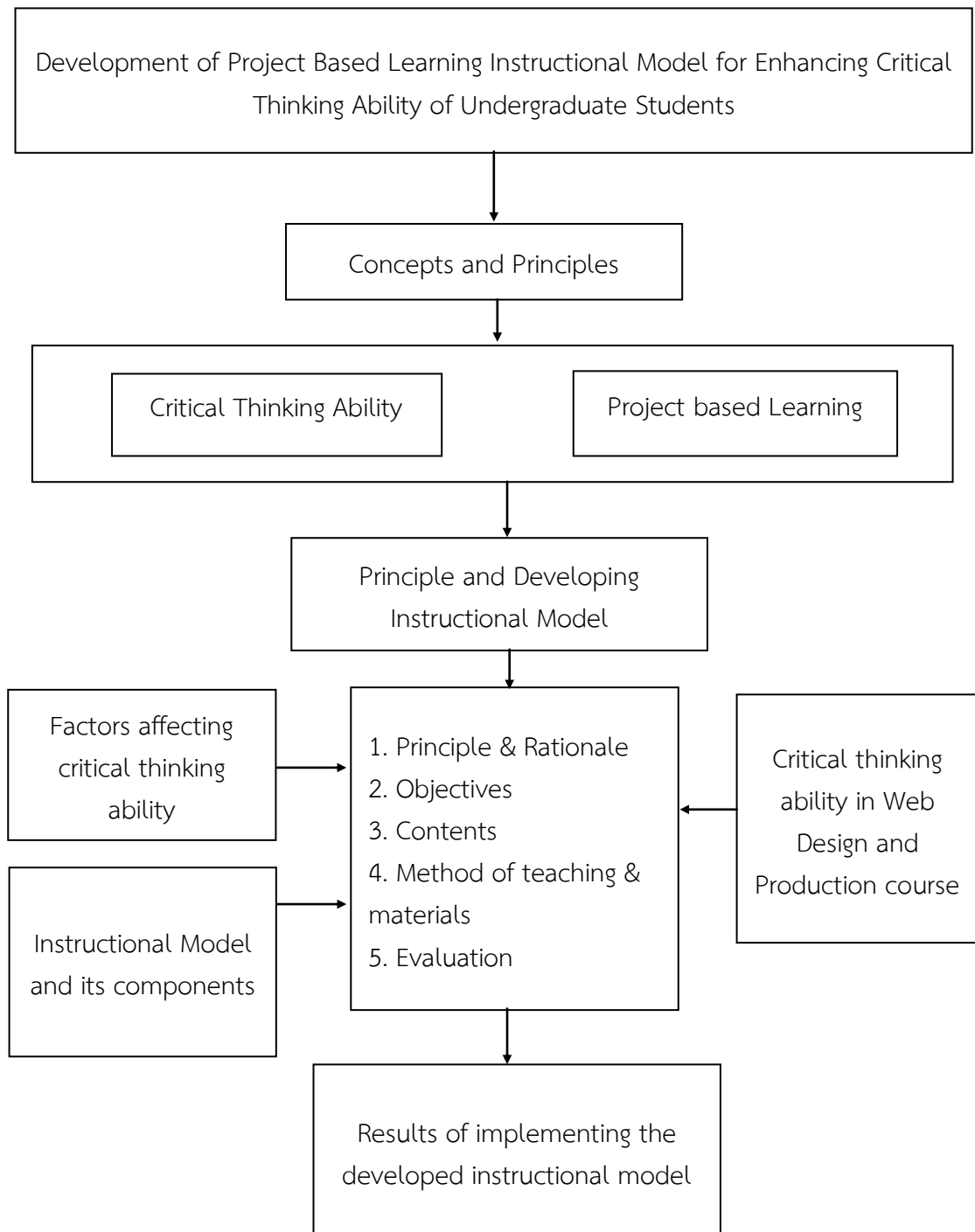


Figure 1.1 Research Framework (By researcher)

Chapter 2

Literature Review

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

1. Web Design and Production course in Yulin Normal University
2. Development of instructional model
3. Project-based learning instructional model
4. Critical thinking ability
5. Related Research

The details are as follows.

Web Design and Production course in Yulin Normal University

Principle

Web Design and Production is a main professional course for undergraduate e-commerce, Journalism and other application majors (Yulin Normal University, 2022). As one of the basic computer courses, it is a comprehensive and practical course. Through the learning of this course, students are required to master the basic concepts of web design, learn to use common web design tools, be able to design and produce common static and Dynamic web page, and have the ability to establish and maintain websites. At the same time, through the study of this course, students' critical thinking ability and innovative spirit will be cultivated. The design idea of this course is employment oriented, creating work scenarios, and focusing on the cultivation of practical skills through the teaching of book knowledge, in order to strengthen the cultivation of students' practical skills.

Objectives

The teaching objectives of this course are mainly divided into the following three aspects:

1. Knowledge objectives: be able to write HTML codes, be able to realize basic graphic information display and be able to design multimedia pages.

2. Skill goal: be able to independently collect and organize data, and have the ability to understand user needs; be able to design and implement project pages according to project requirements; be able to realize page beautification and layout according to static page design principles and CSS technical specifications wait.

3. Quality objectives: to develop a good habit of independent learning that is good at thinking and in-depth research; through teaching, cultivate learners' ability to analyze problems and critical thinking.

Curriculum structure

The Network Design and Production course consists of 6 units, namely Basic Knowledge of Web Page Production, Fundamentals of Web Design, Create Text, Image and Multimedia, Hyperlinks in web pages, Comprehensive Design and Production of Web pages. The specific content is shown in Table 2.1:

Table 2.1 Chapters and Contents Used in the Present Study

Unit	Chapter	Contents	Times (54 hrs.)
1. Basic Knowledge of Web Page Production	1.1 Basic Knowledge of Web Page Production	The definition, classification, basic components, and development tools of web pages.	8 hrs.
	1.2 Overview of Dreamweaver CS6	Start and exit, Home screen function	
	1.3 Web standards technology and HTML5	Web page structure language, commonly used tags, and added tags.	
	1.4 Comprehensive case study	Create web page documents and write code to implement simple web pages.	
2. Fundamentals of Web Design	2.1 Fundamentals of Web Design	Type of webpage layout, overall shape, design elements, website design process and theme	8 hrs.
	2.2 Preliminary planning and content organization	Website demand analysis, website content organization	

Table 2.1 (Continued)

Unit	Chapter	Contents	Times (54 hrs.)
	2.3 Color Application in Websites	Color theory, webpage color rules, color matching	
	2.4 Comprehensive case study	Overall Design of Home Page for Jewelry Sales Website	
3. Create Text	3.1 create documents	New Document, Open, Save	6 hrs.
	3.2 documents editing	Input text, format, style, paragraph editing, add symbols and numbering, horizontal lines	
	3.3 Comprehensive case study	Create Text	
4. Image and Multimedia	4.1 Common image formats in web pages	GIF, JPEG, PNG	8 hrs.
	4.2 Inserting and Setting Images	Insert images, set image attributes, and insert other image elements (placeholders, cursor over images) in web pages	
	4.3 The Application of Multimedia in Web Pages	Add Flash animation objects, insert FLV videos, insert movies, controls, background music, etc.	
	4.4 Comprehensive case study	Multimedia production (insert pictures, audio, video)	
5. Hyperlinks in web pages	5.1 Overview of hyperlinks	Definition, Type, Path	8 hrs.
	5.2 Create and manage hyperlinks	Property panel, pointing to file icons, menus, automatic updates, changes, checking for errors	
	5.3 Comprehensive case study	Create 'I Love Photography Network'	

Table 2.1 (Continued)

Unit	Chapter	Contents	Times (54 hrs.)
6. Comprehensive Design and Production of Web Pages	6.1 Web page planning and design	Website demand analysis, content selection, column design, site definition and catalog management, style design	16 hrs
	6.2 Web design and production	Web page layout, production of website homepage, production of secondary pages, web navigation settings, security, content web production	
	6.3 Web application and optimization	Interactivity, updates and optimizations, etc.	

Unit 6 is chosen by the research for implementing the developed model in the present study.

Development of instructional model

Definition of instructional model

Model refers to the theoretical logical framework of the research object. It is an operable knowledge system between experience and theory, and a simplified theoretical structure for reproducing reality.

Bruce and Marsha (1980) though instructional model is a paradigm or plan that constitutes the activities of teachers in selecting materials for courses and assignments. So instructional model can be defined as a relatively stable structure and procedure of teaching activities established under the guidance of certain teaching and learning ideas or theories (Gu, 1998; Ye, 1991; He, 1997; Cao, 2007). Develop the instructional model means to design teaching objectives, contents, teaching forms, means and evaluation methods under the guidance of certain learning theories.

Components of instructional model

Instructional design is a process used to plan which materials, strategies, activities, and evaluation are necessary to develop instruction using a systematic approach, while translating the principles of learning (Richey et al., 2011). The instruction design process focuses on three major areas (Mager, 1984). The process embraces an analysis of the instructional goals to determine the strategies and medium that would be successful as well as how the instructional materials will be evaluated then revised (Smith & Ragan, 2005).

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

Confirmatory Factor Analysis

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 and Social Impact, 2012)

Utility Standards aims to ensure that the pedagogical models developed meet the information needs of the intended users.

Feasibility Standards aims to ensure that the teaching models developed are realistic, careful, flexible and frugal.

Propriety Standards aims to ensure that the pedagogical model developed will follow the pedagogical principles and deliver positive outcomes

Accuracy Standards aims to ensure that the developed teaching model shows how close to the true value.

In summary, the instructional model developed by the researcher should meet the information needs of the target users, ensure that the developed teaching model is practical, detailed, flexible, and frugal; ensure that the developed teaching model follows teaching principles and achieves positive results. At the same time, ensure how close the values displayed by the developed teaching model are to the true values.

Project-based learning instructional model

1. The concept of project-based learning

The following describes the concept of project-based learning from three parts: background, principle and related theories.

Background

What is project-based learning? Project-based learning (PBL) is a model for organizing learning around projects. According to the definition for teachers in the PBL Handbook, projects are complex tasks, based on challenging problems or problems, that involve student participation in design, problem-solving, decision-making, or investigative activities; that give students the opportunity to work with relative autonomy over extended periods of time; and A realistic product or presentation culminates. (Jones, 1997)

The definition of "project-based instruction" includes features related to the use of real problems, communities of inquiry, and the use of cognitive (technology-based) tools (Kracik, 1994)

Boss and Krauss (2007) define project-based learning as an activity in which students "investigate open-ended problems and apply their knowledge to produce real products.

Ulrich (2016) pointed out that the concept of project-based learning comes from the great thought of scholar and philosopher John Dewey. He believes that students gain practical and effective knowledge when they experience and practice things related to real life. Dewey's philosophy is further known as "learning by doing". In addition, Dewey also proposed that experience is the best way for students to acquire knowledge (Rostitawati, 2014). John Dewey's theory has been extensively developed in various learning concepts. One of these is project-based learning initiated by William Kilpatrick (1871-1965). Project-based learning has been further developed in various language learning studies, one of which is (Kovalyova, 2016) a study on implementing project-based learning of oral English skills. The findings showed that students improved in vocabulary acquisition, grammar comprehension, and reading and writing skills. At the same time, according to the research results of the Buck Institute of Education (BIE, 2012), project-based learning can guide students to acquire 21st century skills, namely 4C skills (communication, collaboration, critical

thinking and problem solving, creativity and innovation), character values and higher order thinking skills.

Project-based learning (PBL) has recently gained attention in the field of education. Over the past decade, research on PBL has been increasingly conducted and adopted in various educational institutions worldwide (Lehmann et al., 2008; Harmer and Stoke, 2014; Kolmos, 2009). In terms of its key functions, Stivers (2010) stated that PBL is a teaching method that is based on learning activities and practical tasks that present challenges for students to solve. Bell (2010) defines PBL as a student-centered learning approach in which students are required to create a project to share with a selected audience by asking questions or exploring and engaging with authentic projects under the supervision of a teacher. In other words, students need to design their own inquiries, plan their learning, organize their research, implement multiple learning strategies, and evaluate their projects. When it comes to the role of the teacher, Bell (2010) also extends the definition of PBL to the method by which the teacher acts as a facilitator. Students work together under the supervision of a teacher who oversees each process and approves each choice, and the students then begin to move toward a common goal (Bell, 2010). In short, PBL originally developed from its roots in constructivist theory, in which learning was conceived as a mental construct; that is, students learn by constructing new ideas or concepts to learn. This approach enables learners to pursue content knowledge on their own, demonstrate their new understanding through a variety of presentation modes, and acquire valuable skills to build a solid foundation for their future in the global economy.

In China's new version of the compulsory education curriculum plan, it is clearly required: to explore large-unit teaching, actively carry out comprehensive teaching activities such as theme-based and project-based learning, promote students to infer other things from one instance, integrate them, strengthen the internal relationship between knowledge, and promote knowledge structure (Curriculum standards, 2022). Project learning is a comprehensive and active form of educational practice in which students comprehensively use multidisciplinary learning achievements to conduct independent learning. Project learning is an indispensable part of school education and an important means of teaching demystified subjects (Guo, 2022). Project learning is based on a new curriculum concept, which changes

the phenomenon of "teacher teaching" and "student learning" in previous teaching. In project learning, learners acquire knowledge not through memorization or rote memorization, but throughout the entire project task, learners are allowed to actively participate in and explore practice in the process of communicating and interacting with teachers and classmates. The evaluation adopts diversified evaluation methods such as teacher-student mutual evaluation and process evaluation, which can make learners acquire knowledge and skills during the completion of project tasks and enrich their emotional experience. Project learning has greatly changed students' problem-solving ability, hands-on ability, and innovative thinking ability. Existing research has found that proactive training can effectively improve critical thinking (Huang, 2013). Project learning emphasizes learners' independent exploration and practical operation. Therefore, project learning is one of the effective ways to realize the cultivation of critical thinking and the transformation from "knowledge-based" to "ability-based".

The development of thinking and cognition of learners in college is at a very critical stage. At this time, a mature cognitive mechanism has been formed in the brain. Under the mature cognitive mechanism, learners can understand all kinds of knowledge and abilities. Quickly comprehend, on this basis, through effective training for learners, use various strategies to cultivate learners' critical thinking awareness and skills, and use appropriate methods at the right time to exercise their thinking and cognitive abilities. As the level of cognition rises, the overall level of critical thinking of learners can be effectively improved, thereby providing sufficient cognitive support for various subsequent learning activities and skill learning, and more effectively promoting learners' learning efficiency and quality.

Principle

Apply the key principles of project-based learning in the classroom. According to Lammer et al. (2015), project-based learning has seven main criteria as main principles, which include:

1) Principles of Challenging Questions

The rationale for problem assignments or basic questions can motivate students to discover the answers. Learning begins with questions, enabling students to understand what to prepare for during an inquiry, the types of inquiry activities to choose, the tools to prepare, and the steps to take to solve or answer a question.

2) The principle of continuous inquiry

This is the principle of an ongoing process of inquiry. Assigning questions and asking questions at the beginning of learning is the starting point of the inquiry process. The inquiry process enhances students' critical thinking skills as well as problem-solving, collaboration, and self-management skills.

3) Principle of authenticity

The true principle of project-based learning is to connect learning to real-life contexts. There are three points to apply authenticity principles in project-based learning:

A. True in the project. Students design projects based on their real-world experiences. For example, a project to create a menu book in a restaurant or a role play between a seller and a buyer.

B. The activities and equipment used in the project are authentic. During the project, students perform activities similar to real life, such as: calculating a travel budget or writing a letter to a magazine editor.

C. The impact of project outcomes is real. Project outcomes are expected to have an impact on the environment, for example, a project that creates ban or notice posters in a school setting has an impact on student discipline.

4) Student Opinion and Selection Principles.

The student voice and choice principle of project-based learning requires students to express ideas and make choices in the process of working on projects. For example, students have more opportunities to express ideas or select details of projects, and students have more opportunities to express their responses when the teacher assigns some questions or basic problems.

5) Reflection principle

The reflective principles of project-based learning apply not only to students but also to teachers. The purpose of this activity is to observe the effectiveness of the activities carried out during the inquiry process, find out the problems faced in the project process and how to overcome the problems found in the process. This reflection also helps students develop metacognitive knowledge in the learning process.

6) Principles of Criticism and Amendment

The principle of critique and revision is a common thing in the course of projects. Groups, teachers, and even experts can provide criticism and suggestions, so that students can find inappropriate places in the project output and make corresponding changes.

7) The principle of public goods

The principle of releasing the product, that is, the project result. Project-based learning gives students the opportunity to present the results of their projects within the class and even in a wider context. By presenting the results of their projects, students gain the satisfaction and motivation to present their work.

Theory

Project based learning places learning in real and meaningful problem situations, allowing students to explore and collaborate independently, learn the knowledge behind problems, develop problem-solving skills, and develop comprehensive abilities during the problem-solving process. The theoretical basis mainly includes the following aspects.

1) Constructivist theory

Constructivism theory is a branch of Cognitive psychology. Its main representatives are J. Piaget, Vygotsky, etc. Its content is very rich, but its core can be summarized in one sentence: student-centered, emphasizing students' active exploration, active discovery and active construction of the meaning of knowledge.

Constructivism advocates learner centered learning under the guidance of teachers, emphasizing the cognitive role of learners while not neglecting the guiding role of teachers. Students are not passive recipients of information stimuli, but rather need to explore, discover, and actively select, process, and process external information during the learning process. Based on their existing knowledge and experience, they should recognize and encode new information, construct their own understanding, and become active builders of meaning. Teachers are helpers and promoters of meaning construction. Teachers should stimulate students' interest in learning, help students form learning motivation, and help and promote students to construct meaning through various teaching methods, such as creating situations that meet the requirements of teaching content, organizing and guiding Collaborative learning, inspiring and guiding students to find problems and solve problems, etc. In

project-based learning, students bring their existing knowledge and experience to solve practical problems and complete tasks. In this process, the existing knowledge is reorganized and transformed into new knowledge, while teachers provide scaffolding to help students reconstruct knowledge and generate a meaningful knowledge system.

2) Pragmatism theory

Pragmatism education thought is an education theory based on Pragmatism philosophy, which appeared in the United States at the end of the 19th century. John Dewey, an American philosopher and educator, is its advocate and the most important representative. Dewey believed that life and experience are the soul of education. Without life and experience, there can be no growth, and therefore no education. Dewey discussed the essence of education based on Empiricism philosophy, which can be summarized as "education is growth", "education is life", and "education is the continuous transformation of experience". Dewey's Pragmatism theory criticizes the traditional education theory, which ignores the constant changes of children's personality characteristics and social life. It criticizes the traditional education theory, which focuses on teachers and textbooks, emphasizes the three major factors of students, experience and activities in education, takes students as the center, takes active courses and learning by doing as the characteristics, and focuses on students' independent exploration and discovery of knowledge. Learning occurs in specific activities, where students are the core of learning, not passively accepting textbook knowledge, but processing students' experiences through activities. Students actively construct their new knowledge, and the role of teachers is to organize and guide students' activities based on their characteristics and needs. The education process is a process of joint participation and cooperation between teachers and students, and there is a democratic and equal teacher-student relationship between teachers and students. These contents are all reflected in project-based learning.

3) Situational Learning Theory

Leif, the representative of situational learning theory, believes that learning is a situational activity, and there is no activity that is not situational. Learning is an integral and inseparable social practice, and is an integral part of creative social

practice in the real world. Then it proposes that learning is a legitimate marginal participation in a community of practice. Wenger (1998) further explored communities of practice in his book "Communities of Practice: Learning, Meaning, and Identity". He believes that the community of practice includes a series of individual shared, mutually clear practices and beliefs, as well as the understanding of long-term pursuit of common interests. or a legitimate role (an identity with a real meaning in the activity) or a real task. "Legitimate marginal participation" is an overall concept, and marginality means pluralism, diversity, more or less participation in it, and some methods included in the process of participation in the community of practice. Anthropologists believe that "legitimate marginal participation" is not a form of education in itself, but a way of understanding learning. It emphasizes that in the community of practice, the corresponding knowledge, skills and attitudes are acquired through "legitimate marginal participation". Project-based learning is to allow students to participate in the work process in multiple ways in the real or simulated work world, complete typical work tasks, and gradually learn from the Novices grow into experts, which is consistent with situational learning theory.

From 3 theories, development of project-based learning instructional model students can use their existing knowledge and experience to solve practical problems and complete tasks. In this process, existing knowledge is reorganized and transformed into new knowledge, while teachers provide guidance to help students reconstruct knowledge and generate meaningful knowledge systems. This learning process conforms to the requirements of constructivism theory. Second, it emphasizes that students actively construct new knowledge, and teachers organize and guide students' activities according to students' characteristics and needs. Emphasize the process of teachers and students participating and cooperating together. These contents are all compatible with the theory of pragmatism. Third, students participate in the work process in multiple ways in the real or simulated work world, complete typical work tasks, and gradually grow from novice to expert, which is consistent with the concept of situational learning.

2. The steps of project- based learning instructional model

There are many academic persons discuss about project-based learning instructional model as follows:

Kovalyova, et al. (2016) believe that the phases of language learning project-based learning mainly include three main phases, namely planning, implementation and reporting. Furthermore, the three main steps of project-based learning led to the following eight learning activities. The learning activities are shown in Figure 2.1:

Step 1. Planning

Planning consists of five activities, which are choosing project topic, pre-communicative activities, asking essential questions, designing project plan and creating project timeline.

Step 2. Implementation

The implementation consists of one activity, namely finishing the project.

Step 3. Reporting

There are two activities in this stage, namely assessing the project results and evaluating the project as well as evaluating project result and learning activity.

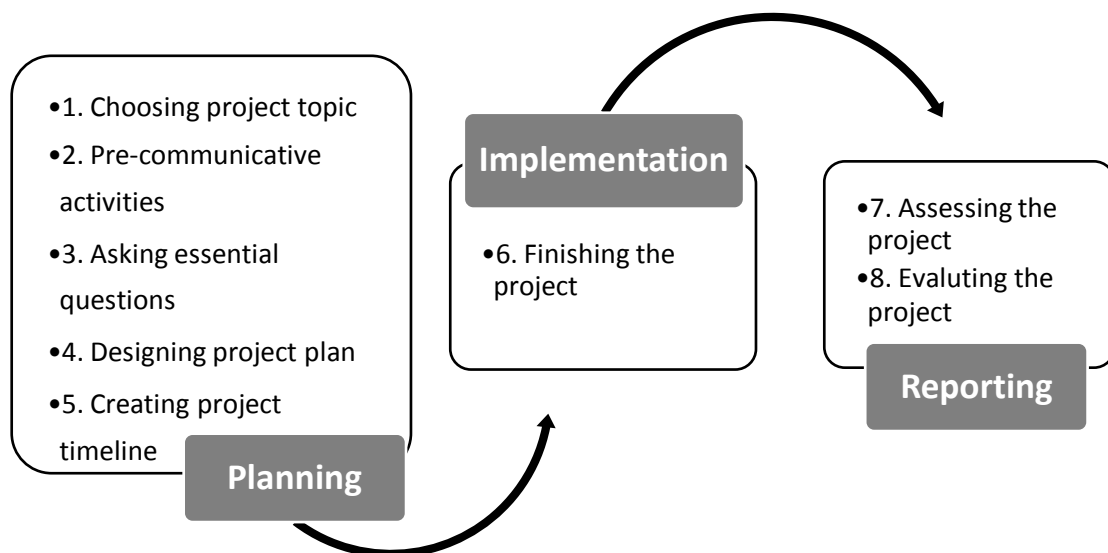


Figure 2.1 Student activities in the project-based learning teaching model
(Kovalyova, et al., 2016)

Based on the principles of teaching design in the flipped classroom teaching model based on project learning, (Luo, 2015) proposed the following teaching steps in the teaching design of project learning to cultivate critical thinking:

Step 1: Start. 1) Teachers provide sufficient and effective communication channels for students. 2) Provide motivation for students to prepare. 3) provide a mechanism for measuring students' understanding. 4) Properly decompose tasks for students and guide the division of labor.

Step 2: Implementation. 1) Provide students with the opportunity to obtain course content before class. 2) Provide students with systematic knowledge teaching. 3) Provide clearly defined and well-structured guidance. 4) Provide sufficient time for students to implement projects.

Step 3: Reflect. 1) Provide timely and timely feedback for students to improve. 2) Providing students with systematic knowledge teaching is not only in the process of implementation, but also in the reflection stage, systematic teaching is also very necessary.

Step 4: Display. 1) Develop a mechanism for students to share and display. 2) Provide convenience for building a learning community. 3) Provide familiar and accessible technology.

Qi (2020) and Yin (2014) divided the project learning process model into the following six steps in the application research of project-based teaching process and effect evaluation and teaching model in educational technology professional practice courses:

Step 1: Select a project

Step 2: Make a Plan

Step 3: Activity Exploration

Step 4 Work Production

Step 5: Exchange of results

Step 6: Activity Evaluation

Wang (2010) divides project learning into five steps in the "project learning" teaching model of research-oriented teachers:

Step 1: Determine the project

Step 2: Activity Exploration

Step 3: production of works

Step 4: Exchange of Results

Step 5: Project Evaluation

Although many scholars do not have a consistent view on the steps and process of the project learning model, it mainly includes the determination of project tasks, the exploration of activities, the design and production of project works, the communication of project results, and the evaluation of projects. According to the research results of Kovalyova (2016), Luo (2015), Qi (2020), Yin (2014), and Wang (2010), after comprehensive analysis, the researcher combined the characteristics of the subject and curriculum to analyze the project-based learning model. The steps have been sorted out and subdivided, and they are mainly divided into the following 6 steps:

- Step 1: Introduction of scenarios and clear tasks.
- Step 2: Collect data and formulate a plan.
- Step 3: Group discussion, specific implementation.
- Step 4: Instruction and process inspection.
- Step 5: Display the results, correct and perfect.
- Step 6: Evaluate and test, expand and sublimate.

Critical Thinking Ability

Definition and Importance

For the definition and importance of critical thinking ability, different scholars do not know how to explain it, mainly from the following points of view:

Edward (2017) pointed out that critical thinking is the analysis of facts, evidence, observations and arguments to form a judgment. Also, the mental training process of actively and proficiently conceptualizing, applying, analyzing, synthesizing, or evaluating information gathered or generated from observation, experience, reflection, reasoning, or communication, as a guide to belief and action.

Clarke (2019) believes that critical thinking usually includes rational, skeptical, and unbiased analysis and evaluation of factual evidence, and it is self-directed, self-disciplined, self-monitoring, and self-correcting thinking.

Canadian psychologist Robert (2000) believes that critical thinking is the tendency or skill to engage in activities with a deliberate attitude.

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

Michael (2000) defines critical thinking as the skillful and dynamic interpretation and evaluation of observations, communications, information, and arguments.

Wang (2006) believes that critical thinking is a thinking that consciously judges the rationality of certain beliefs and behaviors.

Gu (2007) explained critical thinking from both broad and narrow senses. In essence, critical thinking is the ability to ask appropriate questions and make reasonable arguments.

Zhu & Lin (2002) believed that critical thinking refers to the intellectual quality of being good at strictly estimating thinking materials and finely examining the thinking process in thinking activities. It is the degree of independent analysis and criticism in thinking activities. Critical thinking should be used as a problem-solving and creative an integral part of thinking.

Huang (2010) believes that critical thinking is an important part of students' intellectual quality and creativity, and critical thinking education is helpful for the cultivation of undergraduates' creative thinking skills.

Basham (2009) argues that critical thinking means thinking clearly and intelligently. More precisely, critical thinking is the general term given to a wide range of cognitive skills and intellectual dispositions needed to effectively identify, analyze, and evaluate arguments and truth claims; to discover and overcome personal preconceptions and biases; to formulate and present convincing reasons in support of conclusions; and to make reasonable, intelligent decisions about what to believe and what to do.

By summarizing the above definitions and combining the characteristics of web design and production courses, the researchers believe that critical thinking is to have a good judgment on the needs of users in the process of web design and production, and use appropriate evaluation standards to evaluate web information. It is a way of thinking and skill to judge and think about the true value of the content, and to create something after thinking.

As an important ability in the 21st century, critical thinking ability is the consensus of international education and the goal of higher education reform to cultivate critical thinking. Developing students' critical thinking is an inevitable requirement for the cultivation of innovative talents. David (2012) has stated that any

educational system should include the goals of imparting critical thinking knowledge, developing critical thinking ability, and developing critical thinkers with critical thinking attitudes and habits, who are willing and adept at critical thinking when appropriate sexually minded people. China's Higher Education Law emphasizes the cultivation of innovative talents. The revival and development of a country depends on talents, and the cultivation of outstanding talents depends on high-quality education. When learners have high critical thinking ability, they can communicate well with others and express their opinions without being influenced by others. The independence and openness of thinking are also important guarantees for them to become talents. Critical thinking is also an important part of the core competencies in the 21st century. Therefore, cultivating talents with critical thinking is an important aspect of higher education. The most important.

Components of critical thinking ability

Scholars also have their own understandings about the composition of critical thinking ability.

APA (1990) research shows that critical thinking skills are composed of six important core skills of elucidation, analysis, evaluation, inference, interpretation and self-regulation, while the tendencies of critical thinking are composed of truth-seeking, open-mindedness, Analytical, systematic, assertive, inquiring, and mature.

Bassham et al. (2009) believe that critical thinking consists of six parts: interpretation, analysis, evaluation, reasoning, interpretation, and self-regulation. As shown in Figure 2.2:



Figure 2.2 Components of critical thinking (Bassham et al., 2009)

Peter A (1998) The main skills of critical thinking include: interpretation, analysis, evaluation, reasoning, interpretation, self-correction.

Dong (2012) clearly pointed out in the analysis of the three misunderstandings of critical thinking that critical thinking does not mean negation, but careful reflection and creation.

Guo (2014) believes that the cultivation of critical thinking of college students in project learning mainly includes four stages: discovering problems and putting forward hypotheses; collecting information and inductively analyzing; verifying hypotheses and solving problems; reflecting and improving. The thinking process is shown in Figure 2.3:

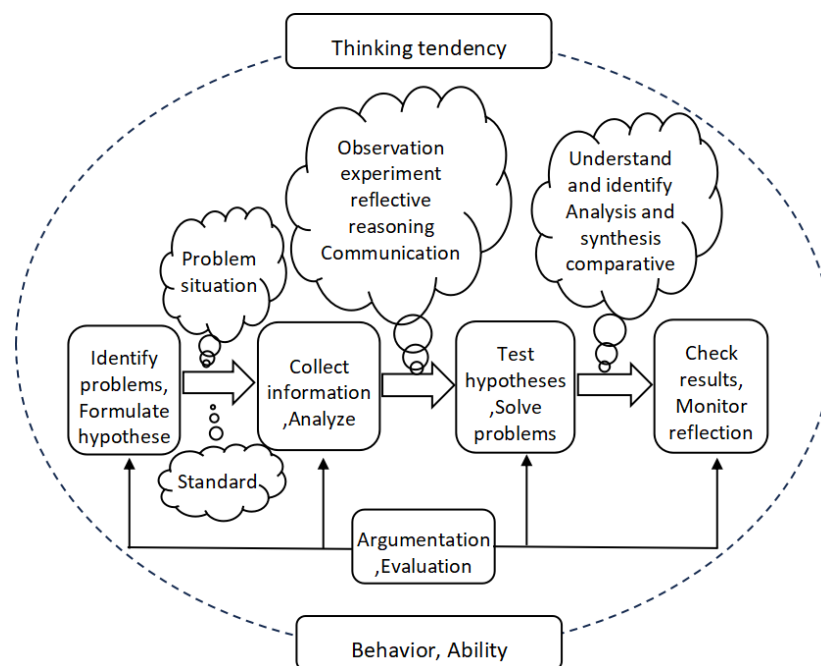


Figure 2.3 Diagram of critical thinking process (Guo, 2014)

Zhu (2016) believes that in project learning to cultivate college students' critical thinking mode, learners' cognitive skills and emotional intentions can be fully paid attention to: students' cognitive skills of critical thinking are mainly acquired from project tasks and designed activities, Improvement, critical thinking tendency is mainly cultivated in the teacher's deliberate guidance.

Yang (2017) believes that critical thinking ability includes 1) the ability to discover problems, collect and process information; 2) the ability to clarify the relationship between facts, personal claims and rigorous logical reasoning; 3) the

ability to state inferences correctly and clearly, and effectively, the ability to explain inferences, pay attention to the role of evidence and the scientific nature of the argumentation process; 4) be able to maintain an open mind, and will not affect your final decision-making because of your beliefs or prejudices. At the same time, critical thinking is a process of dynamic development, emphasizing that in the process of learning and problem solving, we should constantly reflect, revise, evaluate, and constantly correct our existing cognition.

Paul (2022) believes that the goal of critical thinking is based on well-founded judgments, which determine the true value of things by using appropriate judgment criteria. There are three dimensions of critical thinking: analytical, evaluative, and creative. Through the analysis and summary of the literature on the composition of critical thinking ability, the researchers found that analysis, evaluation and creativity are three important aspects of critical thinking ability. Therefore, researchers believe that effectively improving critical thinking ability refers to being able to make accurate assessments and create something based on a comprehensive analysis of problems.

In summary, through comprehensive studies on critical thinking ability by scholars, researchers have comprehensively analyzed that the three important items of critical thinking ability are analysis, evaluation and creativity.

Influencing factors

The factors that affect the development of critical thinking ability of college students are very diverse. Cacho (2022) believes that interactive and active collaborative learning has a positive impact on critical thinking. Qian (2019) believes that the follow-up training of undergraduates' critical thinking puts forward the following suggestions: on the one hand, we should pay attention to the characteristics of the students' own background, we must pay attention to the differences of students, and grasp the key groups; we must also pay attention to the role of parents' expectations, and strengthen home-school education work together. On the other hand, we must grasp the important factors in learning input. First, we must pay attention to the individual input of students and stimulate critical thinking; second, we must cultivate good study habits and consolidate critical thinking; interaction to promote critical thinking; the fourth is to enhance the level of teaching, improve teaching effects, and improve critical thinking. Wang (2020) believes that the

educational environment (including school level, subject, etc.) and students' learning input, such as whether students are actively learning, the degree of student-teacher interaction, and the degree of participation in various extracurricular activities have an impact on students' critical thinking ability. Li (2021) believes that teacher differences, personal emotional characteristics, educational environment, and educational awareness affect the cultivation of critical thinking ability of college students in normal colleges. Chen (2018) believes that the factors that affect the formation and development of students' abilities mainly include: the influence of innate genetic factors, the influence of early experience and environment, the influence of education and practical activities, and the influence of individual subjective initiative. Ma (2022) believes that in addition to important factors such as basic characteristics of students and family background, university education will also affect the development of students' critical thinking, such as university level or type, grade, major, teaching strategy, classroom behavior, learning engagement, course learning, educational activities, etc.

Measuring Tools

There are many kinds of critical test scales, and the currently used measurement tools are CCTST and CCTDI. In addition, Newman developed and designed student scales and content analysis tools for the measurement and meaning analysis of learners' critical thinking (Wu, 2012). Luo (2002) studied critical thinking theory and its evaluation techniques, and together with other scholars revised the commonly used measurement tools CCTST and CCTDI for critical thinking at home and abroad. test, and formulate a "critical thinking ability measurement form" suitable for my country's local culture. At present, there are relatively few thinking ability tests for college students in my country, and there are only a few self-made measuring tools, such as EPP (China) Critical Thinking Ability Test (Zhao, 2015). Most of the existing measuring tools are translations and revisions of foreign measuring tools.

Through the analysis of the literature and the existing scale, the researchers believe that the existing scale mainly measures the critical thinking ability from a macro perspective, and there are complex evaluation elements, many dimensions, and a large number of questions, which fail to focus on specific aspects. Questions such as subject areas do not accurately measure the critical thinking skills of students

in specific subject areas or in specific courses. Therefore, this study combines the evaluation elements of critical thinking ability with the objectives of the web design and production course, and fully considers the factors that affect the improvement of students' critical thinking ability in this course. Rubric scoring is used to evaluate students' critical thinking ability. (By researcher)

Related Research

Li (2015) studied the application of flipped classroom-based project-based teaching in higher vocational courses. It takes the "Webpage Design and Production" course in higher vocational colleges as an example, and conducts empirical research on the teaching application effect of the new model. Studies have shown that project-based teaching based on flipped classrooms can effectively improve students' independent inquiry ability and collaborative learning ability, and can well stimulate learners' learning enthusiasm and creativity, improve learners' comprehensive ability, and finally achieve the improvement of course teaching. purpose of the effect.

Lu (2017) studied the influence of project-based cooperative learning on primary school students' critical thinking tendency and cooperative awareness. The research results show that project-based cooperative learning has a positive effect on primary school students' critical thinking orientation, and is an effective teaching method for cultivating critical thinking orientation.

Lu (2018) studied the design and application of a critical thinking-oriented blended learning environment-taking a college practical English writing course as an example, to explore how to improve students' critical thinking through the design of a blended learning environment. Using an experimental research approach, this paper examines the effects of a critical thinking blended learning environment by comparing it to a traditional learning environment. The experimental data results show that the critical thinking-oriented blended learning environment has a positive effect on students' critical thinking ability and academic level.

Zheng (2019) studied how to achieve the cultivation of higher order thinking ability in the information technology classroom. It designs project-based teaching, and uses the method of experimental research to verify the experimental effect. The research results show that project-based teaching is effective in improving higher-order thinking ability.

Chu (2022) studied the project-based learning of mathematics based on critical thinking. It combined the project-based learning model with the cultivation of mathematical critical thinking, designed project-based learning suitable for students, and gave the general process of project-based learning. As a result of the research, it provides relevant recommendations for developing project-based learning in mathematics and developing critical thinking.

Chen (2023) studied the influence of project teaching on the critical thinking of junior high school students from the perspective of core literacy. The research found that the application of project teaching from the perspective of core literacy in English reading teaching can effectively improve the critical thinking ability of junior high school students, among which the improvement of truth-seeking, critical thinking self-confidence, curiosity and cognitive maturity is the most obvious.

Chapter 3

Research Methodology

In the study of “Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students” the researcher 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 to enhance critical thinking ability of undergraduate students.

Phase 2 was conducted to answer research objective 2: To develop project-based learning instructional model for enhancing critical thinking ability of undergraduate students.

Phase 3 was conducted to answer research objective 3: To study the results of implementing project-based learning instructional model for enhancing critical thinking ability of undergraduate students.

The details are as follows.

Phase 1 was conducted to answer research objective 1: To examine the factors to enhance critical thinking ability of undergraduate students.

The population

Group 1: 200 former undergraduate students of Web Design and Production Course, semester 1 on academic year 2022 in Yulin Normal University.

Class 1: 50 students major in E-commerce

Class 2: 45 students major in Advertising Radio

Class 3: 55 students major in Television Journalism

Class 4: 50 students major in Systems Science

Research instrument

The questionnaire for students

Designing instrument 1

1. Study literatures on critical thinking ability and factors affecting the development of critical thinking of students.

2. Design questionnaires on 2 factors: 15 items of internal factors (Such as learning interest, learning effort, learning motivation, students' cognition, knowledge

level, experience etc.) and 15 items of external factors (Such as social environment, materials, teaching methods, evaluation etc.) to improve critical thinking ability for the students at Yulin Normal University.

3. Present the draft of questionnaires to the advisors for checking correctness and completion.

4. Assess the validity of questionnaire on factors to improve critical thinking ability of students at Yulin Normal University. by 5 experts (List name in Appendix A) through Index of Item-Objective Congruence (IOC) according to the criteria shown below. (Phongsri, 2011)

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

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

-1 = Sure that the contents are not related to the factors

The acceptable items must have the IOC values not less than 0.5. The IOC calculated from the validation measures 1.00.

5. Design Likert 5-point rating scale questionnaires that use all item of internal factor and external factors on the following score rating criteria.

Score rating criteria

5 means strongly agree

4 means agree

3 means neutral

2 means disagree

1 means strongly disagree

Quality Validation

Using IOC by 5 experts to test the quality of questionnaire.

Data Collection

1. Ask for permission for data collection.

2. Collect data from the assigned students using the developed questionnaire.

Data Analysis

The factors affecting critical thinking ability obtained from the students are interpreted using MEAN interpretation criteria proposed by Phongsri (2011).

4.51-5.00 means the highest

3.51-4.50 means high

2.51-3.50 means moderate

1.51-2.50 means few

1.00-1.50 means the fewest

Descriptive Statistics i.e., Frequency, mean (μ), standard deviation (σ)

Key Informants

Group 2: 3 lecturers who teach the Web Design and Production course at Yulin Normal University.

Research instrument

The interview for the lecturers

Designing instrument 2

1. Study literature on critical thinking ability improve of critical thinking ability factors affecting.

2. Design the draft of open-ended interview to 10 questions on 2 factors both internal factors and external factors affecting critical thinking ability

3. Present the draft of open-ended interview to the advisors for checking correctness and completion.

4. Assess the validity of open-end interview on factors affecting critical thinking ability for the students by 5 experts (List name in Appendix A) through Index of Item-Objective Congruence (IOC) according to the criteria shown below. (Phongsri, 2011)

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

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

-1 = Sure that the contents are not related to the factor

The acceptable items must have the IOC values not less than 0.5. The IOC calculated from the validation measures 1.00.

5. Do the structured interview in 3 colleges in Yulin Normal University. The structured interview type can only be answered by the lecturers.

Quality Validation

Using IOC by 5 experts (List name in Appendix A) to test the quality of open-end interview.

Data Collection

1. Ask for permission for data collection.
2. Collect data from the assigned lecturers using the developed interview.

Data Analysis

Content analysis

Output Phase 1

Obtain important information that is used as a basis for examine the internal factors and external factors to critical thinking ability for undergraduate students from the former students and lecturers. And take the result to do project-based learning instructional model. Summary the process to do in Phase 1 by table 3.1

Table 3.1 Summary the process to do in Phase 1

Research Process	Analyzed both internal and external factors
Research Objectives	To examine the factors to enhance critical thinking ability of undergraduate students.
Research Method	Study the factors affecting critical thinking ability both internal and external factors
Resources/Target Group	1. Population- 200 students 2. Key Informants- 3 Lecturers
Instruments	1. Questionnaire 2. Interview by 10 questions
Data Analysis	- Frequency - Mean (μ) - Standard Deviation (σ) - Content analysis
Results	Take the result from students and lecturers to provide Project-Based Learning Instructional Model

Obtain important information that is used as a basis for examine the internal and external factors to enhance critical thinking ability of undergraduate students. And take the result to do Project-Based Learning Instructional Model.

Phase 2 was conducted to answer research objective 2: To develop project-based learning instructional model for enhancing critical thinking ability of undergraduate students.

Designing instrument

Assessment form IOC for validity of project-based learning instructional model questionnaire

1. Designing instrument (the questionnaire for IOC)

1.1 Study related concepts, principles, process about developing instructional model, including results in terms of factors affecting critical thinking ability from research objective 1.

1.2 Design the development of project-based learning instructional model to be the handout which consists of the stable teaching activities and procedures. Such a developed instructional model with 5 components: 1) Principle & Rationale, 2) Objectives, 3) Contents, 4) Methods of teaching & Materials and 5) Evaluation, is in 4 aspects standards: 1) Utility standards, 2) Feasibility standards, 3) Propriety standards and 4) Accuracy standards

1.3 Assess the validity of the questionnaire of the appropriateness of the instructional model by 5 experts (List name in Appendix A) through Item-Objective Congruence (IOC) according to the criteria as shown below: (Phongsri,2011)

+1 = If you are sure the contents measure its objectives

0 = If you are not sure that the measurement contents related its objectives

-1 = If it is certain that the contents are measured and does not relate the objectives

The acceptable items must have the IOC values not less than 0.5. The IOC calculated from the validation measures 1.00.

2. Research instrument

Designing instrument about the questionnaire on confirming the instructional model.

2.1 Design a questionnaire on confirming the appropriateness of the instructional model in terms of accuracy standards, propriety standards, feasibility standards, and utility standards.

2.2 Present the draft of open-ended interview to the advisors for checking correctness and completion.

2.3 Assess the validity of the questionnaire on confirming the appropriateness of the instructional model by 5 experts (List name in Appendix A) through frequency and percentage.

Data Collection

1. Ask for permission of data collection

2. Collect appropriateness of the instructional model in terms of accuracy standards, propriety standards, feasibility standards, and utility standards from the 5 experts (List name in Appendix A) using the developed conformity assessment form of project-based learning instructional model.

Data Analysis

Descriptive analysis i. e. frequency and percentage. The acceptable items must not be less than 100%.

Output Phase 2

Project-based learning instructional model the appropriateness of which is confirmed by experts for further implementation. Summary the process to do in Phase 1 by table 3.2

Table 3.2 Summary the process to do in Phase 2

Research Process	Develop Project-based learning Instructional Model in terms of accuracy standards, propriety standards, feasibility standards, and utility standards.
Research Objectives	To develop project-based learning instructional model for enhancing critical thinking ability of undergraduate students.
Research Method	Study the component for development of Project-based learning Instructional Model
Resources/Target Group	5 experts to confirm model from handout that rating results have agree/disagree
Instruments	Questionnaires
Data Analysis	- Frequency - Percentage
Results	Confirming Project-based learning Instructional Model to teach in the classroom

Obtain important information that developing of Project-based learning instructional model to enhancing critical thinking ability of undergraduate students from 5 experts. And take Project-based learning instructional model to experiment.

Phase 3 was conducted to answer research objective 3: To study the results of implementing project-based learning instructional model for enhancing critical thinking ability of undergraduate students.

Population

The total of 280 sophomore from 5 classes of students with different levels of proficiency-beginner, intermediate, and advanced, who enroll in Web Design and Production Course at Yulin Normal University in semester 1 academic year 2023. Those sections involve the following.

Class A 50 students

Class B 47 students

Class C 63 students

Class D 65 students

Class E 55 students

The sample group

63 students who enroll in Web Design and Production Course from class section C are obtained by cluster random sampling.

Research design

Table 3.3 One group post test design

Group	X	T1
Sample	Project based learning instructional model	Critical thinking ability

X - Project based learning instructional model

T1 - Critical thinking ability

Research instruments

1. Lesson plans using project-based learning instructional model
2. Rubric scoring form 5 level: 5 (Excellent), 4 (Good), 3 (Moderate), 2 (Pass), 1 (Poor).

Designing instrument 1

1. Study 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 5 experts (List name in Appendix A) through Index of Item-Objective Congruence (IOC) according to the criteria shown below. (Phongsri, 2011)

1 = Sure that the contents are related to the lesson plan

0 = Not sure that the contents are related to the lesson plan

-1 = Sure that the contents are not related to the lesson plan

The acceptable items must have the IOC values not less than 0.5. 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 project-based learning.
2. Design rubric scoring criteria in 5 level (In Appendix C)
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 5 experts (List name in Appendix A) through Index of Item-Objective Congruence (IOC) according to the criteria 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 the IOC values not less than 0.5. The IOC calculated from the validation measures 1.00.

Data Collection

1. Ask for permission of data collection
2. Collect students' performance by the lecturers who teach this course and other lecturer assessment.

Data Analysis

Categorize students' performance according to rubric scoring criteria into their levels descriptor Item 1 has 3 standards, Item 2 has 3 standards, Item 3 has 3 standards, total 9 standards.

Table 3.4 Criteria to evaluate critical thinking ability overall (Item 1-3)

Scores	Level
37-45	Excellent
28-36	Good
19-27	Moderate
10-18	Pass
Less than 10	Poor

Table 3.5 Criteria to evaluate each item of critical thinking ability (Item1, Item 2, Item 3)

Scores	Level
13-15	Excellent
10-12	Good
7-9	Moderate
4-6	Pass
Less than 4	Poor

Output Phase 3 (Rubric Scoring Criteria)

After implementing learning through the instructional model based on project-based learning, students' score of critical thinking Ability will be overall improved at 80% (Good Level). Summary the process to do in Phase 3 by table 3.6

Table 3.6 Summary the process to do in Phase 3

Research Process	1. Deign lesson plan 2. Design rubric scoring criteria
Research Objectives	To study the results of implementing project-based learning instructional model for enhancing critical thinking ability of undergraduate students.
Research Method	1. Study how to design lesson plan 2. Study how to design rubric scoring criteria
Resources/Target Group	63 students who enroll in Web Design and Production Course from class section C
Instruments	1. Lesson plan 2. Rubric Scoring Criteria
Data Analysis	- Percentage - Frequency - Mean (\bar{x}) - Standard Deviation (S.D.)
Results	Students' score of critical thinking ability

Obtain important information that developing lesson plans and rubric scoring form to enhancing critical thinking ability of undergraduate students from 5 experts. And take lesson plans and rubric scoring form to experiment.

Chapter 4

Results of Analysis

In the study of “Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students”, the researcher analysis the research results as follows.

Part 1: Analysis results serving objective 1-To examine the factors to enhance critical thinking ability of undergraduate students.

Part 2: Analysis results serving objective 2-To develop project-based learning instructional model for enhancing critical thinking ability of undergraduate students.

Part 3: Analysis results serving objective 3-To study the results of implementing project-based learning instructional model for enhancing critical thinking ability of undergraduate students.

Symbol of Abbreviations

N	refers to population
μ	refers to mean
σ	refers to standard deviation
n	refers to the sample group
\bar{x}	refers to mean
<i>S.D.</i>	refers to standard deviation

Part 1: Analysis results serving objective 1-To examine the factors to enhance critical thinking ability of undergraduate students.

This section presents analysis results serving objective 1 using table and description in terms of MEAN, standard deviation, interpretation (Level of Attitude), and ranking of all factors in overview. After that, items of all factors are presented likewise.

Present Study Participants

Group 1: 200 former undergraduate students of Web Design and Production Course, semester 1 on academic year 2022 in Yulin Normal University.

Class 1: 50 students major in E-commerce

Class 2: 45 students major in Advertising Radio

Class 3: 55 students major in Television Journalism

Class 4: 50 students major in Systems Science

Group 2: 3 lecturers who teach the Web Design and Production course at Yulin Normal University.

1 Lecturer from Business School of Yulin Normal University

1 Lecturer from School of Literature and Media, Yulin Normal University

1 Lecturer from School of Mathematics and Statistics, Yulin Normal University

Present Results of the Survey

Table 4.1 Common data of the respondent in overall

(N = 200)

Data	Frequency	Percentage
Gender		
Male	45	22.50
Female	155	77.50
Total	200	100.00
Age		
A. below 17 yrs.	0	0.00
B. 17-20 yrs.	175	87.50
C. 21-23 yrs.	25	12.50
D. over 23 yrs.	0	0.00
Total	200	100.00

From table 4.1 the common data of the respondent in overall the most gender is female, 77.50%. The most age is 17-20, 87.50%.

Table 4.2 The result of questionnaire from students in overview

				(N =200)
Factors	μ	σ	Interpretation	Ranking within All Factors
Internal factors (respondents)				
No.1 Students are very interested in Web Design and Production course.	4.27	0.76	High	1
No.2 Students have a clear understanding of critical thinking ability knowledge and study by Project Based Learning model in Web design and production course.	2.51	0.52	Moderate	15
No.3 Students are interested in using innovative teaching models such as project-based learning in their courses.	3.04	3.18	Moderate	14
No.4 Students have the will to actively design, practice and develop creative web work.	3.18	0.62	Moderate	13
No.5 Students are industrious in their learning (Assignments, Projects, Participation, etc.) with the highest potential themselves.	3.76	0.71	High	3
No.6 Students are able to master and apply relevant techniques and tools from the course.	3.24	0.65	Moderate	11
No.7 Students feel that Web design and production course is the great significance to personal growth and development in future.	3.35	0.65	Moderate	10
No.8 Students have a sufficient knowledge base and intellectual level to learn web design and production courses.	3.21	0.56	Moderate	12

Table 4.2 (Continued)

				(N =200)
Factors	μ	σ	Interpretation	Ranking within All Factors
No.9 Students can master critical thinking ability by Web design planning and production process in Web design and production course.	3.47	0.73	Moderate	7
No.10 Students are satisfied with the friendly cooperation and interaction between students and teachers or peers in the Web design and production course.	3.49	0.69	Moderate	6
No.11 Students believe that personality and thinking style will affect the course learning effect.	3.46	0.77	Moderate	8
No.12 Students are willing to engage in independent study and explore additional knowledge and skills outside of the classroom.	3.57	0.70	High	5
No.13 Students learn about the latest research trends and developments in their subject area.	3.44	0.68	Moderate	9
No.14 Students have clear learning motivation in course learning.	3.60	0.76	High	4
No.15 Students can develop their sense of accomplishment and pride through different activities in Web design and production course.	3.87	0.68	High	2
Total Average	3.43	0.67	Moderate	
External factors (lecturers, material, and circumstance)				
No.16 Lecturer's appearance, temperament and clothing style.	2.54	0.54	Moderate	15
No.17 Lecturer's emphasis on promoting students' critical thinking.	3.92	0.64	High	2

Table 4.2 (Continued)

				(N =200)
Factors	μ	σ	Interpretation	Ranking within All Factors
No.18 Lecturers' attitudes toward new teaching models that promote critical thinking.	4.05	0.83	High	1
No.19 The lecturer's flexible control over the teaching process and time.	3.23	0.57	Moderate	12
No.20 The assessment methods used by the lecturer in the classroom.	3.62	0.70	High	9
No.21 Lecturer experience and ability to enhance students' critical thinking ability.	3.54	0.72	High	10
No.22 The course objectives set by the lecturer are rich and multi-dimensional.	3.85	0.64	High	3
No.23 The teaching method adopted by the lecturer in the course.	3.78	0.67	High	4
No.24 The textbook fully considers the content and objectives of Web design and production courses and critical thinking training.	3.53	0.73	High	11
No.25 The learning atmosphere created by the lecturer in the course.	3.74	0.67	High	6
No.26 Lecturer's design of learning activities and organization of course content.	3.73	0.66	High	7
No.27 Teaching materials provide practical, interactive and inspiring cases, which are useful to students.	2.71	0.70	Moderate	13
No.28 The learning environment, media and materials provided by the instructor.	3.75	0.70	High	5

Table 4.2 (Continued)

				(N =200)
Factors	μ	σ	Interpretation	Ranking within All Factors
No.29 The degree to which schools value critical thinking ability.	3.65	0.84	High	8
No.30 The environments is clean and bright, with desks and chairs, blackboards, podiums, computers, projectors, large screens, loudspeakers and other multimedia facilities to facilitate the teaching process.	2.56	0.56	Moderate	14
Total Average	3.44	0.67	Moderate	

Table 4.2 Indicates that internal factors affecting critical thinking ability of undergraduate students in Yulin Normal University overall found at moderate level ($\mu =3.43$). Considering only each item, it was found that factor No.1 Students are very interested in Web Design and Production course is the highest mean ($\mu =4.27$), follow factor by No.15 Students can develop their sense of accomplishment and pride through different activities in Web design and production course ($\mu =3.87$) and the fewest mean is factor No.2 Students have a clear understanding of critical thinking ability knowledge and study by Project Based Learning model in Web design and production course. ($\mu =2.51$).

For external factors affecting Web Design and Production course enhance critical thinking ability of undergraduate students in Yulin Normal University overall found at moderate level ($\mu =3.44$). Considering only each item, it was found that factor No.18 Lecturers' attitudes toward new teaching models that promote critical thinking. is the highest mean ($\mu =4.05$), follow by factor No.17 Lecturer's emphasis on promoting students' critical thinking. ($\mu =3.92$) and the fewest mean is factor No.16 Lecturer's appearance, temperament and clothing style. ($\mu =2.54$).

Table 4.3 Common data of the respondent major in class 1 E-commerce

(N =50)

Data	Frequency	Percentage
Gender		
A. Male	10	20.00
B. Female	40	80.00
Total	50	100.00
Age		
A. below 17 yrs.	0	0.00
B. 17-20 yrs.	40	80.00
C. 21-23 yrs.	10	20.00
D. over 23 yrs.	0	0.00
Total	50	100.00

From table 4.3 the common data of the respondent major in E-commerce the most gender is female, 80.00% The most age is 17-20 yrs. 80.00%.

Table 4.4 The result of questionnaire from students major in class 1 E-commerce

(N =50)

Factors	μ	σ	Interpretation	Ranking within All Factors
No.1 Students are very interested in Web Design and Production course.	4.42	0.67	Highest	1
No.2 Students have a clear understanding of critical thinking ability knowledge and study by Project Based Learning model in Web design and production course.	2.4	0.49	Few	15
No.3 Students are interested in using innovative teaching models such as project-based learning in their courses.	2.78	0.41	Moderate	14
No.4 Students have the will to actively design, practice and develop creative web work.	2.86	0.35	Moderate	13

Table 4.4 (Continued)

(N =50)				
Factors	μ	σ	Interpretation	Ranking within All Factors
No.5 Students are industrious in their learning (Assignments, Projects, Participation, etc.) with the highest potential themselves.	3.74	0.44	High	4
No.6 Students are able to master and apply relevant techniques and tools from the course.	3.10	0.61	Moderate	9
No.7 Students feel that Web design and production course is the great significance to personal growth and development in future.	3.00	0.61	Moderate	11
No.8 Students have a sufficient knowledge base and intellectual level to learn web design and production courses.	3.12	0.65	Moderate	8
No.9 Students can master critical thinking ability by Web design planning and production process in Web design and production course.	2.88	0.47	Moderate	12
No.10 Students are satisfied with the friendly cooperation and interaction between students and teachers or peers in the Web design and production course.	3.32	0.55	Moderate	7
No.11 Students believe that personality and thinking style will affect the course learning effect.	3.33	0.61	Moderate	6
No.12 Students are willing to engage in independent study and explore additional knowledge and skills outside of the classroom.	3.50	0.73	Moderate	5
No.13 Students learn about the latest research trends and developments in their subject area.	3.04	0.20	Moderate	10

Table 4.4 (Continued)

(N =50)				
Factors	μ	σ	Interpretation	Ranking within All Factors
No.14 Students have clear learning motivation in course learning.	3.78	0.76	High	3
No.15 Students can develop their sense of accomplishment and pride through different activities in Web design and production course.	4.14	0.49	High	2
Total Average	3.29	0.54	Moderate	
External factors (lecturers, material, and circumstance)				
No.16 Lecturer's appearance, temperament and clothing style.	2.42	0.49	Few	15
No.17 Lecturer's emphasis on promoting students' critical thinking.	4.20	0.57	High	1
No.18 Lecturers' attitudes toward new teaching models that promote critical thinking.	4.15	0.57	High	2
No.19 The lecturer's flexible control over the teaching process and time.	3.11	0.65	Moderate	11
No.20 The assessment methods used by the lecturer in the classroom.	3.56	0.75	High	8
No.21 Lecturer experience and ability to enhance students' critical thinking ability.	3.44	0.78	Moderate	9
No.22 The course objectives set by the lecturer are rich and multi-dimensional.	4.10	0.57	High	5
No.23 The teaching method adopted by the lecturer in the course.	4.12	0.62	High	4
No.24 The textbook fully considers the content and objectives of Web design and production courses and critical thinking training.	3.42	0.80	Moderate	10
No.25 The learning atmosphere created by the lecturer in the course.	3.82	0.59	High	6

Table 4.4 (Continued)

(N =50)				
Factors	μ	σ	Interpreta tion	Ranking within All Factors
No.26 Lecturer's design of learning activities and organization of course content.	4.13	0.55	High	3
No.27 Teaching materials provide practical, interactive and inspiring cases, which are useful to students.	2.47	0.5	Few	13
No.28 The learning environment, media and materials provided by the instructor.	3.64	0.69	High	7
No.29 The degree to which schools value critical thinking ability.	2.94	0.24	Moderate	12
No.30 The environments is clean and bright, with desks and chairs, blackboards, podiums, computers, projectors, large screens, loudspeakers and other multimedia facilities to facilitate the teaching process.	2.46	0.5	Few	14

From table 4.4 Indicates that internal factors affecting critical thinking ability of undergraduate students major in class 1 E-commerce found at moderate level ($\mu =3.29$). Considering only each item, it was found that factor No.1 Students are very interested in Web Design and Production course. is the highest mean ($\mu = 4.42$), follow factor by No.15 Students can develop their sense of accomplishment and pride through different activities in Web design and production course. ($\mu =4.14$) and the fewest mean is factor No.2 Students have a clear understanding of critical thinking ability knowledge and study by Project Based Learning model in Web design and production course. ($\mu =2.4$).

For external factors affecting Web Design and Production course enhance critical thinking ability of undergraduate students major in class 1 E-commerce found at moderate level ($\mu =3.47$). Considering only each item, it was found that factor No.17 Lecturer's emphasis on promoting students' critical thinking is the highest mean

($\mu = 4.20$), follow by factor No.18 Lecturers' attitudes toward new teaching models that promote critical thinking. ($\mu = 4.15$) and the fewest mean is factor No.16 Lecturer's appearance, temperament and clothing style. ($\mu = 2.42$).

Table 4.5 Common data of the respondent major in class 2 Advertising Radio

(N =45)

Data	Frequency	Percentage
Gender		
A. Male	10	22.22
B. Female	35	77.78
Total	45	100
Age		
A. below 17 yrs.	0	0.00
B. 17-20 yrs.	40	88.89
C. 21-23 yrs.	5	11.11
D. over 23 yrs.	0	0.00
Total	45	100.00

From table 4.5 the common data of the respondent major in Advertising Radio the most gender is female, 77.78%. The most age is 17-20 yrs., 88.89%

Table 4.6 The result of questionnaire from students major in class 2 Advertising Radio
(N =45)

Factors	μ	σ	Interpretation	Ranking within All Factors
Internal factors (respondents)				
No.1 Students are very interested in Web Design and Production course.	4.51	0.62	The highest	1
No.2 Students have a clear understanding of critical thinking ability knowledge and study by Project Based Learning model in Web design and production course.	2.67	0.56	Moderate	15
No.3 Students are interested in using innovative teaching models such as project-based learning in their courses.	3.16	0.51	Moderate	12
No.4 Students have the will to actively design, practice and develop creative web work.	3.15	0.56	Moderate	13
No.5 Students are industrious in their learning (Assignments, Projects, Participation, etc.) with the highest potential themselves.	4.16	0.56	High	2
No.6 Students are able to master and apply relevant techniques and tools from the course.	3.13	0.51	Moderate	14
No.7 Students feel that Web design and production course is the great significance to personal growth and development in future.	3.17	0.51	Moderate	11
No.8 Students have a sufficient knowledge base and intellectual level to learn web design and production courses.	3.18	0.53	Moderate	10
No.9 Students can master critical thinking ability by Web design planning and production process in Web design and production course.	3.67	0.84	High	6

Table 4.6 (Continued)

(N =45)				
Factors	μ	σ	Interpretation	Ranking within All Factors
No.10 Students are satisfied with the friendly cooperation and interaction between students and teachers or peers in the Web design and production course.	3.24	0.52	Moderate	9
No.11 Students believe that personality and thinking style will affect the course learning effect.	3.25	0.52	Moderate	8
No.12 Students are willing to engage in independent study and explore additional knowledge and skills outside of the classroom.	3.71	0.62	High	5
No.13 Students learn about the latest research trends and developments in their subject area.	3.93	0.44	High	3
No.14 Students have clear learning motivation in course learning.	3.57	0.79	High	7
No.15 Students can develop their sense of accomplishment and pride through different activities in Web design and production course.	3.78	0.63	High	4
Total Average	3.48	0.58	Moderate	
External factors (lecturers, material, and circumstance)				
No.16 Lecturer's appearance, temperament and clothing style.	2.71	0.54	Moderate	15
No.17 Lecturer's emphasis on promoting students' critical thinking.	4.11	0.48	High	3
No.18 Lecturers' attitudes toward new teaching models that promote critical thinking.	3.96	0.84	High	5
No.19 The lecturer's flexible control over the teaching process and time.	3.19	0.53	Moderate	12

Table 4.6 (Continued)

(N =45)				
Factors	μ	σ	Interpretation	Ranking within All Factors
No.20 The assessment methods used by the lecturer in the classroom.	3.72	0.62	High	6
No.21 Lecturer experience and ability to enhance students' critical thinking ability.	3.70	0.62	High	7
No.22 The course objectives set by the lecturer are rich and multi-dimensional.	3.49	0.58	Moderate	9
No.23 The teaching method adopted by the lecturer in the course.	3.44	0.58	Moderate	10
No.24 The textbook fully considers the content and objectives of Web design and production courses and critical thinking training.	3.69	0.62	High	8
No.25 The learning atmosphere created by the lecturer in the course.	4.14	0.47	High	1
No.26 Lecturer's design of learning activities and organization of course content.	4.12	0.53	High	2
No.27 Teaching materials provide practical, interactive and inspiring cases, which are useful to students.	2.73	0.61	Moderate	13
No.28 The learning environment, media and materials provided by the instructor.	4.00	0.42	High	4
No.29 The degree to which schools value critical thinking ability.	3.31	0.63	Moderate	11
No.30 The environments is clean and bright, with desks and chairs, blackboards, podiums, computers, projectors, large screens, loudspeakers and other multimedia facilities to facilitate the teaching process.	2.72	0.54	Moderate	14
Total Average	3.54	0.57	High	

From table 4.6 Indicates that internal factors affecting critical thinking ability of undergraduate students major in class 2 Advertising Radio found at moderate level ($\mu = 3.48$). Considering only each item, it was found that factor No.1 Students are very interested in Web Design and Production course is the highest ($\mu = 4.51$), follow factor by No.5 Students are industrious in their learning (Assignments, Projects, Participation, etc.) with the highest potential themselves ($\mu = 4.16$) and the fewest mean is factor No.2 Students have a clear understanding of critical thinking ability knowledge and study by Project Based Learning model in Web design and production course. ($\mu = 2.67$).

For external factors affecting Web Design and Production course enhance critical thinking ability of undergraduate students major in class 2 Advertising Radio found at high level ($\mu = 3.54$). Considering only each item, it was found that factor No.25 The learning atmosphere created by the lecturer in the course is the highest ($\mu = 4.14$), follow by factor No.26 Lecturer's design of learning activities and organization of course content. ($\mu = 4.12$) and the fewest mean is factor No.16 Lecturer's appearance, temperament and clothing style ($\mu = 2.71$).

Table 4.7 Common data of the respondent major in class 3 Television Journalism.

(N =55)

Data	Frequency	Percentage
Gender		
A. Male	15	27.27
B. Female	40	72.73
Total	55	100.00
Age		
A. below 17 yrs.	0	0.00
B. 17-20 yrs.	50	90.91
C. 21-23 yrs.	5	9.09
D. over 23 yrs.	0	0.00
Total	55	100.00

From table 4.7 the common data of the respondent major in Television Journalism the most gender is female, 72.73%, the most age is 17-20 yrs, 90.91%.

Table 4.8 The result of questionnaire from students major in class 3 Television Journalism

(N=55)				
Factors	μ	σ	Interpretation	Ranking within All Factors
Internal factors (respondents)				
No.1 Students are very interested in Web Design and Production course.	4.05	0.88	High	1
No.2 Students have a clear understanding of critical thinking ability knowledge and study by Project Based Learning model in Web design and production course.	2.81	0.39	Moderate	15
No.3 Students are interested in using innovative teaching models such as project-based learning in their courses.	2.93	0.63	Moderate	12
No.4 Students have the will to actively design, practice and develop creative web work.	2.92	0.63	Moderate	13
No.5 Students are industrious in their learning (Assignments, Projects, Participation, etc.) with the highest potential themselves.	3.70	0.71	High	5
No.6 Students are able to master and apply relevant techniques and tools from the course.	2.91	0.63	Moderate	14
No.7 Students feel that Web design and production course is the great significance to personal growth and development in future.	3.33	0.74	Moderate	10
No.8 Students have a sufficient knowledge base and intellectual level to learn web design and production courses.	3.11	0.45	Moderate	11

Table 4.8 (Continued)

(N=55)				
Factors	μ	σ	Interpretation	Ranking within All Factors
No.9 Students can master critical thinking ability by Web design planning and production process in Web design and production course.	3.72	0.64	High	4
No.10 Students are satisfied with the friendly cooperation and interaction between students and teachers or peers in the Web design and production course.	3.57	0.71	High	8
No.11 Students believe that personality and thinking style will affect the course learning effect.	3.50	0.71	Moderate	9
No.12 Students are willing to engage in independent study and explore additional knowledge and skills outside of the classroom.	3.61	0.67	High	6
No.13 Students learn about the latest research trends and developments in their subject area.	3.58	0.76	High	7
No.14 Students have clear learning motivation in course learning.	3.76	0.74	High	3
No.15 Students can develop their sense of accomplishment and pride through different activities in Web design and production course.	3.80	0.72	High	2
Total Average	3.42	0.67	Moderate	
External factors (lecturers, material, and circumstance)				
No.16 Lecturer's appearance, temperament and clothing style.	2.85	0.44	Moderate	15
No.17 Lecturer's emphasis on promoting students' critical thinking.	3.54	0.50	High	10

Table 4.8 (Continued)

(N=55)				
Factors	μ	σ	Interpretation	Ranking within All Factors
No.18 Lecturers' attitudes toward new teaching models that promote critical thinking.	4.03	0.88	High	4
No.19 The lecturer's flexible control over the teaching process and time.	3.12	0.45	Moderate	11
No.20 The assessment methods used by the lecturer in the classroom.	3.59	0.67	High	9
No.21 Lecturer experience and ability to enhance students' critical thinking ability.	3.60	0.67	High	8
No.22 The course objectives set by the lecturer are rich and multi-dimensional.	4.11	0.56	High	1
No.23 The teaching method adopted by the lecturer in the course.	4.06	0.60	High	3
No.24 The textbook fully considers the content and objectives of Web design and production courses and critical thinking training.	3.62	0.67	High	7
No.25 The learning atmosphere created by the lecturer in the course.	3.87	0.71	High	5
No.26 Lecturer's design of learning activities and organization of course content.	3.10	0.31	Moderate	12
No.27 Teaching materials provide practical, interactive and inspiring cases, which are useful to students.	2.89	0.48	Moderate	13
No.28 The learning environment, media and materials provided by the instructor.	3.67	0.90	High	6
No.29 The degree to which schools value critical thinking ability.	4.09	0.91	High	2

Table 4.8 (Continued)

(N=55)				
Factors	μ	σ	Interpretation	Ranking within All Factors
No.30 The environments is clean and bright, with desks and chairs, blackboards, podiums, computers, projectors, large screens, loudspeakers and other multimedia facilities to facilitate the teaching process.	2.86	0.44	Moderate	14
Total Average	3.53	0.61	High	

From table 4.8 Indicates that internal factors affecting critical thinking ability of undergraduate students major in class 3 Television Journalism found at moderate level ($\mu = 3.42$). Considering only each item, it was found that factor No.1 Students are very interested in Web Design and Production course is the highest mean ($\mu = 4.05$), follow factor by No.15 Students can develop their sense of accomplishment and pride through different activities in Web design and production course. ($\mu = 3.80$) and the fewest mean is factor No.2 Students have a clear understanding of critical thinking ability knowledge and study by Project Based Learning model in Web design and production course. ($\mu = 2.81$).

For external factors affecting Web Design and Production course enhance critical thinking ability of undergraduate students major in class 3 Television Journalism found at high level ($\mu = 3.53$). Considering only each item, it was found that factor No.22 The course objectives set by the lecturer are rich and multi-dimensional is the highest mean ($\mu = 4.11$), follow by factor No.29 The degree to which schools value critical thinking ability ($\mu = 4.09$) and the fewest mean is factor No.16 Lecturer's appearance, temperament and clothing style. ($\mu = 2.85$).

Table 4.9 Common data of the respondent major in Class 4 Systems Science.

(N =50)

Data	Frequency	Percentage
Gender		
A. Male	10	20.00
B. Female	40	80.00
Total	50	100
Age		
A. below 17 yrs.	0	0
B. 17-20 yrs.	45	90.00
C. 21-23 yrs.	5	10.00
D. over 23 yrs.	0	0
Total	50	100

From table 4.9 the common data of the respondent major in Systems Science the most gender is female, 80.00%, the most age is 17-20 yrs, 90.00%.

Table 4.10 The result of questionnaire from students major in class 4 Systems Science.

(N =50)

Factors	μ	σ	Interpretation	Ranking within All Factors
Internal factors (respondents)				
No.1 Students are very interested in Web Design and Production course.	4.12	0.71	High	1
No.2 Students have a clear understanding of critical thinking ability knowledge and study by Project Based Learning model in Web design and production course.	2.12	0.32	Few	15
No.3 Students are interested in using innovative teaching models such as project-based learning in their courses.	3.32	0.51	Moderate	12
No.4 Students have the will to actively design, practice and develop creative web work.	3.80	0.45	High	3

Table 4.10 (Continued)

(N =50)				
Factors	μ	σ	Interpretation	Ranking within All Factors
No.5 Students are industrious in their learning (Assignments, Projects, Participation, etc.) with the highest potential themselves.	3.46	0.88	Moderate	9
No.6 Students are able to master and apply relevant techniques and tools from the course.	3.79	0.45	High	4
No.7 Students feel that Web design and production course is the great significance to personal growth and development in future.	3.81	0.45	High	2
No.8 Students have a sufficient knowledge base and intellectual level to learn web design and production courses.	3.44	0.54	Moderate	11
No.9 Students can master critical thinking ability by Web design planning and production process in Web design and production course.	3.56	0.57	High	8
No.10 Students are satisfied with the friendly cooperation and interaction between students and teachers or peers in the Web design and production course.	3.78	0.80	High	5
No.11 Students believe that personality and thinking style will affect the course learning effect.	3.76	0.99	High	6
No.12 Students are willing to engage in independent study and explore additional knowledge and skills outside of the classroom.	3.45	0.75	Moderate	10
No.13 Students learn about the latest research trends and developments in their subject area.	3.30	0.75	Moderate	13

Table 4.10 (Continued)

(N =50)				
Factors	μ	σ	Interpretation	Ranking within All Factors
No.14 Students have clear learning motivation in course learning.	3.18	0.59	Moderate	14
No.15 Students can develop their sense of accomplishment and pride through different activities in Web design and production course.	3.75	0.77	High	7
Total Average	3.51	0.64	High	
External factors (lecturers, material, and circumstance)				
No.16 Lecturer's appearance , temperament and clothing style.	2.10	0.44	Few	15
No.17 Lecturer's emphasis on promoting students' critical thinking.	3.86	0.75	High	2
No.18 Lecturers' attitudes toward new teaching models that promote critical thinking.	3.85	0.72	High	3
No.19 The lecturer's flexible control over the teaching process and time.	3.50	0.54	Moderate	8
No.20 The assessment methods used by the lecturer in the classroom.	3.58	0.75	High	6
No.21 Lecturer experience and ability to enhance students' critical thinking ability.	3.38	0.75	Moderate	11
No.22 The course objectives set by the lecturer are rich and multi-dimensional.	3.52	0.50	High	7
No.23 The teaching method adopted by the lecturer in the course.	3.43	0.57	Moderate	9
No.24 The textbook fully considers the content and objectives of Web design and production courses and critical thinking training.	3.39	0.75	Moderate	10
No.25 The learning atmosphere created by the lecturer in the course.	3.14	0.35	Moderate	12

Table 4.10 (Continued)

(N =50)				
Factors	μ	σ	Interpreta tion	Ranking within All Factors
No.26 Lecturer's design of learning activities and organization of course content.	3.66	0.62	High	5
No.27 Teaching materials provide practical, interactive and inspiring cases, which are useful to students.	2.70	0.50	Moderate	13
No.28 The learning environment, media and materials provided by the instructor.	3.70	0.61	High	4
No.29 The degree to which schools value critical thinking ability.	4.14	0.66	High	1
No.30 The environments is clean and bright, with desks and chairs, blackboards, podiums, computers, projectors, large screens, loudspeakers and other multimedia facilities to facilitate the teaching process.	2.22	0.46	Few	14
Total Average	3.34	0.60	Moderate	

From table 4.10 Indicates that internal factors affecting critical thinking ability of undergraduate students major in class 4 Systems Science found at high level ($\mu=3.51$). Considering only each item, it was found that factor No.1 Students are very interested in Web Design and Production course is the highest mean ($\mu= 4.12$), follow factor by No.7 Students feel that Web design and production course is the great significance to personal growth and development in future. ($\mu=3.81$) and the fewest mean is factor No.2 Students have a clear understanding of critical thinking ability knowledge and study by Project Based Learning model in Web design and production course. ($\mu=2.12$).

For external factors affecting Web Design and Production course enhance critical thinking ability of undergraduate students major in class 4 Systems Science found at high level ($\mu=3.34$). Considering only each item, it was found that factor

No.29 The degree to which schools value critical thinking ability. is the highest mean ($\mu=4.14$), follow by factor No.17 Lecturer's emphasis on promoting students' critical thinking. ($\mu=3.86$) and the fewest mean is factor No.16 Lecturer's appearance, temperament and clothing style. ($\mu=2.10$).

The lecturers interview analysis results

The amount of lecturers' university by table 4.11

Table 4.11 Common data of the respondents in overall

(N =3)

Data	Frequency	Percentage
Gender		
A. Male	1	33.33
B. Female	2	66.67
Total	3	100.00
Experience teaching		
A. Below 3 yrs.	0	0.00
B. 3-6 yrs.	1	33.33
C. 7- 9 yrs.	2	66.67
D. Over 9 yrs.	0	
Total	3	100.00
Age		
A. Below 25 yrs.	0	0
B. 25-35 yrs.	0	0
C. 36-49 yrs.	3	100
D. Over 49 yrs.	0	0
Total	3	100

From table 4.11 the common data of the respondents in Yulin Normal University. The most gender is female, 66.67%, the most Experience teaching is 7-9 yrs.,66.67%, the most age is 36-49 yrs.,100%.

Interview Lecturers Results

After the results from interview with the 3 lecturers, the factors affecting students' critical thinking ability can be concluded as follows.

Internal Factors

Student's knowledge and experience

1) 3 lecturers stated in the interview that the critical thinking ability of current college students is generally not high. The lecturers believe that the main reason is that students' understanding of critical thinking ability is not clear enough, and students are influenced by their existing basic knowledge level. The main performance is whether students have a clear understanding of the training objectives of the course and the evaluation criteria for critical thinking ability. When completing learning tasks and dealing with problems, they can quickly analyze and evaluate the key information of the problem from their own cognitive structure, raise reasonable questions, reflect and summarize, and creatively solve the problem.

2) 3 lecturers believe that students' personal practical experience can affect their critical thinking abilities. Critical thinking ability is a complex thinking process and a practical process that comprehensively applies knowledge, experience, and relevant information skills. Personal special life and practical experience have a certain impact on critical thinking ability.

Student psychology

1) 3 lecturers mentioned in the interviews that students' success or failure experiences can affect their improvement in critical thinking ability. Students are prone to developing a fear of difficulty, and when encountering difficult knowledge, they are prone to giving up. In learning, students expect recognition and recognition, and when they succeed or receive recognition, they will gain a sense of achievement and pride. If students receive recognition and recognition, they can also stimulate their potential and actively engage in learning.

2) 3 lecturers interviewed believe that students' interests and motivations can affect their ability to improve critical thinking. If students have a strong interest in this course, like it, and believe that it helps them achieve their self-worth, they will be more active in learning, and their learning effectiveness and critical thinking ability will be significantly improved.

External Factors

Social environment: All 3 lecturers promote an interactive and collaborative learning environment. They encourage group discussions, peer reviews and collaborative projects, thereby enhancing students' teamwork skills.

Materials: Each instructor uses a variety of teaching materials, including textbooks and online learning resources. These materials are used to facilitate learning, increase students' interest in learning, and broaden their knowledge base.

Teaching method: The 3 lecturers mainly adopt the teaching method of lectures, combined with group discussions and homework demonstrations to allow students to participate in the classroom. Assigned learning tasks include: designing and making personal web pages, class web pages, etc. They are relatively satisfied with the current school media equipment, technical environment and material environment, which can meet the needs of improving critical thinking ability. They have no clear position on whether the project-based learning model can enhance the critical thinking ability of undergraduates and how the project-based learning model can enhance the critical thinking ability of undergraduates and the significant benefits of instructional design, because they have not specifically done. However, this model has not been used in teaching. They expressed their support for the reform of teaching model or teaching method.

Evaluation: The 3 lecturers evaluate students based on their usual performance (40% of the total evaluation) and final grades (60% of the total evaluation). Among them, the usual performance includes: attendance rate, class questions and answers, homework, etc.; the final grade is mainly determined by the works submitted by the students. The methods of evaluating teaching effects and students' learning are relatively traditional. At present, no more reasonable standards and evaluation methods have been found to evaluate students' learning effects and critical thinking ability.

Present the results of the questionnaire and interviews

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 4.12 below.

Table 4.12 Summary of factors affecting students' critical thinking ability

Students' opinion		Lecturers' opinion		Synthesized opinion	
Internal Factors	External Factors	Internal Factors	External Factors	Internal Factors	External Factors
1) Students are interested in the course, willing to develop web works, and have a clear motivation for learning.	1) The lecturer did not pay enough attention to improving students' critical thinking, and the lecturer failed to create a good learning atmosphere in the course. Lecturer's design of learning activities and organization of course content need to be improved.	1) The three lecturers are proficient in web design and production knowledge, so they choose to teach this course. Lecturers believe that students' learning interest and learning motivation may be important factors affecting critical thinking ability.	1) Basically implement the teaching according to the teaching plan and teaching plan. It is hoped that the school will provide strong support and attach importance to the cultivation of critical thinking skills.	1) Students' interest in the course and learning motivation have a certain influence on the cultivation of critical thinking ability; the lecturer's familiarity with the course is also one of the important factors affecting critical thinking ability.	1) A good learning atmosphere in the course, the design of learning activities and the organization of course capacity have an impact on students' interest; the degree of attention of schools and lecturers is an important factor affecting critical thinking ability.

Table 4.12 (Continued)

Students' opinion		Lecturers' opinion		Synthesized opinion	
Internal Factors	External Factors	Internal Factors	External Factors	Internal Factors	External Factors
2) Students' interest in innovative teaching models such as project-based learning. Students are willing to work independently and explore additional knowledge and skills outside of the classroom. Appreciate teacher-student interaction.	2) Students' interest in innovative teaching models such as project-based learning. Students are willing to work independently and explore additional knowledge and skills outside of the classroom. Appreciate teacher-student interaction.	2) All three lecturers advocate the development of teaching models. How to improve the critical thinking ability of undergraduates and the significant benefits of instructional design are still unclear.	2) Lecturers mainly adopt the teaching method of lectures, combined with group discussions and homework demonstrations, to allow students to participate in the classroom. Lecturers do not have a clear understanding of the teaching mode of project-based learning.	2) Students' attitudes towards innovative teaching models, students' attitude towards independent learning and exploring additional knowledge and skills outside the classroom, and lecturers' attitudes towards developing teaching models have an important impact on the improvement of critical thinking ability.	2) Innovative and reasonable teaching mode is an important factor to improve students' critical thinking ability.

Table 4.12 (Continued)

Students' opinion		Lecturers' opinion		Synthesized opinion	
Internal Factors	External Factors	Internal Factors	External Factors	Internal Factors	External Factors
3) The students study hard, develop their own potential and sense of accomplishment, and the students are not satisfied with the way the lecturers are evaluated.	3) The curriculum objective dimensions formulated by the lecturer are not rich enough, and the evaluation methods used in the classroom.	3) Improve the understanding of critical thinking skills, formulate scientific and reasonable curriculum objectives, and strengthen reflection on student evaluation models.	3) Lecturers have a relatively traditional way of evaluating students' learning, and no more reasonable standards and evaluation methods have been found to evaluate students' learning effects and critical thinking ability.	3) The degree of diligence of students in learning; the lecturer's understanding of critical thinking ability and reflection on the evaluation model have an important impact on the improvement of critical thinking ability.	3) The rationality of curriculum objectives and the reform of evaluation methods are important factors affecting the improvement of students' critical thinking ability.

Table 4.12 (Continued)

Students' opinion		Lecturers' opinion		Synthesized opinion	
Internal Factors	External Factors	Internal Factors	External Factors	Internal Factors	External Factors
4) Students have a certain knowledge base and intelligence level, basically master and apply relevant technologies and tools in the course, and have a basic understanding of the latest research trends and developments in this subject area.	4) The textbook takes into account the content and goals of web design and production courses and critical thinking training, providing practical, interactive, and stimulating cases.	4) The lecturer is consciously familiar with the teaching materials, collects a large number of learning materials and prepares teaching aids.	4) Lecturers use a variety of teaching materials, including textbooks and online learning resources. Before teaching, mainly through online video learning, textbooks and handouts to familiarize yourself with the teaching content. Tutor students through social software after class.	4) Students' knowledge base, intelligence level, and understanding of the development trend of the subject field have a certain impact on the improvement of critical thinking ability.	4) The teaching materials, teaching resources and after-school tutoring provided by lecturers have a certain influence on the improvement of students' critical thinking ability.

Table 4.12 (Continued)

Students' opinion		Lecturers' opinion		Synthesized opinion	
Internal Factors	External Factors	Internal Factors	External Factors	Internal Factors	External Factors
5) Students think that personality and way of thinking will affect the course learning effect.	5) The school provides many powerful teaching environments, but the school's emphasis on critical thinking skills needs to be further improved.	5) All three lecturers advocate an interactive and collaborative learning environment. The learning environment advocated and created has a certain influence on the learning effect.	5) The school's current equipment and environment can meet the needs of improving critical thinking ability.	5) The personality and way of thinking of students will affect the learning effect of the course. The learning environment advocated and created by lecturers also has a certain influence on the improvement of critical thinking ability.	5) The school's emphasis and the equipment and learning environment provided have a certain impact on the improvement of students' critical thinking ability.

From table 4.12 It can be seen that the internal factors that affect the improvement of critical thinking ability of undergraduate web design and production courses in Yulin Normal University mainly include: students' interest and motivation in courses, students' interest in innovative teaching models (such as project-based learning), Students' diligence, reflection on teaching evaluation, knowledge base, intelligence level, personality and way of thinking, and the learning environment advocated and created, etc.

Aiming at the external factors that affect the improvement of critical thinking ability of undergraduate web design and production courses of Yulin Normal University, it mainly includes: learning atmosphere, innovative and reasonable teaching mode, evaluation methods, teaching resources, after-school tutoring, school's emphasis and learning environment wait.

Students are generally interested in web design and production courses and innovative teaching models, and are willing to develop web works. They believe that the traditional teaching model cannot effectively improve students' critical thinking ability, and more effective teaching models need to be developed. Students generally think that the goal of design is not well combined with critical thinking ability, and the teaching activities are not rich enough. Students have no more avenues to find more knowledge, and teachers have limited teaching resources. They also believe that the existing evaluation methods are relatively traditional and fail to scientifically evaluate students' learning effects and critical thinking ability.

Part 2: Analysis results serving objective 2–To develop project-based learning instructional model for enhancing critical thinking ability of undergraduate students.

To serve objective 2, the collected data of confirming the appropriateness of 6 components of instructional model are analyzed in 4 areas, i.e. utility, feasibility, propriety, and accuracy and presented by frequency and percentage of the specialists as shown in table and description below.

Table 4.13 Frequency and percentage of conformability of utility, feasibility, propriety, and accuracy of the instructional model components in 6 areas by specialists

No.	Components of project-based learning instructional model for enhancing critical thinking ability of university students	Opinion of the specialists															
		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	5	100	0	0	5	100	0	0	5	100	0	0	5	100	0	0
2	Objectives	5	100	0	0	5	100	0	0	5	100	0	0	5	100	0	0
3	Contents	5	100	0	0	5	100	0	0	5	100	0	0	5	100	0	0
4	Methods of Teaching & Materials	5	100	0	0	5	100	0	0	5	100	0	0	5	100	0	0
5	Evaluation	5	100	0	0	5	100	0	0	5	100	0	0	5	100	0	0

From table 4.13, the conformability of each component of the instructional model by 5 specialists can be elaborated as follows.

Principle and Rationale

The utility of principle and rationale of the instructional model is confirmed to be appropriate by 5 specialists or 100% of all specialists; feasibility 5 specialists or 100%; propriety 5 specialists or 100%; and accuracy 5 specialists or 100%.

Objectives

The objectives of principle and rationale of the instructional model is confirmed to be appropriate by 5 specialists or 100% of all specialists; feasibility 5 specialists or 100%; propriety 5 specialists or 100%; and accuracy 5 specialists or 100%.

Contents

The contents of principle and rationale of the instructional model is confirmed to be appropriate by 5 specialists or 100% of all specialists; feasibility 5 specialists or 100%; propriety 5 specialists or 100%; and accuracy 5 specialists or 100%.

Methods of Teaching & Materials

The methods of teaching & materials of principle and rationale of the instructional model is confirmed to be appropriate by 5 specialists or 100% of all specialists; feasibility 5 specialists or 100%; propriety 5 specialists or 100%; and accuracy 5 specialists or 100%.

Evaluation

The evaluation of teaching & materials of principle and rationale of the instructional model is confirmed to be appropriate by 5 specialists or 100% of all specialists; feasibility 5 specialists or 100%; propriety 5 specialists or 100%; and accuracy 5 specialists or 100%.

Part 3: Analysis results serving research objective 3-To study the results of implementing project-based learning instructional model for enhancing critical thinking ability of undergraduate students.

Table 4.14 Students' critical thinking ability after implementing project based learning instructional model assessed by rubric scoring criteria in overview (Total scores=45)

Items	\bar{x}	S.D.	Interpretation
Item 1: Analysis	11.46	1.17	Good
Item 2: Evaluation	10.90	1.22	Good
Item 3: Creativity	10.49	1.27	Good
Average Scores	10.95	1.22	Good
Total Scores	32.85	3.00	Good

From table 4.14 indicates that the average score after the experiment from students measure 10.95 (Good Level). Considering each item individually, it was found that the learners perform item1: Analysis best (\bar{x} =11.46, Good Level), followed by item 2: Evaluation (\bar{x} =10.90, Good Level), and the lowest mean is item 3: Creativity (\bar{x} = 10.49, Good Level).

Table 4.15 Students' critical thinking ability after implementing project-based learning instructional model assessed by rubric scoring criteria in item 1: Analysis (Total scores=15)

Standard	\bar{x}	S.D.
Standard 1: Group positioning	3.56	0.56
Standard 2: Content Selection	3.38	0.55
Standard 3: Functional Settings	4.52	0.56
Average Scores	3.82	0.56
Total Scores	11.46	1.15

From table 4.15: For Item 1, Analysis of critical thinking ability for undergraduate students, the average score measures 3.82. Considering each item individually, it was found that Standard 3: Functional Settings analysis has the highest mean (\bar{x} =4.52), followed by Standard 1: Group positioning analysis (\bar{x} = 3.56), and the lowest mean is Standard 2: Content selection analysis (\bar{x} = 3.38).

Table 4.16 Students' critical thinking ability after implementing project-based learning instructional model assessed by rubric scoring criteria in item 2: Evaluation (Total scores=15)

Standard	\bar{x}	S.D.
Standard 1: Layout Design	3.24	0.56
Standard 2: Web Navigation	3.14	0.50
Standard 3: Web Security	4.52	0.56
Average Scores	3.63	0.54
Total Scores	10.90	1.22

Table 4.16: For Item 2, Evaluation of critical thinking ability for undergraduate students for undergraduate students, the average score measures 3.63. Considering each item individually, it was found that Standard 3: The web security evaluation has the highest mean (\bar{x} =4.52), followed by Standard 1: Layout design evaluation (\bar{x} =3.24), and the lowest mean is Standard 2: Web Navigation evaluation (\bar{x} =3.14).

Table 4.17 Students' critical thinking ability after implementing project-based learning instructional model assessed by rubric scoring criteria in item 3: Creativity (Total scores=15)

Standard	\bar{x}	S.D.
Standard 1: Design Highlights	3.56	0.53
Standard 2: User Experience	3.70	0.52
Standard 3: Updating and Optimizing	3.23	0.53
Average Scores	3.50	0.53
Total Scores	10.49	1.27

Table 4.17: For Item 3, Creativity of critical thinking ability for undergraduate students, the average score measures 3.50. Considering each item individually, it was found that Standard 2: User experience creativity has the highest mean (\bar{x} =3.70), followed by Standard 1: Design highlights creativity (\bar{x} = 3.56), and the lowest mean is Standard 3: Updating and Optimizing creativity (\bar{x} = 3.23).

Table 4.18 The students' critical thinking ability level after implementing project-based learning instructional model in 3 Items (Total scores=45)

Level	Frequency	Percentage
Excellent	9	14.29
Good	50	79.36
Moderate	4	6.35
Pass	-	-
Poor	-	-
Total	63	100.00

From Table 4.18: It was found that 14.29% of 63 students whose critical thinking ability is at excellent level, 79.36% of students are at good level, while another 6.35% of them are assessed to be at Moderate level. A total of 93.65% are above the good level. From this we can see after implementing project-based learning model, students' critical thinking ability will be overall improved exceed at 80%. The experimental results are consistent with the research hypothesis.

Table 4.19 The students' critical thinking ability in Item 1: Analysis (Total sores=15)

Level	Frequency	Percentage
Excellent	15	23.81
Good	46	73.02
Moderate	2	3.17
Pass	-	-
Poor	-	-
Total	63	100.00

From table 4.19, it was found that 23.81% students whose Analytical skills in critical thinking ability is at excellent level, 73.02% students' Analytical skills is at good level and other 3.17% students are at Moderate level.

Table 4.20 The students' critical thinking ability in Item 2: Evaluation (Total sores=15)

Level	Frequency	Percentage
Excellent	6	9.53
Good	51	80.95
Moderate	6	9.52
Pass	-	-
Poor	-	-
Total	63	100.00

From table 4.20, it was found that 9.53% students whose Evaluation skills in critical thinking ability is at excellent level, 80.95% students' Evaluation skills is at good level and other 9.52% students' Evaluation skills is at Moderate level.

Table 4.21 The students' critical thinking ability in Item 3: Creativity (Total sores=15)

Level	Frequency	Percentage
Excellent	2	3.18
Good	43	68.25
Moderate	18	28.57
Pass	-	-
Poor	-	-
Total	63	100.00

From table 4.21, it was found that 3.18% students whose Creativity in critical thinking ability is at excellent level, 68.25% students' creativity is at good level and other 28.57% students' creativity is at Moderate level.

Summary

The project-based learning instructional mode (PBLI) is based on constructivist theory, pragmatic theory, and situational learning theory, fully

considering the influencing factors of critical thinking. Through task introduction, planning, implementation, practice, presentation, and evaluation, it learns web design and production courses. The project-based learning instructional mode enhances students' critical thinking abilities. Summary development of project-based learning instructional model for enhancing critical thinking ability of undergraduate students in figure 4.1

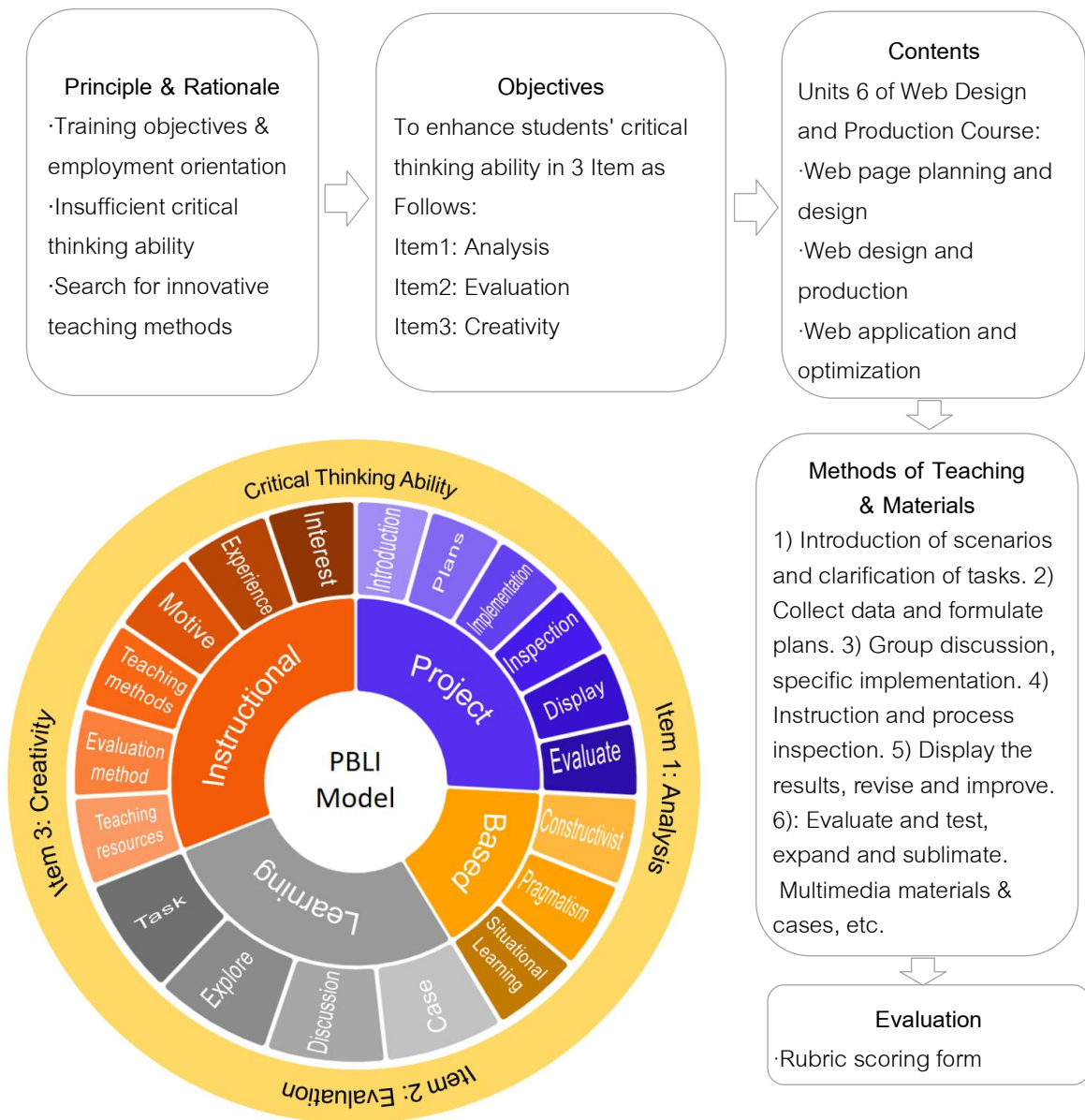


Figure 4.1 Development of project-based learning instructional model for enhancing critical thinking ability of undergraduate students (By researcher)

Chapter 5

Conclusion Discussion and Recommendations

After analyzing and presenting data analysis results in chapter 4 as serving all research 4 research objectives of the present study “Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students”, it can be concluded and discussed as follows. Further, some approaches are recommended on basis of the findings.

Conclusion

From the objectives of research

1. The factors which enhancing critical thinking ability of undergraduate students include 2 factors: Internal factors and external factors. Data analysis results from students' data reveal that that learning interest, learning effort, and learning motivation are the most influential internal factors. The attitude of the instructor towards innovative teaching models, the emphasis placed on cultivating critical thinking abilities, the course objectives set by the instructor, and the teaching methods adopted by the instructor are external factors that have a significant impact. Lecturers' opinion reflect also both internal and external factors in terms of internal factors, students' cognition, knowledge level, and experience can affect their critical thinking ability. Researcher summarize these internal factors into two aspects: students' knowledge and experience (participation in classroom activities and practices) and students' psychology (promoting self-directed learning, making learners interested in web design and production courses). Regarding external factors, including social environment (creating a classroom atmosphere to achieve teaching objectives), materials (preparing teaching aids, learning resources, and other necessary equipment to promote learning, interest, and broaden knowledge), teaching methods (integrating various teaching methods), and evaluation (analyzing the effectiveness of course teaching).

2. Project based learning instructional model for enhancing critical thinking ability of undergraduate students include 5 components: 1) Principle and rationale,

2) Objectives, 3) Contents, 4) Method of teaching & materials and 5) Evaluation. The model is 100% conformed to utility, feasibility, propriety, and accuracy as assessed by 5 specialists.

3. It was found that 14.29% of 63 students whose critical thinking ability is at excellent level while another 79.36% of them are assessed to be at a good level. A total of 93.65% are above the good level. The result is consistent with the research hypothesis that 80% upwards of the participants will have critical thinking ability at good level after learning through project-based learning instructional model.

Discussions

In the study of "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" the researchers submitted the following relevant literature.

1. The data obtained through the questionnaire survey of learners and the interviews with lecturers show that both internal and external factors can affect the learning effect of learners learning web design and production courses. As Cacho (2022) believes that interactive and active collaborative learning has a positive impact on critical thinking. Wang (2020) believes that the educational environment (including school level, subject, etc.) and students' learning input, such as whether students are actively learning, the degree of student-teacher interaction, and the degree of participation in various extracurricular activities have an impact on students' critical thinking ability. Li (2021) believes that teacher differences, personal emotional characteristics, educational environment, and educational awareness affect the cultivation of critical thinking ability of college students in normal colleges. Chen (2018) believes that the factors that affect the formation and development of students' abilities mainly include: the influence of innate genetic factors, the influence of early experience and environment, the influence of education and practical activities, and the influence of individual subjective initiative. Ma (2022) believes that in addition to important factors such as basic characteristics of students and family background, university education will also affect the development of students' critical thinking, such as university level or type, grade, major, teaching strategy, classroom behavior, learning engagement, course learning, educational activities, etc. The researchers summed up the views of scholars, and it can be

concluded that the factors that affect the learning effect of learners and the improvement of critical thinking ability can be divided into two types: internal factors and external factors, and internal factors and external factors influence each other. Through the analysis of experimental data by the researchers, it is found that the main factors that affect the improvement of students' critical thinking ability in web design and production courses are: Learning interest and motivation, teaching methods, assessment methods, learning resources and environment.

2. The 5 components of project-based learning instructional model

1) Principle and Rationale, 2) Objectives, 3) Contents, 4) Method of teaching & materials and 5) Evaluation fully align with 5 conformity standards i.e. utility standards, feasibility standards, propriety standards, and accuracy standards as assessed by 5 specialists. The followings explain such conformity.

In terms of utility standards, the teaching mode of project-based learning instructional model helps students improve their critical thinking ability and find out the results of two types of factors (internal factors and external factors). Students learn through project-based learning. The main advantages Including 1) Promote the combination of cognitive learning and social development 2) Provide each student with a more personalized learning experience 3) The development of students' cooperation ability and communication ability 4) From knowledge imparting to literacy development, promoting critical thinking (Artama, 2023). Through the form of the project, through the setting of different situations, closely related to social issues, effectively stimulate students' learning interest, clarify learning goals, cultivate students' cooperation and communication skills, create a good learning atmosphere, and consolidate students' basic knowledge. At the same time, it also effectively improves students' analytical, evaluation and creative skills, and effectively improves students' critical thinking ability.

Meeting the feasibility standards shows that such a model is realistic, deliberate, flexible, frugal, and appropriate for students to assess whether a proposed project or solution is a good idea and, if so, how best to implement it. The objectives of the feasibility study include learners acquiring knowledge, attitudes and skills. (United Nations, 1978)

For the propriety standards, project-based learning is based on challenging problems or issues that involve student participation in design, problem-solving,

decision-making, or investigative activities; that give students the opportunity to work with relative autonomy over extended periods of time; and culminate in a realistic product or demonstration. The educational method meets the requirements of today's society. (Rohm, 2021)

Accuracy standards are developed by instructors and students considering students' level of academic progress and their requirements when assigning and implementing projects.

3. After implementing project-based learning instructional model for enhancing critical thinking ability of undergraduate students, and assessing students' critical thinking ability within 3 scopes of items (9 standards) using rubric scoring criteria 14.29% of the students are at the excellent level, 79.36% of the students are at the good level, and 93.65% of them are above the good level. After implementing the instructional model of project-based learning, the students' critical thinking ability was evaluated in an overview (total score= 45) according to the scoring standard, the total score at 32.86, and average score at 10.95. The total score which is in domain of good level range between 28-36 points. According to the dimensions of critical thinking ability, each item has a full score of 15 points, the measurement value of item 1-Analysis, it is the highest (\bar{x} =11.46), followed by item 2- Evaluation (\bar{x} =10.90), and the lowest is item 3-Creativity (\bar{x} =10.49). Contrasted with the research hypothesis, the researchers proved that the experimental results are consistent with the research hypothesis, that is the project-based learning instructional model can make 80% of the learners achieve an overall good level. At the same time, when analyzing each ability of the students on a smaller scale (total score =15), it was found that the critical thinking ability of the students was rated as excellent, good and Moderate respectively. In detail, 14.29% of the participants' critical thinking ability was rated as excellent in the 1-3 item, 79.36 % was rated as a good level, 6.35% was rated as a Moderate level. The excellent performance is found in item 1- Analysis (23.81%), the item 2- Evaluation (9.53%), and the item 3- Creativity (3.17%). The good performance is found in item 2- Evaluation ability (80.95%), the item 1- Analysis (73.02%), and the item 3- Creativity (68.25%). Just like Yang (2017) pointed out that in the teaching of web design and production courses, the teaching mode of project-based learning can effectively improve students' ability to analyze problems, evaluate and solve problems, and help improve critical thinking ability. Artama (2023)

believes that learners can use Participate in project-based learning courses to promote the combination of cognitive learning and social development, obtain a personalized learning experience, develop cooperation and communication skills, and promote the improvement of critical thinking ability.

Recommendations

In the study of "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" the researcher will make the following recommendations to students, lecturers and universities.

To the students: 1) Must have certain subject knowledge and skills. Students must first learn the knowledge of pre-order courses such as computer application basics, and make a good knowledge reserve for better learning web design and production courses. At the same time, the self-learning ability should be actively improved, and more new skills can be mastered through self-learning. 2) Have a good teamwork spirit and communication skills. On the basis of clear goals and tasks and a full understanding of their own needs, students seek solutions to problems through teamwork and active communication, so as to efficiently complete goals and tasks and meet their own needs. 3) To improve information acquisition and processing capabilities. Students can obtain learning resources and information through multiple channels, master the methods and skills of information processing and analysis, and correctly evaluate and screen out useful information and resources. 4) To improve innovation and practical ability. Students should enhance their awareness of innovation, master innovative methods, and constantly optimize their works through practice.

To the lecturers: 1) Pay attention to the cultivation of students' critical thinking ability. Lecturers cultivate students' critical thinking ability through clear teaching objectives, rich teaching activities and teaching methods. 2) Improve the ability to develop and implement new teaching models. Lecturers use new teaching modes (such as project-based learning teaching mode) to stimulate students' interest in learning, guide students to actively learn and explore, create a good classroom atmosphere, pay attention to each student's learning situation, and give timely guidance, do a good job of answering questions. 3) Provide high-quality online learning resources for course learning, release learning tasks and update resources in

a timely manner, provide learners with a variety of learning activities, and cooperate with the implementation of offline courses. 4) Enhance information literacy and innovation spirit. Lecturers should enhance information literacy, actively think about how to promote and impart knowledge through new ways such as "Internet + education", so that learners can better acquire new knowledge, and cultivate students' skills in analysis, evaluation and innovation through effective innovative teaching models to enhance learners' critical thinking ability.

To the universities: 1) Optimizing personnel training objectives and curriculum arrangements. Combined with the characteristics of the school and majors, the school attaches great importance to the cultivation of students' critical thinking ability by optimizing training objectives and curriculum arrangements, adding special courses or integrating critical thinking ability training into existing courses. 2) Improve teaching facilities and provide high-quality teaching environment. The school actively provides logistics support so that students can study in a high-quality environment. 3) Improve the system management, strengthen the teaching of lecturers and the supervision of students' learning. By understanding the current situation and characteristics of lecturers and students, set evaluation indicators, and make evaluation and guidance on the teaching situation. At the same time, formulate a reward and punishment system to encourage lecturers to better implement teaching and encourage students to better participate in learning. 4) Regularly organize business training. Organize the training of lecturers' teaching theory knowledge and practical ability, gain a deep understanding of how to implement the project-based learning teaching mode, effectively improve the teaching level, and enhance students' critical thinking ability.

Future research

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

1. Expand the scope of research and promote the Learning instructional model. The subjects of this study are undergraduate students in the web design and production course of Yulin Normal University. In the future, the scope of research should be expanded and the teaching model should be promoted. For example, the project-based learning instructional model can be promoted and applied to other

subject areas and even other universities, so that more majors and groups can efficiently acquire new knowledge through the project-based learning teaching model. Improve the critical thinking ability of more learners.

2. Pay attention to the cultivation of creativity in critical thinking ability. In this study, it can be seen from the experimental analysis data that the students performed well in terms of analysis and evaluation. However, the performance in terms of creativity is slightly insufficient. In the future, we need to pay attention to the creative cultivation of critical thinking ability, constantly innovate teaching methods and means, scientifically formulate teaching objectives, enrich teaching resources, and comprehensively improve students' critical thinking ability.

3. Increase research on practical application. In this study, a unit in the web design and production course was selected as an experiment to evaluate students' critical thinking ability. In the future, we will also increase practical application research to connect critical thinking ability with real life.

Project-based learning aims to cultivate learners' multiple abilities. In the Internet age, information supports project-based learning in many aspects such as learning resources, technology, and management. This also means that my country's education industry still has broad room for development. to implement project-based learning. Therefore, the project-based learning teaching model has broad application prospects.

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Appendices

Appendix A

List name of specialists

- List name the specialist to check research instruments for IOC
- List name the specialist to confirm instructional model for obj.2

List name the specialist to check research instruments for IOC

1. Assistant Professor Dr.Wapee Kong-In English Science Program
Bansomdejchaopraya Rajabhat University
2. Assistant Professor Dr.Saiphon English Program Bansomdejchaopraya
Songsiengchai Rajabhat University
- 3.Assistant Professor Dr.Sarayuth Administration Program
Sethakajorn Bansomdejchaopraya Rajabhat University
4. Professor Jiang Shihui Curriculum and Teaching Theory of
Guangxi Normal University
5. Professor Chen Qingwen Curriculum and Teaching Theory of Yulin
Normal University

List name the specialist to confirm instructional model for obj.2

- | | |
|--|--|
| 1. Associate Professor Jittawisut
Wimutipanya | 1.Science Program Bansomdejchaopraya
Rajabhat University |
| 2. Assistant Professor Dr.Wanida
Ploysangwal | 2.English Program University of the Thai
Chamber of Commerce |
| 3. Dr. Panas Jansritong | 3. Admistration Program Krirk University |
| 4. Professor Xie Qingli | 4. Curriculum and Teaching Theory of
Yulin Normal Normal University |
| 5. Professor Liang Zhaohua | 5. Curriculum and Teaching Theory of
Yulin Normal University |

Appendix B

Official letters

- Research tool validation request
- Instructional model evaluation request
- Permission of experimental implementation
- Data collection request

Ref. No. MHESI 0643.14/ 763



Graduate School
Bansomdejchaopraya Rajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

26. July 2023

Subject Request for research tool validation

Dear Assistant Professor Dr.Wapee Kong-In

Attachment Validation sheets

Regarding the thesis entitled "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" of Mr. Qin Lizhong, a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103216, Thailand under the supervision of Assistant Professor Dr. Tanaput Chanchaoren and Associate Professor Dr. Areewan Iamsa-ard and Assistant Professor Dr. Prapai Sridama, the written pretest-posttest and questionnaire as instruments will be used in the said research. In view with this, the researcher would like your expertise to validate the attached pretest-posttest and questionnaires to qualify for conduction. Knowing your experience in the field of Education, I would like to ask for your help in validating the said instrument before administering it to the participants of the study.

The research objective, definitions of terms, the pretest-posttest, questionnaire and the validation sheets are hereby attached. I will be glad to hear your suggestions and comments for the improvement of the instrument. Your positive response is highly appreciated.

Sincerely,

A handwritten signature in blue ink, appearing to be 'K' followed by a flourish.

(Asst.Prof.Dr.Kanakorn Sawangcharoen)
Dean of Graduate School
Bansomdejchaopraya Rajabhat University

Tel. +66 0204737000 Ext.

Fax. +66 0204737000

Ref. No. MHESI 0643.14/ 764



Graduate School
Bansomdejchaopraya Rajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

26 July 2023

Subject Request for research tool validation

Dear Assistant Professor Dr.Saiphon Songsiengchai

Attachment Validation sheets

Regarding the thesis entitled "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" of Mr.Qin Lizhong , a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103216 , Thailand under the supervision of Assistant Professor Dr. Tanaput Chanchaoren and Associate Professor Dr.Areewan Iamsa-ard and Assistant Professor Dr. Prapai Sridama, the written pretest-posttest and questionnaire as instruments will be used in the said research. In view with this, the researcher would like your expertise to validate the attached pretest-posttest and questionnaires to qualify for conduction. Knowing your experience in the field of Education, I would like to ask for your help in validating the said instrument before administering it to the participants of the study.

The research objective, definitions of terms, the pretest-posttest, questionnaire and the validation sheets are hereby attached. I will be glad to hear your suggestions and comments for the improvement of the instrument. Your positive response is highly appreciated.

Sincerely,

(Asst.Prof.Dr.Kanakorn Sawangcharoen)
Dean of Graduate School
Bansomdejchaopraya Rajabhat University

Tel. +66 0204737000 Ext.
Fax. +66 0204737000

Ref. No. MHESI 0643.14/765



Graduate School
Bansomdejchaopraya Rajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

๒๖ July 2023

Subject Request for research tool validation

Dear Assistant Professor Dr.Sarayut Sethakajorn

Attachment Validation sheets

Regarding the thesis entitled "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" of Mr.Qin Lizhong , a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103216 , Thailand under the supervision of Assistant Professor Dr. Tanaput Chanchaoren and Associate Professor Dr.Areewan Iamsa-ard and Assistant Professor Dr. Prapai Sridama, the written pretest-posttest and questionnaire as instruments will be used in the said research. In view with this, the researcher would like your expertise to validate the attached pretest-posttest and questionnaires to qualify for conduction. Knowing your experience in the field of Education, I would like to ask for your help in validating the said instrument before administering it to the participants of the study.

The research objective, definitions of terms, the pretest-posttest, questionnaire and the validation sheets are hereby attached. I will be glad to hear your suggestions and comments for the improvement of the instrument. Your positive response is highly appreciated.

Sincerely,

A handwritten signature in blue ink, appearing to be 'K. Sawangcharoen'.

(Asst.Prof.Dr.Kanakorn Sawangcharoen)
Dean of Graduate School
Bansomdejchaopraya Rajabhat University

Tel. +66 0204737000 Ext.
Fax. +66 0204737000

Ref. No. MHESI 0643.14/ 766



Graduate School
Bansomdejchaopraya Rajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

26 July 2023

Subject Request for research tool validation

Dear Professor Jiang Shihui

Attachment Validation sheets

Regarding the thesis entitled "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" of Mr. Qin Lizhong, a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103216, Thailand under the supervision of Assistant Professor Dr. Tanaput Chanchaoren and Associate Professor Dr. Areewan Iamsa-ard and Assistant Professor Dr. Prapai Sridama, the written pretest-posttest and questionnaire as instruments will be used in the said research. In view with this, the researcher would like your expertise to validate the attached pretest-posttest and questionnaires to qualify for conduction. Knowing your experience in the field of Education, I would like to ask for your help in validating the said instrument before administering it to the participants of the study.

The research objective, definitions of terms, the pretest-posttest, questionnaire and the validation sheets are hereby attached. I will be glad to hear your suggestions and comments for the improvement of the instrument. Your positive response is highly appreciated.

Sincerely,

A handwritten signature in blue ink, appearing to be 'Kanakorn Sawangcharoen'.

(Asst. Prof. Dr. Kanakorn Sawangcharoen)
Dean of Graduate School
Bansomdejchaopraya Rajabhat University

Tel. +66 0204737000 Ext.

Fax. +66 0204737000

Ref. No. MHESI 0643.14/ 767



Graduate School
Bansomdejchaopraya Rajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

26 July 2023

Subject Request for research tool validation

Dear Professor Chen Qingwen

Attachment Validation sheets

Regarding the thesis entitled "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" of Mr. Qin Lizhong, a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103216, Thailand under the supervision of Assistant Professor Dr. Tanaput Chanchaoren and Associate Professor Dr. Areewan Iamsa-ard and Assistant Professor Dr. Prapai Sridama, the written pretest-posttest and questionnaire as instruments will be used in the said research. In view with this, the researcher would like your expertise to validate the attached pretest-posttest and questionnaires to qualify for conduction. Knowing your experience in the field of Education, I would like to ask for your help in validating the said instrument before administering it to the participants of the study.

The research objective, definitions of terms, the pretest-posttest, questionnaire and the validation sheets are hereby attached. I will be glad to hear your suggestions and comments for the improvement of the instrument. Your positive response is highly appreciated.

Sincerely,

(Asst. Prof. Dr. Kanakorn Sawangcharoen)
Dean of Graduate School
Bansomdejchaopraya Rajabhat University

Tel. +66 0204737000 Ext.
Fax. +66 0204737000

Ref. No. MHESI 0643.14/ 768



Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

.....26.....July 2023

Subject Request for evaluation of instructional model

Dear Associate Professor Jittawisut Wimutipanya

Attachment

Regarding the thesis entitled "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" of Qin Lizhong, a Ph.D. student majoring in Curriculum and Instruction Programme at BansomdejchaoprayaRajabhat University code number 6373103216, Thailand under the supervision of Assistant Professor Dr. Tanaput Chancharoen as major advisor and Associate Professor Dr. Areewan Iamsa-ard and Assistant Professor Dr. Prapai Sridama as co-advisors, the instructional model will be developed in the said research. In view with this, the researcher would like your expertise to evaluate the appropriateness of such a developed instructional model. Knowing your experience in the field of Education, I would like to ask for your help in evaluating the said instructional model before its implementation.

I will be glad to hear your suggestions and comments for the improvement of the instructional model. Your positive response is highly appreciated.

Sincerely,

(Assistant Professor Dr. Kanakorn Sawangcharoen)
Dean of Graduate School
BansomdejchaoprayaRajabhat University

Tel. (662) 4737000

Fax. (662) 4737000

Ref. No. MHESI 0643.14/ 769



Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

.....26.....July 2023

Subject Request for evaluation of instructional model

Dear Assistant Professor Dr.Wanida Ploysangwal

Attachment

Regarding the thesis entitled "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" of Qin Lizhong, a Ph.D. student majoring in Curriculum and Instruction Programme at BansomdejchaoprayaRajabhat University code number 6373103216, Thailand under the supervision of Assistant Professor Dr. Tanapat Chancharoen as major advisor and Associate Professor Dr.Areewan Iamsa-ard and Assistant Professor Dr. Prapai Sridama as co-advisors, the instructional model will be developed in the said research. In view with this, the researcher would like your expertise to evaluate the appropriateness of such a developed instructional model. Knowing your experience in the field of Education, I would like to ask for your help in evaluating the said instructional model before its implementation.

I will be glad to hear your suggestions and comments for the improvement of the instructional model. Your positive response is highly appreciated.

Sincerely,

A handwritten signature in blue ink, appearing to be 'Kanakorn'.

(Assistant Professor Dr.Kanakorn Sawangcharoen)
Dean of Graduate School
BansomdejchaoprayaRajabhat University

Tel. (662) 4737000

Fax. (662) 4737000

Ref. No. MHESI 0643.14/ 710



Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

.....²⁶.....July 2023

Subject Request for evaluation of instructional model

Dear Dr.Panas Jansritong

Attachment

Regarding the thesis entitled "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" of Qin Lizhong, a Ph.D. student majoring in Curriculum and Instruction Programme at BansomdejchaoprayaRajabhat University code number 6373103216, Thailand under the supervision of Assistant Professor Dr. Tanaput Chanchaeroen as major advisor and Associate Professor Dr.Areewan Iamsa-ard and Assistant Professor Dr. Prapai Sridama as co-advisors, the instructional model will be developed in the said research. In view with this, the researcher would like your expertise to evaluate the appropriateness of such a developed instructional model. Knowing your experience in the field of Education, I would like to ask for your help in evaluating the said instructional model before its implementation.

I will be glad to hear your suggestions and comments for the improvement of the instructional model. Your positive response is highly appreciated.

Sincerely,

(Assistant Professor Dr.Kanakorn Sawangcharoen)
Dean of Graduate School
BansomdejchaoprayaRajabhat University

Tel. (662) 4737000

Fax. (662) 4737000

Ref. No. MHESI 0643.14/ 771



Graduate School
 BansomdejchaoprayaRajabhat University
 1061 Itsarapap 15 Itsarapap Rd.
 Thonburi Bangkok 10600

.....²⁶.....July 2023

Subject Request for evaluation of instructional model

Dear Professor Xie Qingli

Attachment

Regarding the thesis entitled "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" of Qin Lizhong, a Ph.D. student majoring in Curriculum and Instruction Programme at BansomejchaoprayaRajabhat University code number 6373103216, Thailand under the supervision of Assistant Professor Dr. Tanaput Chancharoen as major advisor and Associate Professor Dr. Areewan Iamsa-ard and Assistant Professor Dr. Prapai Sridama as co-advisors, the instructional model will be developed in the said research. In view with this, the researcher would like your expertise to evaluate the appropriateness of such a developed instructional model. Knowing your experience in the field of Education, I would like to ask for your help in evaluating the said instructional model before its implementation.

I will be glad to hear your suggestions and comments for the improvement of the instructional model. Your positive response is highly appreciated.

Sincerely,

(Assistant Professor Dr. Kanakorn Sawangcharoen)
 Dean of Graduate School
 BansomejchaoprayaRajabhat University

Tel. (662) 4737000

Fax. (662) 4737000

Ref. No. MHESI 0643.14/772



Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

.....²⁶.....July 2023

Subject Request for evaluation of instructional model

Dear Professor Liang Zhaohua

Attachment

Regarding the thesis entitled "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" of Qin Lizhong, a Ph.D. student majoring in Curriculum and Instruction Programme at BansomdejchaoprayaRajabhat University code number 6373103216, Thailand under the supervision of Assistant Professor Dr. Tanaput Chancharoen as major advisor and Associate Professor Dr. Areewan Iamsa-ard and Assistant Professor Dr. Prapai Sridama as co-advisors, the instructional model will be developed in the said research. In view with this, the researcher would like your expertise to evaluate the appropriateness of such a developed instructional model. Knowing your experience in the field of Education, I would like to ask for your help in evaluating the said instructional model before its implementation.

I will be glad to hear your suggestions and comments for the improvement of the instructional model. Your positive response is highly appreciated.

Sincerely,

(Assistant Professor Dr. Kanakorn Sawangcharoen)
Dean of Graduate School
BansomdejchaoprayaRajabhat University

Tel. (662) 4737000

Fax. (662) 4737000

Ref. No. MHESI 0643.14/773



Graduate School
Bansomdejchaopraya Rajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

24 July 2023

Subject Request for permission to implement experiment

Dear President of Yulin Normal University

Regarding the thesis entitled "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" of Mr. Qin Lizhong, a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University code number 6373103120 Thailand under the supervision of

Major Advisor: Assistant Professor Dr. Tanaput Chanchaoren

Co-advisor: Associate Professor Dr. Areewan Iamsa-ard

Co-advisor: Assistant Professor Dr. Prapai Sridama

the researcher needs to implement an experiment in compliance with approved methodology and collect data in terms of critical thinking aptitude from 280 sophomore from 5 classes of students with different levels of proficiency – beginner, intermediate, and advanced, who enroll in Web Design and Production Course (sample group e.g. 63 second year students of section C Television Journalism) of School of Literature and Media and School of Business during the 1st semester of academic year 2023. 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.

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,

(Asst. Prof. Dr. Kanakorn Sawangcharoen)
Dean of Graduate School
Bansomdejchaopraya Rajabhat University

Tel. +66 0204737000 Ext.

Fax. +66 0204737000



Ref. No. MHESI 0643.14/ ๗๗๑

Graduate School
Bansomdejchaopraya Rajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

๒๖ July 2023

Subject Request for data collection

Dear President of Yulin Normal University

Attachment critical thinking ability copies of questionnaire

Regarding the thesis entitled "Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students" of Mr.Qin Lizhong , a Ph.D. student majoring in Curriculum and Instruction Programme at Bansomejchaopraya Rajabhat University code number 6373103120 Thailand under the supervision of

Major Advisor:Assistant Professor Dr. Tanaput Chancharoen

Co-advisor:Associate Professor Dr.Areewan Iamsa-ard

Co-advisor:Assistant Professor Dr. Prapai Sridama

the researcher needs to collect data using questionnaire in terms of Influencing factors of critical thinking ability from 200 former undergraduate students year 2 of Web Design and Production Course, semester 1 on academic year 2022 in Yulin Normal University of School of Literature and Media and School of Business. Hence, 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:910921696@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,

(Asst.Prof.Dr.Kanakorn Sawangcharoen)
Dean of Graduate School
Bansomejchaopraya Rajabhat University

Tel. +66 0204737000 Ext.

Fax. 66 0204737000

Appendix C

Research instruments

- Questionnaire for students
- Interview for lecturers
- Confirm Instructional Model
- Lesson Plan
- Rubric Scoring form

Questionnaire For students

Directions:

These questionnaires are the instruments for collecting data in 1st phase of the research entitled “Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students” conducted by Qin Lizhong, a Ph.D. student in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University under the supervision of Assistant Professor Dr. Tanaput Chanchaoren , Associate Professor Dr.Areewan Iamsa-ard and Assistant Professor Dr. Prapai Sridama

This questionnaire is divided into 3 sections i.e.

Section 1 Common data of the respondent

Section 2 Information on factors influencing critical thinking ability of Undergraduate students in Yulin Normal University.

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:

Section 1 Common data of the respondent

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

1. Gender is Male Female
2. Students from
 - Yulin Normal University, E-commerce Major
 - Yulin Normal University, Advertising Radio Major
 - Yulin Normal University, Television Journalism Major
 - Yulin Normal University, Systems Science Major
3. Age
 - A. below 17 yrs. B. 17-20 yrs.
 - C. 21-23 yrs. D. over 23 yrs.

Section 2 Questionnaire on factors affecting the of critical thinking ability of Undergraduate students in Yulin Normal University.

Directions: Please rate the following factors affecting the Integration of critical thinking ability by putting ✓ into the attitude level column based on the criteria given below. Each question can select only one answer.

- 5 means strongly agree
- 4 means agree
- 3 means neutral
- 2 means disagree
- 1 means strongly disagree

Questions	Answers				
	5	4	3	2	1
Internal factors (respondents)					
1. Students are very interested in Web Design and Production course.					
2. Students have a clear understanding of critical thinking ability knowledge and study by Project Based Learning model in Web design and production course.					
3. Students are interested in using innovative teaching models such as project-based learning in their courses.					
4. Students have the will to actively design, practice and develop creative web work.					
5. Students are industrious in their learning (Assignments, Projects, Participation, etc.) with the highest potential themselves.					
6. Students are able to master and apply relevant techniques and tools from the course.					
7. Students feel that Web design and production course is the great significance to personal growth and development in future.					
8. Students have a sufficient knowledge base and intellectual level to learn web design and production courses.					
9. Students can master critical thinking ability by Web design planning and production process in Web design and production course.					
10. Students are satisfied with the friendly cooperation and interaction between students and teachers or peers in the Web design and production course.					
11. Students believe that personality and thinking style will affect the course learning effect.					
12. Students are willing to engage in independent study and explore additional knowledge and skills outside of the classroom.					
13. Students learn about the latest research trends and developments in their subject area.					

Questions	Answers				
	5	4	3	2	1
14. Students have clear learning motivation in course learning.					
15. Students can develop their sense of accomplishment and pride through different activities in Web design and production course.					
External factors (lecturers, instructional model, environment)					
16. Lecturer's appearance, temperament and clothing style.					
17. Lecturer's emphasis on promoting students' critical thinking.					
18. Lecturers' attitudes toward new teaching models that promote critical thinking.					
19. The lecturer's flexible control over the teaching process and time.					
20. The assessment methods used by the lecturer in the classroom.					
21. Lecturer experience and ability to enhance students' critical thinking ability.					
22. The course objectives set by the lecturer are rich and multi-dimensional.					
23. The teaching method adopted by the lecturer in the course.					
24. The textbook fully considers the content and objectives of Web design and production courses and critical thinking training.					
25. The learning atmosphere created by the lecturer in the course.					
26. Lecturer's design of learning activities and organization of course content.					
27. Teaching materials provide practical, interactive and inspiring cases, which are useful to students.					
28. The learning environment, media and materials provided by the instructor.					
29. The degree to which schools value critical thinking ability.					

Questions	Answers				
	5	4	3	2	1
30.The environments is clean and bright, with desks and chairs, blackboards, podiums, computers, projectors, large screens, loudspeakers and other multimedia facilities to facilitate the teaching process.					

Section 3 Suggestions for improving the better instruction

.....

.....

.....

Thank you for your kind cooperation for completing the questionnaire!

Researcher
Mr.Qin Lizhong

Interview for Lecturers

Directions:

This interview is a part of research entitled “Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students”

Research Objectives: 1. To examine the factors to enhance critical thinking ability of undergraduate students.

It is conducted by Qin Lizhong, a Ph.D. student in Curriculum and Instruction Programme at Bansomdejchaopraya Rajabhat University under the supervision of

1. Assistant Professor Dr. Tanaput Chanchaoren
2. Associate Professor Dr. Areewan Iamsa-ard
3. Assistant Professor Dr. Prapai Sridama

The following open questions are the instrument for collecting data in 1st phase of the research, concerning about factors to effect enhancing critical thinking ability.

Please write down your own opinion for each questions. 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 are the instrument for collecting data in 1st phase of the research.

1. Gender is A. Male B. Female

2. What university did you come to? What secondary college?
 - A. From Business School of Yulin Normal University
 - B. From School of Literature and Media, Yulin Normal University
 - C. From School of Mathematics and Statistics, Yulin Normal 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. 25-35 yrs.
 - C. 36-49 yrs. D. over 49 yrs.

Section 2 Interview on factors influencing critical thinking ability of Undergraduate students in Yulin Normal University.

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. Why do you accept or select to teach this subject? (Example, prefer to teach, be expert in the content, be requested, or other reasons.)
2. How do you prepare to teach this subject? (Preparing contents, materials, teaching location)
3. What do you think are the main factors affecting the improvement of undergraduates' critical thinking ability?

4. Do you always implement teaching according to your teaching plan? Do you think your teaching plan can effectively enhance students' critical thinking ability? Do you often think about how to improve teaching?
5. How do you give the opportunity for students to participate in the teaching? (Please clarify the methodology.)
6. What kind of teaching evaluation do you think is more conducive to enhancing students' critical thinking ability?
7. What Learning Tasks do you carry out to improve students' learning enthusiasm?
8. Do you provide the time for students after their regular class? If yes, how do you help students solve their difficulties?
9. Do you think the current school media equipment, technological environment and physical environment can meet the needs of improving students' critical thinking ability?
10. In your opinion how does project-based learning instructional model to enhance critical thinking ability of undergraduate students and a significant benefit of instructional design?

Comment and recommendation for improving the better instruction

Thank you for your kind cooperation for completing the questions.

Researcher
Mr. Qin Lizhong

Confirm Instructional Model

Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students

Dear assessors,

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

Assistant Professor Dr. Tanaput Chanchaen

Associate Professor Dr. Areewan Iamsa-ard

Assistant Professor Dr. Prapai Sridama

The attached open questions are the instrument for collecting data in phase 2 of the research, the objective of which is to confirm instructional.

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.

Name Qin Lizhong
Ph.D. student
Curriculum and
Instruction Program
Bansomdejchaopraya
Rajabhat University

Development of Project Based Learning Instructional Model for Enhancing Critical Thinking Ability of Undergraduate Students

Assessor: Associate Professor Jittawisut Wimutipanya

Position: The lecturer of Science Program

Workplace: Bansomdejchaopraya Rajabhat University

Direction: Assessment of confirm the quality of instructional model

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

Assessment Items	Rating Results		
	Agree	Disagree	Remarks
Utility Standard			
1. Project Based Learning instructional model is useful to lecturers to enhance learning achievement.			
2. Project Based Learning instructional model is useful to students to enhance learning achievement.			
3. Project Based Learning instructional model includes necessary and enough contents.			
4. Project Based Learning instructional model promotes to enhance learning achievement more compared to traditional teaching.			
5. Project Based Learning instructional model increases the learning achievement of students.			
Feasibility Standard			

Assessment Items	Rating Results		
	Agree	Disagree	Remarks
1.The lecturer can apply Project 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 enhance learning achievement from using Project Based Learning instructional model.			
3.The Project Based Learning instructional model to enhance learning achievement proficiency is easy to use.			
4.The students always develop their learning all time by Project Based Learning instructional model to enhance learning achievement.			
5. The students are comfortable in learning by themselves with Project Based Learning instructional model to enhance learning achievement.			
Propriety Standard			
1. Project Based Learning instructional model to enhance learning achievement is appropriate for lecturers to use assessment results to improve the students.			
2. Project Based Learning instructional model to enhance learning achievement is appropriateness for students to create knowledge by themselves.			
3. Project Based Learning instructional model to enhance learning achievement is convenient to use.			
4. Project Based Learning instructional model to enhance learning achievement is a systematic process to use.			

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

Suggestions:

Sign

Lesson Plan 1

Lesson Plan 1 (6 hour)

The class time for this part is 6 hours. The key points of this part are evaluate project based learning instructional model improves students' analysis method of critical thinking ability, evaluate project based learning instructional model improves students' analysis skills, evaluate project based learning instructional model improves students' group positioning analysis, content selection and functional settings analysis skills.

UNIT 6: Improve students' analysis method of critical thinking ability

Topic: Web page planning and design (6 hours)

1. Learning Objectives

Standard 1: Group Positioning. Evaluate project-based learning instructional model improves students' group positioning analysis skills.

Students can improve their group positioning analysis skill, make their analysis method is scientific nature, then teachers judge it by class performance and homework.

Standard 2: Content Selection. Evaluate project-based learning instructional model improves students' content selection analysis skills.

Students can master the content selection skills, content selection reasonably, then teachers judge it by class performance and homework.

Standard 3: Functional Settings. Evaluate project-based learning instructional model improves students' functional settings analysis skills.

Students can functional settings normally, then teachers judge it by class performance and homework.

2. Contents

Web page planning and design.

3. Instructional

Project based learning instructional model.

The first two hours (2 hour)

Step 1: Introduction of scenarios and clarification of tasks (20 minutes)

1. On the premise of the goal of this session, the lecturer sets up the project learning situation, introduces the main methods of group positioning analysis in the course of Web page planning and design process, and clarifies the work tasks of students for the content of group positioning and demand analysis of the webpage.

2. Under the guidance of the objectives of this session, students start learning according to the tasks assigned by the lecturer.

Situation and problem description :

With the continuous popularization of the Internet, more and more industries need to build webpages for publicity or brand promotion. If you are a professional in webpage design and production, and a unit or individual comes to you to design and make a webpage, What procedure will you follow? Need to understand and analyze those issues? What analysis methods? What should we pay attention to?

Step 2: Collect data and formulate plans (20 minutes)

1. Students collect relevant information on group positioning analysis through literature, the Internet and their own experience, mainly including: user needs, basic situation of competitors, etc.

2. After in-depth analysis of the collected data, formulate a preliminary plan for group positioning.

Step 3: Group discussion, specific implementation (30 minutes)

1. Students discuss the problems and solutions in the process of project implementation through cooperative discussion and other means.

2. Guided by improving the goal of this link, implement the specific requirements of the plan.

Step 4: Instruction and process inspection (10 minutes)

1. The lecturer pays attention to the project implementation of the students and gives guidance in a timely manner.
2. The lecturer records the work process and performance of the students.

Step 5: Display the results, revise and improve (30 minutes)

1. Students display the group positioning analysis report in web page planning and design through PPT and other multimedia.
2. The report was revised and improved through mutual evaluation by students and comments by lecturers.

Step 6: Evaluate and test, expand and sublimate (10 minutes)

1. Evaluate students' performance and analysis reports according to the evaluation criteria.
2. Students continue to expand and optimize in practical applications.

The second two hours (2 hour)**Step 1: Introduction of scenarios and clarification of tasks (20 minutes)**

1. On the premise of the goal of this session, the lecturer sets up the project learning situation, introduces the main methods of content selection analysis in the course, and clarifies the work tasks of students for the content analysis of the web.
2. Under the guidance of the objectives of this session, students start learning according to the tasks assigned by the lecturer.

Situation and problem description :

We analyzed the group positioning earlier. If you are a professional in web design and production, how should we choose the content of the web page next? How to classify? Are there any methods and techniques?

Step 2: Collect data and formulate plans (20 minutes)

1. Combined with the previous group positioning analysis, students collect relevant information about the information content of the webpage through literature, the Internet and their own experiences.
2. After categorizing and analyzing the collected data, formulate a preliminary plan for information content selection.

Step 3: Group discussion, specific implementation (30 minutes)

1. Students discuss the problems and solutions in the process of project implementation through cooperative discussion and other means.
2. Guided by improving the goal of this link, implement the specific requirements of the plan.

Step 4: Instruction and process inspection (10 minutes)

1. The lecturer pays attention to the project implementation of the students and gives guidance in a timely manner.
2. The lecturer records the work process and performance of the students.

Step 5: Display the results, revise and improve (30 minutes)

1. Students present analysis reports on content selection in web page planning and design through PPT and other multimedia.
2. The report was revised and improved through mutual evaluation by students and comments by lecturers.

Step 6: Evaluate and test, expand and sublimate (10 minutes)

1. Evaluate students' performance and analysis reports according to the evaluation criteria.
2. Students continue to expand and optimize in practical applications.

The third two hours (2 hour)

Step 1: Introduction of scenarios and clarification of tasks (20 minutes)

1. On the premise of the goal of this session, the lecturer sets up the project learning situation, introduces the main methods of functional settings analysis and clarifies the work tasks of students for the functional settings of the web.

2. Under the guidance of the objectives of this session, students start learning according to the tasks assigned by the lecturer.

Situation and problem description :

We already have a certain understanding of the needs of users, so how should we set the functions of the webpage? What issues need attention? What are the main functions of the web pages you have seen?

Step 2: Collect data and formulate plans (20 minutes)

1. Combined with the analysis of the previous two links of group positioning and content selection, students collect relevant information about function settings through literature, the Internet and their own experiences.

2. After classifying and analyzing the collected data, formulate a preliminary plan for setting web page functions.

Step 3: Group discussion, specific implementation (30 minutes)

1. Students discuss the problems and solutions in the process of project implementation through cooperative discussion and other means.

2. Guided by improving the goal of this link, implement the specific requirements of the plan.

Step 4: Instruction and process inspection (10 minutes)

1. The lecturer pays attention to the project implementation of the students and gives guidance in a timely manner.

2. The lecturer records the work process and performance of the students.

Step 5: Display the results, revise and improve (30 minutes)

1. Students display the analysis report of web page function settings through PPT and other multimedia.

2. The report was revised and improved through mutual evaluation by students and comments by lecturers.

Step 6: Evaluate and test, expand and sublimate (10 minutes)

1. Evaluate students' performance and analysis reports according to the evaluation criteria.

2. Students continue to expand and optimize in practical applications.

Yulin Normal University

After-class manual (report) requirements

Directions: Write about mind map and analysis report of group positioning, content selection, functional settings (report).

1. Group positioning analysis method is scientific nature: Practice alone to complete the mind map of analysis method and form an analysis report. (exercise1)

2. Content selection reasonably: Practice alone to master the basic content selection analysis skills and complete the mind map of content selection analysis and form an analysis report. (exercise2)

3. Rationality of the function setting method: Practice alone to complete the mind map of function setting method and form an analysis report. (exercise3)

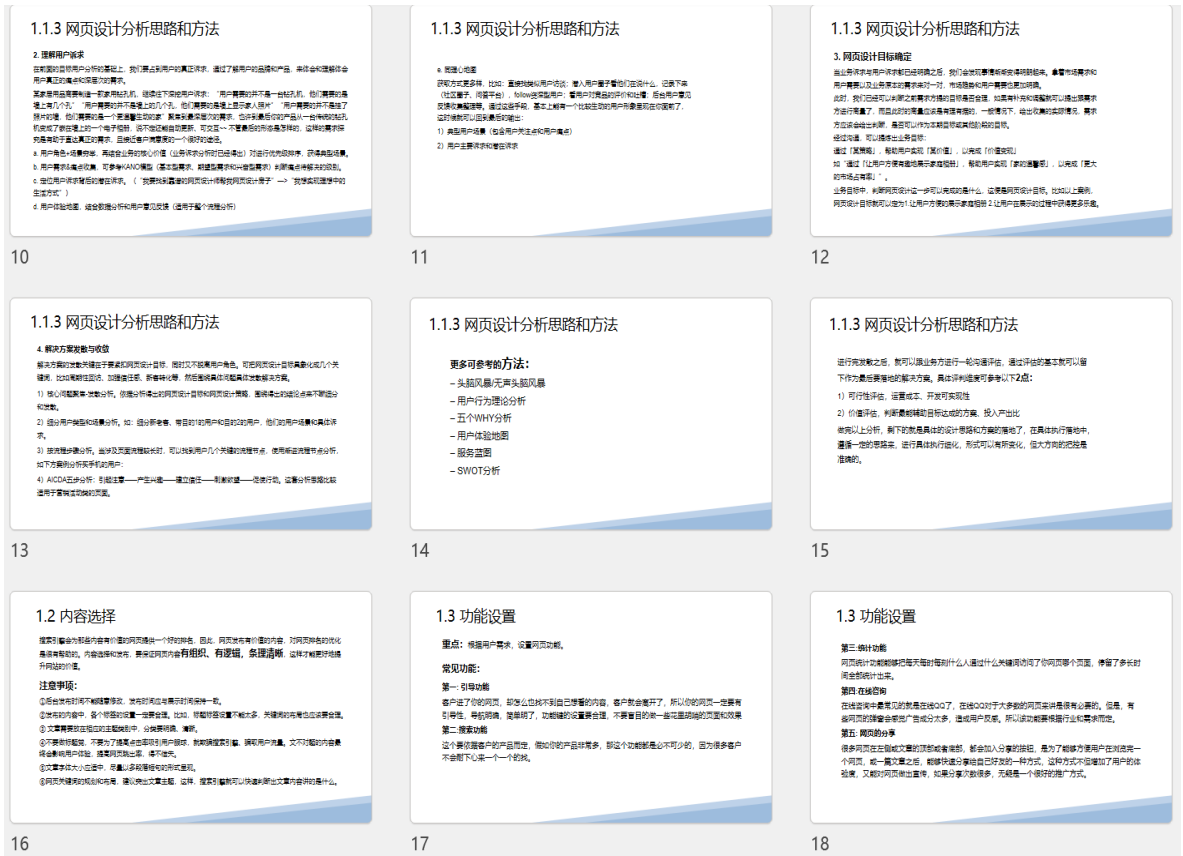
Evaluation: Analysis report and the mind maps of group positioning analysis method, content selection, function setting method in the form of an after-class manual (report).

4. Learning material

- 1) PPT presentation
- 2) Whiteboard/blackboard and pens
- 3) Computer/Tablet/Mobile Phone
- 4) White paper (draft paper)
- 5) Books on critical thinking analysis, web planning and design (Group positioning, Content Selection, Functional Settings)

For lesson plan 1

Teaching PPT pictures



5.Learning Resources

1) Web planning and design analysis method learning videos.

Clip video or webpage:

<https://www.icourse163.org/course/NCU-1205813837>

<https://www.bing.com/videos/search>

<https://www.bilibili.com/video/BV1Fe411u7Nb/>

<https://www.bilibili.com/video/BV1o7411p7v8/?p=6>

<https://haokan.baidu.com/v?pd=wisenatural&vid=9943630774213628736>

<https://www.bilibili.com/video/av757496065/?p=4>

<https://haokan.baidu.com/v?pd=wisenatural&vid=2558991048225551008>

<https://tv.sohu.com/v/dXMvMzM1OTQyMjQzLzQwOTA3MzUzOC5zaHRtBA==.html>

<https://haokan.baidu.com/v?pd=wisenatural&vid=6692768935366505064>

<https://haokan.baidu.com/v?pd=wisenatural&vid=130644400477366192>

<https://zhuanlan.zhihu.com/p/71761894>

2) Related academic papers.

6.Evaluation and Assessment

Evaluation by scoring score.

Item	Score				
	5	4	3	2	1
Analysis					
Standard 1: Group positioning- Evaluate project-based learning instructional model improves students' group positioning analysis skills.	Have a good command of the group positioning analysis method of web design and production, group positioning analysis method completely correctly.	Be able to master the group positioning analysis method of web design and production, group positioning analysis method correct.	Basically be able to master the group positioning analysis method of web design and production, group positioning analysis method basically correct.	Be able to master some of the group positioning some analysis method of web design and production, group positioning analysis method have some problems.	Unable to master the group positioning analysis method of web design and production, group positioning analysis method have serious problem.

Item	Score				
	5	4	3	2	1
<p>Standard 2: Content Selection- Evaluate project-based learning instructional model improves students' content selection analysis skills.</p>	<p>Have a good command of the content selection analysis method of web design and production. It can present the information content of the webpage in a very scientific and reasonable manner.</p>	<p>Be able to master the content selection analysis method of web design and production. It can present the information content of the webpage relatively scientifically and reasonably.</p>	<p>Basically be able to master the content selection analysis method of web design and production. It can present the information content of the webpage basically scientifically and reasonably.</p>	<p>Be able to master the content selection analysis some method of web design and production. There are some issues with the informational content of the page.</p>	<p>Unable to master the content selection analysis method of web design and production. There are serious problem with the informational content of the page.</p>

Item	Score				
	5	4	3	2	1
Standard 3: Functional Settings- Evaluate project-based learning instructional model improves students' functional settings analysis skills.	Have a good command of the functional settings analysis method of web design and production, functional settings method completely correctly. Functional settings of web very convenient and reasonable	Be able to master the functional settings analysis method of web design and production, functional settings method correct. Functional settings of web convenient and reasonable	Basically be able to master the functional settings analysis method of web design and production. Functional Settings method basically correct. Functional settings of web basically convenient and reasonable	Be able to master the functional settings some analysis method of web design and production. There are some issues with the functional settings of web.	Unable to master the functional settings analysis method of web design and production. There are serious problem with the functional settings of web.

Scores	Level
13-15	Excellent
10-12	Good
7-9	Moderate
4-6	pass
Less than 4	Poor

7. Note after teaching

Result: Write a mind map of group positioning analysis, content selection, and function setting methods. At the same time, form an analysis report, present it in the form of an after-school manual (report) and send it to the teacher.

The problem: There are problems such as knowledge forgetting, unclear structure, and the Improper method, incomplete analysis.

Solving the problem: Clarify the requirements of the manuals, provide practice manuals, conduct sample sharing, and provide exercises and guidance to improve analysis skill.

Rubric Scoring form
Rubric Score

Item	Score				
	5	4	3	2	1
1. Analysis					
Standard 1: Group positioning- Evaluate project-based learning instructional model improves students' group positioning analysis skills.	Have a good command of the group positioning analysis method of web design and production, group positioning analysis method completely correctly.	Be able to master the group positioning analysis method of web design and production, group positioning analysis method correct.	Basically be able to master the group positioning analysis method of web design and production, group positioning analysis method basically correct.	Be able to master some of the group positioning some analysis method of web design and production, group positioning analysis method have some problems.	Unable to master the group positioning analysis method of web design and production, group positioning analysis method have serious problem.
Standard 2: Content Selection- Evaluate project-based learning instructional model improves students' content selection analysis skills.	Have a good command of the content selection analysis method of web design and production. It can present the information content of the webpage in a very scientific and reasonable manner.	Be able to master the content selection analysis method of web design and production. It can present the information content of the webpage relatively scientifically and reasonably.	Basically be able to master the content selection analysis method of web design and production. It can present the information content of the webpage basically scientifically and reasonably.	Be able to master the content selection analysis some method of web design and production. There are some issues with the informational content of the page.	Unable to master the content selection analysis method of web design and production. There are serious problem with the informational content of the page.

Item	Score				
	5	4	3	2	1
<p>Standard 3: Functional Settings- Evaluate project-based learning instructional model improves students' functional settings analysis skills.</p>	<p>Have a good command of the functional settings analysis method of web design and production, functional settings method completely correct. Functional settings of web very convenient and reasonable</p>	<p>Be able to master the functional settings analysis method of web design and production, functional settings method correct. Functional settings of web convenient and reasonable</p>	<p>Basically be able to master the functional settings analysis method of web design and production. Functional Settings method basically correct. Functional settings of web basically convenient and reasonable</p>	<p>Be able to master the functional settings some analysis method of web design and production. There are some issues with the functional settings of web.</p>	<p>Unable to master the functional settings analysis method of web design and production. There are serious problem with the functional settings of web.</p>
2. Evaluation					
<p>Standard 1: Layout Design- Evaluate project-based learning instructional model improves students' layout design evaluate skills.</p>	<p>Have a good command of the layout design evaluation method of web design and production. The layout design of the web is well-structured, the visual elements are diverse, and the design is very clear.</p>	<p>Be able to master the layout design evaluation method of web design and production. The layout design of the web has a certain sense of hierarchy, there are some visual elements, and the design is relatively clear.</p>	<p>Basically be able to master the layout design evaluation method of web design and production. The layout hierarchy and visual elements of the web are basically clearly visible.</p>	<p>Be able to master the layout design some evaluation method of web design and production. There are some problems in layout design layering, visual elements, etc.</p>	<p>Unable to master the layout design evaluation method of web design and production. There are serious problem with the layout design of web.</p>

Item	Score				
	5	4	3	2	1
Standard 2: Web Navigation- Evaluate project-based learning instructional model improves students' web navigation evaluate skills	Have a good command of the web navigation evaluation method of web design and production. The web navigation design is very simple, and it can accurately locate specific modules and content in multiple ways.	Be able to master the web navigation evaluation method of web design and production. With web navigation, you can locate specific modules and content.	Basically be able to master the web navigation evaluation method of web design and production. With web navigation, only a small number of specific modules and content can be located.	Be able to master the web navigation some evaluation method of web design and production. There is web navigation, but the positioning is not accurate, and there are some problems.	Unable to master the web navigation evaluation method of web design and production. There is no web navigation, and no search or location is possible.
Standard 3: Web Security- Evaluate project-based learning instructional model improves students' Web Security evaluate skills.	Have a good command of the web security evaluation method of web design and production. The web security performance is strong, and the operation is very stable.	Be able to master the web security evaluation method of web design and production. The security performance of the web is average, and the operation is relatively stable.	Basically be able to master the web security evaluation method of web design and production. The security performance of the web basically meets the requirements, and the operation is basically stable.	Be able to master the web security some evaluation method of web design and production. The security of the web is relatively poor, and there are many security loopholes.	Unable to master the web security evaluation method of web design and production. The security of the web is poor, and there are serious security loopholes.

Item	Score				
	5	4	3	2	1
3. Creativity					
Standard 1: Design Highlights- Evaluate project-based learning teaching mode improves students' creativity, whether masters the method of web design highlights, and makes the works have highlights.	Have a good command of the design highlights creativity method of web design and production. The highlights of the web design are very prominent and very creative.	Be able to master the design highlights creativity method of web design and production. The web design is bright and creative.	Basically be able to master the design highlights creativity method of web design and production. There are a few bright spots and ideas in web design.	Be able to master the design highlights some creativity method of web design and production. The web design is relatively ordinary and lacks creativity.	Unable to master the design highlights creativity method of web design and production. The web has no sense of design and lacks creativity.
Standard 2: User Experience- Evaluate a project-based learning model improves student creativity in web user experience.	Have a good command of the user experience creativity method of web design and production. The web has strong interactivity, fast response, and excellent user experience.	Be able to master the user experience creativity method of web design and production. The web has good interactivity, good response and good user experience.	Basically be able to master the user experience creativity method of web design and production. The interactivity of the web is average, the response is average, and the user experience is average.	Be able to master the user experience some creativity method of web design and production. There are some issues with web interactivity, responsiveness and user experience.	Unable to master the user experience creativity method of web design and production. There are serious issues with web interactivity, responsiveness, and user experience.

Item	Score				
	5	4	3	2	1
<p>Standard 3: Updating and Optimizing- Evaluate the model of project-based learning improves students' creativity in updating and optimizing web pages.</p>	<p>Have a good command of the updating and optimizing method of web design and production. The creativity, timeliness and compatibility of web updating and optimization are strong.</p>	<p>Be able to master the updating and optimizing method of web design and production. The creativity of web updating and optimization is Moderate, the timeliness is Moderate, and the compatibility is Moderate.</p>	<p>Basically be able to master the updating and optimizing method of web design and production. The creativity, timeliness, and compatibility of web updates and optimization are average.</p>	<p>Be able to master the updating and optimizing method of web design and production. There are some problems with the creativity, timeliness, and compatibility of web updates and optimization.</p>	<p>Unable to master the updating and optimizing method of web design and production. There are serious problems with the creativity, timeliness, and compatibility of web updates and optimization.</p>

Scoring Criteria About Analysis

Scores	Level
13-15	Excellent
10-12	Good
7-9	Moderate
4-6	pass
Less than 4	Poor

Scoring Criteria About Evaluation

Scores	Level
13-15	Excellent
10-12	Good
7-9	Moderate
4-6	pass
Less than 4	Poor

Scoring Criteria About Creativity

Scores	Level
13-15	Excellent
10-12	Good
7-9	Moderate
4-6	pass
Less than 4	Poor

Criteria to evaluate critical thinking ability over all

Scores	Level
37-45	Excellent
28-36	Good
19-27	Moderate
10-18	pass
Less than 10	Poor

Appendix D

The results of quality analysis of research instruments

- Evaluation Results of IOC for Questionnaire of Factor Analysis (For Students)
- Evaluation Results of IOC for Interview of Factor Analysis (For Lectures)
- Evaluation Results of IOC for Validity of Instructional Model
- Evaluation Results of Instructional Model Appropriateness Evaluation
- Evaluation Results of IOC for Lesson Plans by 5 experts
- Evaluation Results of IOC for Validity of Rubric

Evaluation Results of IOC for Questionnaire of Factor Analysis (For Students)

No	Item	Experts' rating					Total	MEAN	Results
		Exper t 1	Exper t 2	Exper t 3	Exper t 4	Exper t 5			
Internal factor									
1	Students are very interested in Web Design and Production course.	+1	+1	+1	+1	+1	5	1.00	Valid
2	Students have a clear understanding of critical thinking ability knowledge and study by Project Based Learning model in Web design and production course.	+1	+1	+1	+1	+1	5	1.00	Valid
3	Students are interested in using innovative teaching models such as project-based learning in their courses.	+1	+1	+1	+1	+1	5	1.00	Valid
4	Students have the will to actively design, practice and develop creative web work.	+1	+1	+1	+1	+1	5	1.00	Valid
5	Students are industrious in their learning (Assignments, Projects, Participation, etc.) with the highest potential themselves.	+1	+1	+1	+1	+1	5	1.00	Valid
6	Students are able to master and apply relevant techniques and tools from the course.	+1	+1	+1	+1	+1	5	1.00	Valid

No	Item	Experts' rating					Total	MEAN	Results
		Exper	Exper	Exper	Exper	Exper			
		t	t	t	t	t			
		1	2	3	4	5			
7	Students feel that Web design and production course is the great significance to personal growth and development in future.	+1	+1	+1	+1	+1	5	1.00	Valid
8	Students have a sufficient knowledge base and intellectual level to learn web design and production courses.	+1	+1	+1	+1	+1	5	1.00	Valid
9	Students can master critical thinking ability by Web design planning and production process in Web design and production course.	+1	+1	+1	+1	+1	5	1.00	Valid
10	Students are satisfied with the friendly cooperation and interaction between students and teachers or peers in the Web design and production course.	+1	+1	+1	+1	+1	5	1.00	Valid
11	Students believe that personality and thinking style will affect the course learning effect.	+1	+1	+1	+1	+1	5	1.00	Valid
12	Students are willing to engage in independent study and explore additional knowledge and skills outside of the classroom.	+1	+1	+1	+1	+1	5	1.00	Valid
13	Students learn about the latest research trends and developments in their subject area.	+1	+1	+1	+1	+1	5	1.00	Valid

No	Item	Experts' rating					Total	MEAN	Results
		Exper	Exper	Exper	Exper	Exper			
		t	t	t	t	t			
		1	2	3	4	5			
14	Students have clear learning motivation in course learning.	+1	+1	+1	+1	+1	5	1.00	Valid
15	Students can develop their sense of accomplishment and pride through different activities in Web design and production course.	+1	+1	+1	+1	+1	5	1.00	Valid
External factor									
16	Lecturer's appearance, temperament and clothing style.	+1	+1	+1	+1	+1	5	1.00	Valid
17	Lecturer's emphasis on promoting students' critical thinking.	+1	+1	+1	+1	+1	5	1.00	Valid
18	Lecturers' attitudes toward new teaching models that promote critical thinking.	+1	+1	+1	+1	+1	5	1.00	Valid
19	The lecturer's flexible control over the teaching process and time.	+1	+1	+1	+1	+1	5	1.00	Valid
20	The assessment methods used by the lecturer in the classroom.	+1	+1	+1	+1	+1	5	1.00	Valid
21	Lecturer experience and ability to enhance students' critical thinking ability.	+1	+1	+1	+1	+1	5	1.00	Valid

No	Item	Experts' rating					Total	MEAN	Results
		Exper	Exper	Exper	Exper	Exper			
		t 1	t 2	t 3	t 4	t 5			
22	The course objectives set by the lecturer are rich and multi-dimensional.	+1	+1	+1	+1	+1	5	1.00	Valid
23	The teaching method adopted by the lecturer in the course.	+1	+1	+1	+1	+1	5	1.00	Valid
24	The textbook fully considers the content and objectives of Web design and production courses and critical thinking training.	+1	+1	+1	+1	+1	5	1.00	Valid
25	The learning atmosphere created by the lecturer in the course.	+1	+1	+1	+1	+1	5	1.00	Valid
26	Lecturer's design of learning activities and organization of course content.	+1	+1	+1	+1	+1	5	1.00	Valid
27	Teaching materials provide practical, interactive and inspiring cases, which are useful to students.	+1	+1	+1	+1	+1	5	1.00	Valid
28	The learning environment, media and materials provided by the instructor.	+1	+1	+1	+1	+1	5	1.00	Valid
29	The degree to which schools value critical thinking ability.	+1	+1	+1	+1	+1	5	1.00	Valid

No	Item	Experts' rating					Total	MEAN	Results
		Exper	Exper	Exper	Exper	Exper			
		t	t	t	t	t			
		1	2	3	4	5			
30	The environments is clean and bright, with desks and chairs, blackboards, podiums, computers, projectors, large screens, loudspeakers and other multimedia facilities to facilitate the teaching process.	+1	+1	+1	+1	+1	5	1.00	Valid
Total (In Overview)							150	1.00	Valid

Note: Valid when ≥ 0.50 .

Evaluation Results of IOC for Interview of Factor Analysis (For Lectures)

No	Item	Experts' rating					Total	MEAN	Results
		Expert 1	Expert 2	Expert 3	Expert 4	Expert 5			
Section 1									
1	Common data of the respondent	+1	+1	+1	+1	+1	5	1.00	Valid
Section 2									
2	Why do you accept or select to teach this subject? (Example, prefer to teach, be expert in the content, be requested, or other reasons.)	+1	+1	+1	+1	+1	5	1.00	Valid
3	How do you prepare to teach this subject? (Preparing contents, materials, teaching location.)	+1	+1	+1	+1	+1	5	1.00	Valid
4	What do you think are the main factors affecting the improvement of undergraduates' critical thinking ability?	+1	+1	+1	+1	+1	5	1.00	Valid
5	Do you always implement teaching according to your teaching plan? Do you think your teaching plan can effectively enhance students' critical thinking ability.? Do you often think about how to improve teaching?	+1	+1	+1	+1	+1	5	1.00	Valid

No	Item	Experts' rating					Total	MEAN	Results
		Expert 1	Expert 2	Expert 3	Expert 4	Expert 5			
6	How do you give the opportunity for students to participate in the teaching? (Please clarify the methodology.)	+1	+1	+1	+1	+1	5	1.00	Valid
7	What kind of teaching evaluation do you think is more conducive to enhancing students' critical thinking ability?	+1	+1	+1	+1	+1	5	1.00	Valid
8	What Learning Tasks do you carry out to improve students' learning enthusiasm?	+1	+1	+1	+1	+1	5	1.00	Valid
9	Do you provide the time for students after their regular class? If yes, how do you help students solve their difficulties?	+1	+1	+1	+1	+1	5	1.00	Valid
10	Do you think the current school media equipment, technological environment and physical environment can meet the needs of improving students' critical thinking ability?	+1	+1	+1	+1	+1	5	1.00	Valid
11	In your opinion how does project-based learning instructional model to enhance critical thinking ability of undergraduate students and a significant benefit of instructional design?	+1	+1	+1	+1	+1	5	1.00	Valid
Total (In Overview)							55	1.00	Valid

Note: Valid when ≥ 0.50 .

Evaluation Results of IOC for Validity of Instructional Model

No	Item	Experts' rating					Total	MEAN	Results
		Expert	Expert	Expert	Expert	Expert			
		1	2	3	4	5			
1	Principle and Rationale	+1	+1	+1	+1	+1	5	1.00	Valid
2	Objectives	+1	+1	+1	+1	+1	5	1.00	Valid
3	Contents	+1	+1	+1	+1	+1	5	1.00	Valid
4	Methods of teaching & Materials	+1	+1	+1	+1	+1	5	1.00	Valid
5	Evaluation	+1	+1	+1	+1	+1	5	1.00	Valid
Total (In Overview)							25	1.00	Valid

Note: Valid when ≥ 0.50 .

Evaluation Results of Instructional Model Appropriateness Evaluation

Components of project-based learning instructional model for enhancing critical thinking ability of university students	Opinion of the specialists							
	Utility		Feasibility		Propriety		Accuracy	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1 Principle & Rationale	5	100	5	100	5	100	5	100
2 Objectives	5	100	5	100	5	100	5	100
3 Contents	5	100	5	100	5	100	5	100
4 Methods of teaching & Materials	5	100	5	100	5	100	5	100
5 Evaluation	5	100	5	100	5	100	5	100

The appropriateness of design-based learning instructional model is unanimously confirmed by 10 experts in terms of utility (100%), feasibility (100%), propriety (100%), and accuracy (100%).

Evaluation Results of IOC for Lesson Plans by 5 experts

No	Item	Experts' rating					Total	MEAN	Results
		Expert	Expert	Expert	Expert	Expert			
		1	2	3	4	5			
Learning Objectives									
1	Complying with content of the course	+1	+1	+1	+1	+1	5	1.00	Valid
2	Covering knowledge, process, and attitude (KPA)	+1	+1	+1	+1	+1	5	1.00	Valid
3	Being measurable in 3 aspects (KPA)	+1	+1	+1	+1	+1	5	1.00	Valid
Contents									
4	Complying with learning objective	+1	+1	+1	+1	+1	5	1.00	Valid
5	Being appropriate in terms of time management	+1	+1	+1	+1	+1	5	1.00	Valid
Project Based Learning Instructional Model									
6	Complying with the designed instructional model	+1	+1	+1	+1	+1	5	1.00	Valid
7	Supporting students' learning	+1	+1	+1	+1	+1	5	1.00	Valid
8	Including various activities	+1	+1	+1	+1	+1	5	1.00	Valid
Learning materials									
9	Complying with the learning objectives	+1	+1	+1	+1	+1	5	1.00	Valid
10	Complying with the contents	+1	+1	+1	+1	+1	5	1.00	Valid
Evaluation and Assessment									
11	Complying with the learning objectives	+1	+1	+1	+1	+1	5	1.00	Valid
12	Including various methods and instruments	+1	+1	+1	+1	+1	5	1.00	Valid
Total (In Overview)							60	1.00	Valid

Note: Valid when ≥ 0.50 .

Evaluation Results of IOC for Validity of Rubric

No	Item/ Standard	Experts' rating					Total	MEAN	Results
		Expert 1	Expert 2	Expert 3	Expert 4	Expert 5			
Item 1: Analysis									
1	Standard 1:	+1	+1	+1	+1	+1	5	1.00	Valid
2	Standard 2:	+1	+1	+1	+1	+1	5	1.00	Valid
3	Standard 3:	+1	+1	+1	+1	+1	5	1.00	Valid
Item 2: Evaluation									
4	Standard 1:	+1	+1	+1	+1	+1	5	1.00	Valid
5	Standard 2:	+1	+1	+1	+1	+1	5	1.00	Valid
6	Standard 3:	+1	+1	+1	+1	+1	5	1.00	Valid
Item 2: Creativity									
7	Standard 1:	+1	+1	+1	+1	+1	5	1.00	Valid
8	Standard 2:	+1	+1	+1	+1	+1	5	1.00	Valid
9	Standard 3:	+1	+1	+1	+1	+1	5	1.00	Valid
Total (In Overview)							45	1.00	Valid

Note: Valid when ≥ 0.50 .

Appendix E
Certificate of English



This is to certify that

Mr. Qin Lizhong

Achieved BSRU English Proficiency Test (BSRU-TEP) level

C1

Given on 25th January 2021



(Assistant Professor Dr Kulsirin Aphiratvoradej)

Director

Appendix F
Response for Publication

MHESI 8038.1/36



**McU Ubonratchathani journal
of Buddhist Studies (TCI.2)**
Mahachulalongkornrajavidyalaya
University, Ubon Ratchathani Campus

RESPONSE FOR PUBLICATION OF THE ARTICLE

27th July 2023

The Editorial Department of McU Ubonratchathani journal of Buddhist Studies (TCI.2) MCU, Ubon Ratchathani Campus has considered the article

Title DEVELOPMENT OF PROJECT BASED LEARNING INSTRUCTIONAL MODEL FOR ENHANCING CRITICAL THINKING ABILITY OF UNDERGRADUATE STUDENTS

Writer Qin Lizhong, Tanaput Chancharoen, Areewan Iamsa-ard and Prapai Sridama

Publication Approval McU Ubonratchathani journal of Buddhist studies (ISSN : 2774-0463 (Online)) Mahachulalongkornrajavidyalaya University, Ubon Ratchathani Campus

Period of Publication 5th Year, Volume II (May-August, 2023)

The article has been sent to a team of peer review and found that its quality is at a “Good” level and it is academically useful.

Please be informed accordingly.

(Assoc.Prof. Dr.Phrakhruwutthidhampanit)

Editor of McU Ubonratchathani journal of Buddhist studies (TCI)
Mahachulalongkornrajavidyalaya University,
Ubon Ratchathani Campus

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