THE DEVELOPMENT OF BLENDED TEACHING MODEL BASED ON DEEP LEARNING THEORY TO ENHANCE COLLEGE STUDENTS' CRITICAL THINKING

GUO ZHONGHUA

A thesis submitted in partial fulfillment of the requirements for
the Degree of Doctor of Philosophy Program in Curriculum and Instruction
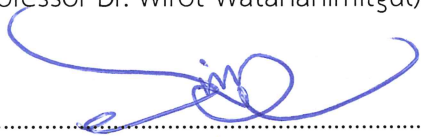Academic Year 2023

Thesis Title   The Development of Blended Teaching Model Based on Deep Learning
              Theory to Enhance College Students' Critical Thinking

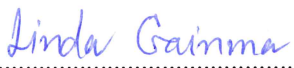**Author**   Mr.Gou Zhonghua

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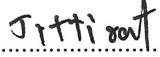
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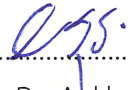the Requirements for the Degree of Doctor of Philosophy in Curriculum and Instruction

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Title	The development of blended teaching model based on deep learning theory to enhance college students' critical thinking
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Academic Year	2023

ABSTRACT

The purposes of the study are1 (to investigate the current situation of college students 'critical thinking in Guangxi Normal University; 2) to develop the blended teaching model based on Deep Learning Theory to enhance college students' critical thinking; and3 (to access the efficiency of the blended teaching model based on deep learning theory through comparing the college students' critical thinking ability before and after the implementation of teaching model.The sample groups for this research were1(400sophomores who participated in the questionnaire survey and were selected from a pool of approximately 7, 000sophomores at Guangxi Normal University during the first semester of the academic year2023, 2) 50sophomores who participated in a quasi-teaching experiment ,randomly selected from the 400students who had previously taken part in the survey.The research instr uments were1 (college students' critical thinking disposition scale, 2) the blended teaching model based on deep learning theory; 3) lesson plan of the"CIPSE" model, 4) examination paper of college students' critical thinking ability. ally analyzed by meanData were statistic, standard deviation, data analytics statistics for confirmation of instructional model and data analytics statistics for scoring rubric.

The results were found that:

1. College students' critical thinking level is good)$\overline{X}$ = 4.75.(From the seven specific dimensions of critical thinking tendency, thirst for knowledge is the highest rank which is in the Good level)$\overline{X}$ = 5.21(, followed by Openness)$\overline{X}$ = 5.08(,   while self-confidence is the lowest   )$\overline{X}$ = 4.33 .(

2. This study has developed a blended teaching model based on Deep Learning Theory named the"CIPSE" model. The"CIPSE" stands for the abbreviation of a five-during the instructional process stage teaching method employed: Clearly Providing, Intensive Teaching, Process Reporting, Stating the question, Evaluating and Summarizing. The ”ESPIC“ model comprises four key components: 1) Principles, 2) Objectives, 3) Learning Processes, and4 (Results. The model has been evaluated by three specialists and found to align with criteria of utility, feasibility, propriety, and accuracy.

3. After a planned20-class teaching experiment on the "CIPSE "model ,the data show that the critical thinking ability of50 sophomores who participated in the teaching experiment has been obviously improved, and the overall average score has increased from23.80 to28.72 .After the paired sample t-test ,it is found that there are significant differences)t=27.631 ,p=0.000>0.01 (in the pre-test and post-test scores of college students 'critical thinking ability .This fully proves that the blended model based on Deep Learning Theory has obvious advantages and effects in cultivating college students 'critical thinking ability.

In summary," the CIPSE "modehas obvious effect on improving the critical l thinking ability of college students in an all-round way, which is in line with the current development trend of university education and the individualized learning entsneeds of stud. This study provides a reference for the reform of university curriculum in China, and also provides a reference for the cultivation of critical thinking of college students

Keywords: B lendedteaching model, Deep learning theory, Critical thinking , The "CIPSE "model

Acknowledgement

Completing this doctoral dissertation marks the end of a beautiful yet challenging journey of studying abroad. This journey has been filled with ups and downs, but I never gave up. best reward for my years of The doctoral degree is the continuous effort, and it will inspire me to continue pursuing my dreams because life has no endpoint; it only has new beginnings.

First and foremost, I would like to express my deep gratitude to my advisors, Dr ssociate Professora. Wichian Intarasompun and Professor Dr. Wirot Watananimitgul. Their profound knowledge, rigorous academic approach, gentle humility, and optimistic spirit have profoundly influenced me. Their guidance in selecting topics, writing, completion of this dissertation possible and revising made the. Without their dedication, this academic achievement would not have been realized. From them, I have drawn the spirit of academic excellence and a commitment to rigor and practicality.I'Professor Dr ssociatea m thankful to. Areewan lamsa-ard, as the program leader for Curriculum and Instruction. She has been a source of support and opportunities for our studies. Her enthusiasm, generosity, and optimism have left a deep impression on me.e of MrI appreciate the assistanc.Qing Zhang, our translation teacher. He not only helped bridge language and cultural gaps but also introduced us to the various cultural landmarks in Thailand, allowing us to gain a deeper understanding of Thai culture. other guiding us in a He has been like an elder br foreign land.

My gratitude extends to all the teachers who have taught us, as well as to Bansomdejchaopraya Rajabhat University for providing an excellent learning environment.Most importantly, I would like to thank my family, ll always be who wi the strongest backing on my way forward.I would also like to thank my fellow students in the Curriculum and Instruction program. Your support and camaraderie have filled me with motivation and helped me complete my studies smoothly.Finally, extend my thanks to the leaders I, colleagues, and friends who have assisted and supported me throughout my life journey. Your kindness, tolerance, and selflessness have made me feel warm and resolute.

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Chapter 1
Introduction

Rationale

Improving college students' critical thinking ability is the need of talent cultivation in the 21st century and the strategic requirement of innovation-driven development in China.

It is imperative to enhance the critical thinking skills of college students, as it plays a pivotal role in the information-driven society, talent cultivation, innovation, and adaptation to the evolving social landscape (David Hitchcock, 2012). In the 21st century, often referred to as the Information Age, we are experiencing an unprecedented explosion of information. Without the capacity for critical thinking, individuals are susceptible to the influence of inaccurate or misleading information when confronted with myriad choices and decisions, resulting in a state of 'informational ignorance' or 'cognitive indigestion', hindering their ability to navigate the challenges presented by the information society.

Furthermore, critical thinking serves as the cornerstone for the development of high-quality innovative talents. In this era of innovation-driven progress, knowledge is constantly evolving, demanding the capacity to question established knowledge and propose novel solutions. Critical thinking nurtures the ability for 'reflective skepticism' and 'informed judgment,' fostering the emergence of innovative thought (Dewey J., 1910). Equipping individuals with critical thinking skills also aids in their capacity to adapt to the ever-changing dynamics of future society. With the ascent of the knowledge economy and digital economy, critical thinking has become the linchpin for knowledge workers (Huang, 2010). Lastly, critical thinking fosters individual psychological and personality development. It encourages individuals to internalize social culture through discerning comprehension rather than blindly conforming. Grounded in understanding and critique, critical thinking cultivates autonomous decision-making, choice, and personality development, ultimately facilitating productive dialogues and interactions with others.

Blended teaching is the direction of college teaching reform in the information age, which can effectively improve the quality of talent training.

Technology is profoundly affecting all aspects of human life, and information technology is increasingly showing great potential to drive the development of education. It has become an important strategic choice for all countries in the world to use information technology to promote educational reform and reshape the educational system. The American Educational Technology Development Program 2010 (NETP, 2010), Transforming American Education: Learning Powered by Technology, puts forward the goal of "applying technology to promote the structural change of school education system". Japan supports the learning promotion strategy in the new era with cutting-edge technology and proposes that information and communication technology and big data should be used to drive educational innovation and learning change. modernization of education in China 2035 further put forward the idea of "accelerating education reform in the information age" and "accelerating the reform of talent training model by using modern technology".

Undoubtedly, the arrival of the information age strongly promotes the rapid development of blended teaching. Blended teaching has been widely recognized and practiced in developed countries with high degree of informatization (Yen and Lee, 2011), such as the United States, Britain, Japan, and Australia. In the survey of "Technology-Assisted Teaching" conducted for the first time in 2016, the miscellaneous records of American School Science and Technology found that 71% of college teachers used online and face-to-face mixed teaching environment in their teaching. The Horizon Report of 2017 of American new media pointed out that blended learning combined the best practice experience of online learning and face-to-face learning and listed it as one of the development trends of higher education in the next 1-2 years for the fourth time in a row. The reason why blended teaching is highly sought after and praised is inseparable from its powerful characteristics. It fully realizes the advantages of online and offline linkage, the push of receptive learning and discovery learning, the integration of traditional learning and modern learning methods, and simultaneous learning and asynchronous learning (Guo, 2020). Guangxi Normal University has issued a new document in 2020 in order to meet the new requirements of the development of the times for university teaching reform, encouraging schoolteachers to actively explore blended teaching practice, and taking the situation of blended teaching as one of the teaching evaluation indicators.

Blended teaching based on deep learning theory can effectively improve the critical thinking of college students.

Blended teaching can't simply be defined as the reallocation of teaching time between online and face-to-face instruction. As a new teaching model, it not only harnesses the strengths of both approaches but also mitigates the limitations of each individual model (Goodyear, 2015). Blended teaching actively facilitates the effective integration of collaborative and self-directed learning among students. Its unique characteristic of linking and mutually reinforcing online and offline components creates additional opportunities for innovative instructional design. To fully leverage the advantages and distinctive features of blended teaching, meticulous instructional design is of paramount importance. The quality of instructional design directly influences the efficacy of blended teaching.

The current educational field places significant emphasis on the theory of deep learning, which, as a meaningful form of learning, emphasizes the promotion of students' growth and development as specific, socially situated agents. It fosters core competencies that facilitate students' autonomous development in the future. Deep learning theory, grounded in the individual learning process, focuses on a thorough understanding of students' cognitive, emotional, and social needs to provide personalized educational support and resources, thereby enhancing learning outcomes (Guo, 2016). This theory contributes to the cultivation of students' comprehensive abilities, enabling them to better adapt to the ever-changing society and pursue autonomous development in the future. Therefore, when considering the concepts of blended teaching and deep learning, it is found that it is an approach that can promote critical thinking skill.

Research Questions

1. What is the current situation of college students critical thinking in China?

2. What is the component of Blended teaching based on deep learning theory?

3. Can the blended teaching model based on deep learning theory effectively improve the critical thinking ability of college students after the implementation than before?

Research Objectives

1. To investigate the current situation of college students' critical thinking in Guangxi Normal University.

2. To develop the blended teaching model based on Deep Learning Theory to enhance college students' critical thinking.

3. To assess the efficiency of the blended teaching model based on deep learning theory through comparing the college students' critical thinking ability before and after the implementation of teaching model.

Research Hypothesis

The blended teaching model based on deep learning theory can improve the critical thinking ability of college students.

Scope of the Research

The Population and the Sample Group

The Population

The population comprises approximately 7,000 sophomore students at Guangxi Normal University during the first semester of the academic year 2023.

The Sample Group

1. The sample group consists of 400 sophomores who participated in the questionnaire survey, used Krejcie and Morgan's table (Krejcie, R.V.and Morgan D.W., 1970) and were purposively selected from the population of 7,000 sophomores at Guangxi Normal University in the first semester of the 2023 academic year.

2. The sample group comprises 50 sophomores who participated in a quasi-teaching experiment, randomly selected from the 400 students who had previously taken part in the survey.

The Variable

Independent Variable

Blended teaching model based on deep learning theory

Dependent Variable

College students' critical thinking ability of Guangxi Normal University

Contents

This study will rely on the course *Critical thinking training* for the design and practice of blended teaching research. *Critical thinking training* is a public elective course, mainly for sophomores. About 200 students choose the course every semester, and the students are arranged by the university to study in two natural classes. The study will be conducted in one of the classes at random, with about 80 sophomores.

The main contents of this study are as follows:

1. Under the guidance of deep learning theory, relying on the course of *Critical thinking training*, systematically design the teaching resources, teaching activities, teaching methods and learning evaluation in three stages before, during and after class, and build a blended teaching plan;

2. Carry out the blended teaching practice. By comparing and analyzing the scores of students' critical thinking ability before and after the blended teaching practice, and using paired sample T test, this paper explores the mechanism and influencing factors of blended teaching based on deep learning theory to improve college students' critical thinking ability.

Time

From January to December, 2023

Advantages

To students, this research will help to enhance college students' critical thinking in China.

Critical thinking is an important skill and core accomplishment in the 21st century. However, in China, many college students are used to seeing things from newspapers, textbooks, TV, books, movies, self-media and other media as unchangeable scientific truths, laws, conclusions, and definite facts, and even a few students accept all the legends and superstitions in their daily lives without thinking. The lack of critical thinking ability will seriously affect the social life of college students, and it is not conducive to their better career development in the rapidly changing social environment. The 21st century is an information age, and knowledge production and dissemination are carried out at an unprecedented speed. Massive information makes people enjoy abundant information, but at the same time, people

are overwhelmed by a lot of ineffective and worthless information. Under this background, if college students lack enough critical thinking ability, they will really be overwhelmed by the vast amount of knowledge in the information age and feel powerless and frustrated.

To teachers, this research can help them better grasp the characteristics and advantages of blended teaching model under the background of new technology, and actively use deep learning theory to design blended teaching scheme, and better promote college students' critical thinking ability in class.

The development of the times and the progress of technology make blended teaching both necessary and possible. In 2016, Ministry of Education of China issued *the Guiding Opinions on Deepening Education and Teaching Reform in Colleges and Universities Affiliated to the Central Department*, demanding "promoting the online and offline blended teaching reform of Inter-school and intra-school". In 2019, Ministry of Education of China issued About Opinions on the Construction of First-class Undergraduate Courses and put forward "Double Ten-Thousand Plan" for first-class undergraduate courses, including about 6,000 national online and offline blended first-class courses. The sudden outbreak and global epidemic of COVID-19 have led many colleges and universities around the world to adopt online teaching methods. Under the call that "stop classes, keep teaching, keep learning" by Ministry of Education of China, colleges and universities in China have also actively carried out online teaching through various ways, which has accumulated experience for the implementation of blended teaching. It is not difficult to imagine that blended teaching will become the development trend and main form of college teaching in the future. However, blended teaching is still in its infancy in China, and blended teaching design is unfamiliar to most teachers. Therefore, the results of this study can help teachers to better design blended teaching and improve their teaching level and critical thinking ability of college students.

To the university, this research will be more conducive to promoting the reform of university teaching, promoting the effective advance of blended teaching in universities, and improving the quality of university talent training.

Teaching is the core of university education and the guarantee of the quality of university education. Therefore, it is the top priority of universities to adapt to the development and changes of the times and actively promote the reform of teaching.

Under the background of the rapid development of information technology with the Internet as the core, vigorously promoting blended teaching practice has become a trend of university teaching reform. In order to better guide and serve practice, it is necessary to strengthen theoretical research. Therefore, the research results can provide theoretical guidance for universities to promote the blended teaching reform, and at the same time provide a feasible scheme for universities to improve students' critical thinking ability through blended teaching.

Definition of Terms

Deep learning refers to a kind of active and critical learning method, which refers to a meaningful learning process in which students actively participate, experience success, and get development around challenging learning topics under the guidance of teachers. In this process, students master the core knowledge of the subject, understand the learning process, grasp the essence and thinking methods of the subject, and form positive intrinsic learning motivation, advanced social feelings, positive attitude, and correct values, and become excellent learners with independence, criticism, creativity, cooperative spirit, and solid foundation. In essence, deep learning is characterized by higher-order thinking.

Blended teaching refers to a teaching model that combines the advantages of traditional classroom teaching and online teaching. It can not only play the leading role of teachers in guiding, inspiring and monitoring the teaching process, but also fully reflect students' initiative, enthusiasm, and creativity as subjects in the learning process. Blending teaching is an improvement of teaching philosophy, which makes the cognitive way of teaching change, and teachers' teaching model, teaching strategies and roles will also change. This change is not only a change in form, but on the basis of analyzing students' needs, teaching content and actual teaching environment, it makes full use of the complementary advantages of online teaching and classroom teaching to improve students' cognitive effect.

Blended teaching model based on deep learning theory refers to the systematic and integrated design of blended teaching according to the connotation, principle, and basic idea of deep learning. It includes not only the online and offline integrated design of before, during and after class, but also the systematic design of learning objectives, learning contents, learning activities, learning evaluation, and

learning resources. It is the organic integration of deep learning theory and blended teaching.

Critical thinking refers to an individual's judgment on the authenticity, accuracy, nature, and value of what he has learned. It is reasonable and reflective thinking for deciding what to believe or do and plays a key role in decision-making and problem solving. Critical thinking consists of critical thinking skills and critical spirit. Critical thinking must be based on general thinking abilities (such as comparison, classification, analysis, synthesis, abstraction, and generalization), and at the same time have some specific critical thinking skills (such as questioning, reasonable argumentation and reflection). The critical spirit is the mental state, willingness, and tendency of conscious judgment. It can activate the individual's critical thinking consciousness, urge the individual to think in a certain direction, and look at problems with a critical eye. Specifically, the critical spirit includes the following six elements: independence; Full of confidence; Willing to think; Do not believe in authority; Open-minded; Respect others.

Research Framework

Deep learning theory is intricately coupled with blended teaching, leveraging the advantages of online and face-to-face instruction to provide personalized learning support and foster critical thinking for students. Thus, blended teaching based on deep learning theory offers a novel perspective and practical framework for cultivating critical thinking in college students. This study, anchored in a thorough understanding of deep learning theory and the essence of blended teaching, aims to explore strategies for promoting college students' critical thinking through blended teaching based on deep learning theory.

Basic information study

- College students' critical thinking
- Circumstances, problems, obstacles to enhance college students' critical thinking
- Policy to promote college students' critical thinking

Knowledge of teaching model development

- Meaning of teaching model
- Teaching model composition
- Teaching model format
- Characteristics of a good teaching model

Educational philosophy and teaching model development

Deep learning

Blended teaching

Critical thinking

Related research

Teaching model development

1. Analytical study of philosophy, concepts, theories
2. Determine the elements of the teaching model
3. Link the relationship of the elements of the teaching model
4. Create a teaching model
5. Create teaching materials
6. Check the quality of the teaching model

(Independent variable)

The blended teaching model based on deep learning theory

Experimental teaching model

(Dependent variable)

College students' critical thinking ability

Figure 1.1 Research Framework

Chapter 2
Literature Review

The purpose of this study is to develop a blended teaching model based on deep learning theory to enhance college students' critical thinking. This chapter is divided into four sections. Section 1 discusses evolution, connotation and significance of deep learning; Section 2 discusses development, analysis framework and evaluation of blended teaching; Section 3 discusses connotation, cultivation and evaluation of college students' critical thinking; Section 4 is related research.

  1. Evolution, connotation and significance of deep learning

  2. Development, analysis framework and evaluation of blended teaching

  3. Connotation, cultivation and evaluation of college students' critical thinking

  4. Related Research

  The details are as follows.

Evolution, connotation and significance of deep learning

The research of deep learning mainly includes the fields of artificial intelligence, psychology and pedagogy. The deep learning mentioned in this paper is explained from the perspective of pedagogy. The proposal of in-depth learning and its promotion in educational practice in various countries are the inevitable requirements of the development of the times and the active response of education. The complexity and rapid change of today's world have far exceeded our imagination. Autopilot, wearable technology, artificial intelligence, gene sequencing, nanotechnology, quantum computing, the Internet of Everything, meta-universe. Human beings have collapsed into the fourth industrial revolution era. The explosive and fission brain growth is challenging and reshaping our social foundation in a new, powerful and surprising way, even reorganizing our brains and changing the way we live, work and study. It will not only bring great changes to human life, but also lead to the change of human life style and social industry structure, thus changing the demand for future talents.

In 2013, the German government launched the "Industry 4.0" strategy, which officially opened the door to the fourth industrial revolution of mankind. When talking about the fourth industrial revolution, Klaus Schwab, founder of the World Economic Forum, pointed out that apart from the rapid development of intelligent interconnected machines and the whole social system, technological breakthroughs in various fields, from gene sequencing to nanotechnology, from renewable energy to quantum computing, are surging, and new technologies are constantly giving birth to the emergence and development of newer and more powerful technologies. The symbiotic relationship between science and technology and human beings has been embodied in an unprecedented way, the life span of human beings has been prolonged, the cancer cure has become a reality, the contradiction between human beings and the environment has been gradually reconciled, and everything indicates the coming of "singularity".

Singularity, originally an astrophysical term, refers to a point in time and space where ordinary physical rules do not apply. In the theory of American futurist Ray Kurzweil, singularity refers to the mutual integration of human beings and other species (objects). To be exact, it refers to the wonderful moment when computer intelligence is compatible with human brain intelligence. When that moment comes (he predicts that it will be 2045), artificial intelligence will completely surpass human intelligence. After the singularity, if human intelligence can be completely transferred to the computer, even death will become meaningless. Many people may disagree, but Kurzweil believes that most people underestimate the power of future development when predicting future technologies, because this prediction is mainly based on the concept of "intuitive linear growth" rather than "historical exponential growth". The world is changing so fast that the singularity is approaching. "Knowledge workers" have become history. What the world needs now is "intelligent creators" who can dance with machines. Such creators will have the abilities of design, creation and empathy that machines don't have.

The global education system is changing, and the global economic situation that will be dominated by technology is changing, which puts forward new demands for the quality of future talents and new challenges to education. How to make learners not be replaced by artificial intelligence in the future is an urgent problem for school education to think about and try to solve. In response to the needs of the

times, deep learning research has flourished rapidly in recent years. There are two main reasons for this: on the one hand, the quality of talents needed in the digital age is greatly different from the previous requirements; On the other hand, it is the application and support of technology development in education, which provides the possibility for the development and promotion of deep learning, and effectively improves the quality, breadth and depth of students' learning and collaboration. For example, students are using various new media social platforms, such as Facebook, WeChat and Weibo, to discover new knowledge, publish new ideas and learn by creating knowledge.

The real educational transformation between information technology and the Internet is that information technology creates the freedom of learning and the freedom to contribute to and participate in global affairs. This was impossible and impossible twenty years ago. Therefore, in-depth learning, which emphasizes active participatory learning and understanding, transferring applications and creatively solving problems, has become a necessary learning skill in the technology-driven world.

1. On the evolution of deep learning research

"Deep learning" expresses new views on students' learning. Ference Marton & Roger Saljo (1976), a professor at the School of Education, Gothenburg University, Sweden, published on qualitative differences in learning: I-outcome and process, based on the study of students' learning process, and put forward and expounded these two relative concepts for the first time. The design is to ask students to read an academic article and tell them to answer some related questions after reading it. The result shows that some students regard the article as scattered information units, guess possible questions and try to remember the relevant information, namely "surface learning"; Other students regard the article as something with meaning structure, so they will search for the main concerns of the article, think about the meaning of the article and its meaning to themselves, that is, "Deep Learning". The research shows that students who adopt the method of Deep Learning have more understanding of articles, can answer questions better, and can remember relevant information more effectively and permanently.

Subsequently, many scholars such as John Biggs have studied deep learning, and the basic consensus is that shallow learning is a mechanical memory of

scattered and irrelevant content without criticism, and the learning content is divorced from the reality of life and lacks relevance to students' past experience, so it is useless to learn; Deep learning is the active understanding of the learning content, the establishment of connection and structure, the pursuit of basic principles, the weighing of relevant evidence, critical reflection and application.

In recent years, the research and practice of deep learning has attracted great attention all over the world, especially in the United States and Canada. For example, America's Let Every Student Succeed Act puts special emphasis on promoting students' in-depth learning and cultivating their abilities. Michael Fullan, a famous Canadian educator, put forward a "new teaching theory" on how to realize real and effective teaching and learning activities in a society with rich technology, aiming at promoting the change of students' ability and attitude through deep learning.

Fullan et al (2013, 2014). made a comparative analysis of the new and old teaching theories, pointing out that although the old teaching theories will involve the use of technology, the ultimate goal of teaching is only to impart what must be mastered. And truly valuable learning should be able to apply what one has learned and have innovative practice. Therefore, change education is not simply adding some expensive technical tools and trying some so-called new learning methods in the traditional classroom, but seeing the role of these technologies and learning methods and what they really change in teaching. As shown in Figure (2-1) below, Fullan believes that the new teaching theory has the following characteristics.

(1) Emphasize the creation of new knowledge and promote its application in real life.

(2) Emphasize the importance of the learning process, and create a new type of relationship between teachers and students who jointly discover, create and use knowledge.

(3) Emphasize the application of technology in education, and adapt to students' habits of using digital products inside/outside the school.
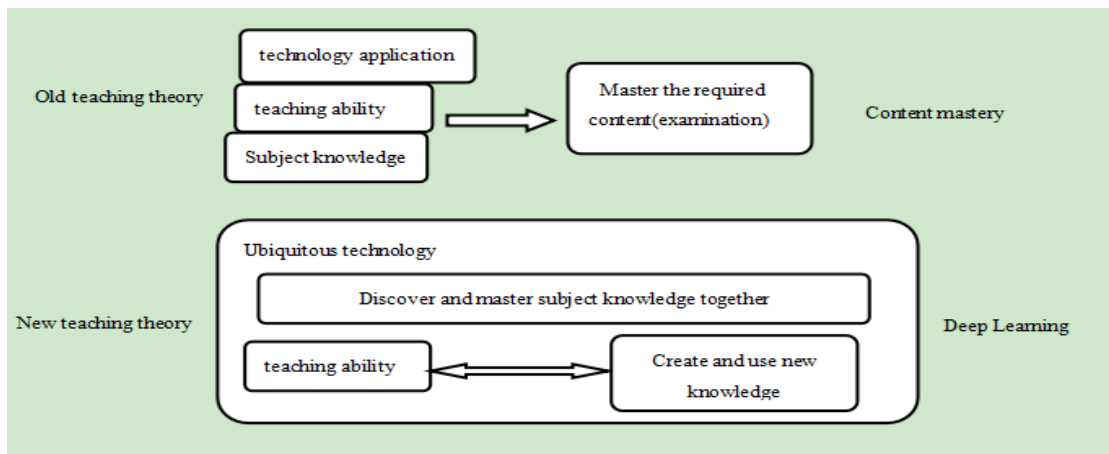
Figure 2.1 Differences between New and 01d Teaching Theories

Fullan's new teaching theory mainly consists of three core elements (see Figure 2.2): First, a new learning partnership between teachers and students; Second, deep learning tasks, which can reconstruct the learning process and thus drive the creation and purposeful application of knowledge; Third, digital tools and resources that can accelerate the process of deep learning. Fullan pointed out that these elements of the new teaching theory all come from the cases and stories of excellent teachers, which are very similar to the educational theories and research in the past century, such as knowledge construction, real-world problem solving, feedback, and the importance of metacognitive strategies. The reason why it is called "new" is that the goal is new, that is, to achieve the goal of deep learning including creating and using new knowledge in the real world. Secondly, the relationship is new. Teachers and students have formed a new learning partnership in the learning process of exploring, creating and using knowledge together. Finally, digital technology links inside and outside the school. These three forces are interrelated to realize the change of learning together.
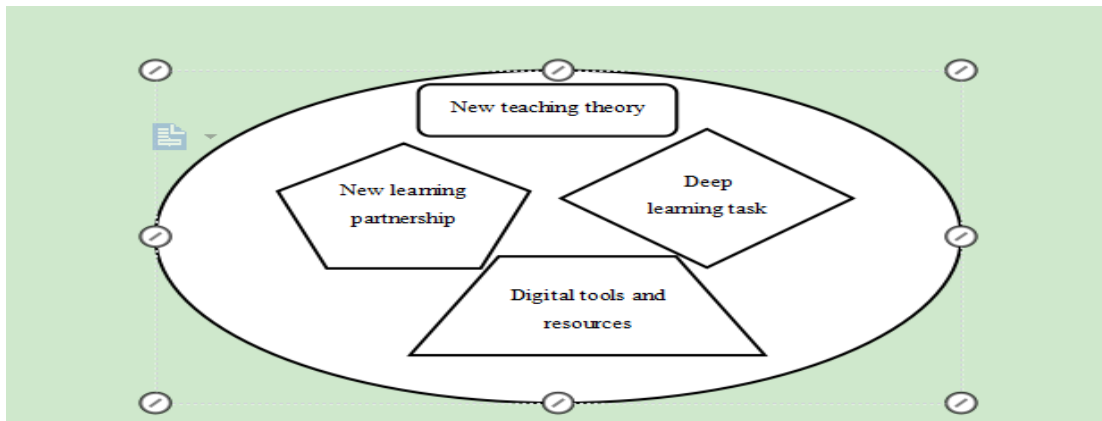
Figure 2.2 Core elements of new teaching theory

2. Connotation and characteristics of deep learning

2.1 The connotation of deep learning

The proposal of in-depth learning is based on the cultivation and development of students' core literacy, in order to promote students' all-round development. In-depth study encourages teachers to deeply explore the teaching rules and study the students' learning rules, so that students can learn more effectively in the new era and new technology background, really help students learn and grow, and become talents with core literacy and key abilities in the 21st century. Therefore, to understand the connotation of deep learning, we should grasp the teaching rules in the concrete situation of teaching practice. The core points include the following aspects: (1) Deep learning is the students' learning in teaching rather than the self-study of ordinary learners, which needs the guidance and help of teachers; (2) The content of deep learning is challenging, rather than common sense and routine; (3) Deep learning is an activity in which students' perception, thinking, emotion, will and values are fully involved and fully engaged; (4) The purpose of deep learning points to the all-round development of concrete and social people, and it is the basic way to form students' core literacy.

It can be seen from the above core points that deep learning emphasizes students' active participation and active construction under the guidance of teachers and emphasizes students' educational development. Therefore, deep learning is quite different from the general learning theory of psychology. It talks about learning

from the perspective of promoting students' all-round development and cultivating social practice subjects who can create a bright future. Deep learning not only emphasizes abstract individual participation and individual construction in psychological sense, but also emphasizes individual active construction and participation in social relations and emphasizes the development of students as social individuals rather than the development of abstract mental functions. In this sense, deep learning is beyond the expectation of psychology for learners' development. Emphasis is placed on promoting the growth and development of students as concrete social and historical practice subjects, forming the core literacy that will help students develop independently in the future, and emphasizing that students as social subjects must have healthy body and mind, high-level cultural accomplishment, strong practical ability and noble spiritual realm. On the basis of the above understanding, deep learning can be defined as follows. The so-called deep learning refers to a meaningful learning process in which students actively participate, experience success and get development around challenging learning topics under the guidance of teachers. In this process, students master the core knowledge of the subject, understand the learning process, grasp the essence and thinking methods of the subject, and form positive intrinsic learning motivation, advanced social feelings, positive attitude and correct values. They become excellent learners with independence, criticism, creativity and cooperative spirit, and a solid foundation, and become the subject of future social and historical practice. (Guo, 2016)

The above definition of deep learning has two sentences. The first sentence is to define and judge the nature of deep learning. First of all, it emphasizes that deep learning is a teaching activity rather than a self-study activity of ordinary learners. It emphasizes the guidance and help of teachers to students' learning activities as the main body. Secondly, it emphasizes the meaningful learning process of students. In the primary sense, the meaningful learning process refers to meaningful learning, which is opposite to mechanical learning, that is, the meaningful learning process that D.P. Ausubel said. Its essence is that "the new knowledge represented by symbols establishes a non-arbitrary and substantive connection with the learners' cognition of the existing appropriate concepts" (Chen & Liu, 2007). This kind of meaningful learning needs several conditions: First, the learning materials

must have logical significance; Second, learners themselves must have the intention of meaningful learning (such as the tendency to actively establish meaningful association), advance knowledge related to new knowledge, and be able to actively associate new and old knowledge. The last sentence is to define the purpose and task of deep learning. Specifically, "mastering the core knowledge of the subject, understanding the learning process, grasping the essence and thinking methods of the subject, and forming positive intrinsic learning motivation, advanced social emotion, positive attitude and correct values" stipulates several tasks of deep learning; "To be an excellent learner with independent, critical, creative and cooperative spirit, with a solid foundation, and to be the main body of future social and historical practice" is the ultimate goal of in-depth study, that is, to "cultivate people".

2.2 Characteristics of deep learning

Deep learning has the following five characteristics.

(1) Association and structuring: the reciprocal transformation of experience into knowledge.

"Association and structure" refer not only to the pattern of students' learning style, but also to the learning content (learning objects) handled by such learning style. As a kind of learning style, "association and structure" deals with the mutual transformation between human cognitive achievements (knowledge) and students' individual experience. Students who come to class always come with their existing experience, which includes both daily life experience and internalization of the knowledge they have learned in the past, and the practical experience they have gained in students' lives. Before entering teaching, most of these experiences exist freely, and they need teachers' help to wake up and transform them, so that they can consciously enter teaching, which not only helps the current teaching, but also makes the experience enter a new structure and get further promotion. The activity of awakening or transforming past experiences can be called "association", while the process of integrating past experiences into current teaching and being promoted and structured can be called "structure".

Emphasizing "association and structure" is intended to emphasize that individual experience and human knowledge are not opposites here in deep learning, but mutual achievements and mutual transformation. "Association" (arousing and

mobilizing) is to care for and attach importance to students' individual experience (including daily life experience), while "structure" is the integration and structuring of experience and knowledge through teaching activities. Because of the participation of experience, the learning of knowledge has the foundation of growth, which can transform knowledge into the content (object) related to individual students and capable of operation and thinking. Because of the learning of knowledge, experience has become a conscious and meaningful content, and it has become an important bridge between students' learning and human knowledge and discovery. "Association and structure" require the participation of students' memory, understanding, relevance ability and systematic thinking and structure ability. At the same time, these abilities will be further developed in the learning process.

As the learning content handled by the learning style, "association and structure" means that the learning content is not isolated, but the knowledge in the structure and system, which can be awakened and called, and can show that other knowledge can also be explained by other' knowledge. It is not a simple combination of knowledge words, but a structure and system with internal relations, and its meaning is shown in the structure and system. As Bruner (1973), a famous American scholar, said, "To master the structure of a thing is to understand it in a way that allows many other things to be meaningfully associated with it. Simply put, learning structure is learning how things are related to each other. "For example, the word "color" is meaningful because objects have features such as shape, size, texture, etc. besides color, so "color" has an independent meaning in the connection and distinction with other features; "Color is meaningful because it has many specific manifestations and dimensions, such as black, white, red, green, etc." Color "is an abstraction of the common features of its various manifestations.

To establish a connection between things is to establish a connection between students' existing experience and new experience (knowledge), so that students can establish a meaningful connection with knowledge. What students learn in teaching is not scattered, fragmented and disorganized information, but logical, structure and systematic knowledge. Students do not learn knowledge in isolation, but, under the guidance of teachers, associate, mobilize and activate past experiences according to current learning activities, organize learning content in a comprehensive way, and thus construct their own knowledge structure. In other

words, students learn the knowledge in the structure in a constructive way, so that they can re-relate and re-construct the association and structure of the learning content through construction, thus forming their own knowledge structure.

Learning subject knowledge in an associative and structured way is an important feature of deep learning, which will play an important role in students' intellectual development. As Bruner (1973) said, "No matter what subject we choose to teach, we must make students understand the basic structure of the subject. The center of the classic migration problem is not so much the simple mastery of facts and skills as the teaching and learning structure. "Only by mastering the basic structure of the discipline can we understand the general picture of the discipline and the relationship between things.

(2) Activity and experience: understanding the learning mechanisms in students.

"Activity and experience" are the core features of deep learning, which answers the operational mechanism of deep learning. "Activity" refers to active activities with students as the main body, rather than physical activities or physical activities dominated by others; "Experience" refers to students' inner experience arising from activities. Activity is accompanied by experience. If it is active, it will definitely lead to inner experience; rational and noble experience must be born in meaningful social activities. If students want to be the subject of learning rather than passive receivers of knowledge, they must have the opportunity to "move" and have opportunity to "experience" the process of knowledge discovery (invention), formation and development (with their own bodies, minds and hearts to simulate and simply experience).

In-depth study is to make the teaching content and learning about the teaching content become the nutrients and means for students to develop themselves. Therefore, students can't study static characters alone, but should take the initiative under the guidance of teachers and find out the principles contained in these characters by listening, experimenting and exploring. That is, through their own active activities, students should turn the written conclusion and its implied meaning into their own cognitive objects, nutrients for their own growth and the process of their own growth. Of course, students' active activities are not spontaneous, but depend on teachers' guidance and teachers' careful design of teaching content and

students' learning process and methods. The process of students' active activities is a process in which they fully experience the rich and complex connotations and meanings of knowledge, and it is also a process in which they develop rich inner experience and enhance their personal experience and spiritual realm.

Students' active learning activities are accompanied by communication, communication, cooperation and competition with teachers and classmates, with teachers' inspiration and guidance, students' mutual assistance and cooperation in experimental activities, mutual inspiration in classroom discussions, interdependence and trust in group work, and so on. These activities themselves also typically reproduce the interdependence, trust, competition and cooperation among people in the process of knowledge discovery (invention). It can be said that the learning process itself is also an important activity for students to experience social emotions and emotions and carry out positive socialization. In deep learning, teaching is no longer a cold intellectual activity, but a lively and warm activity in which reason and emotion coexist. Students feel and experience the richness, complexity, subtlety and profundity of learning activities with all their thoughts and spirits, and truly or simulated the painful or joyful feeling experience accompanying the activities.

(3) Essence and variation: engaging in deep-level processing in learning objects.

"Essence and variation" answer the question of how to deal with the learning content (learning object) so as to grasp the essence of knowledge and realize the transfer. That is to say, students who have deep learning can grasp the essential attributes of teaching content, fully grasp the internal relations of knowledge, and introduce some variations from the essence.

The process of grasping essence is the process of removing the interference of non-essential attributes, distinguishing the difference between essence and non-essential attributes, and also the process of deep processing of learning content. This process is not a process in which teachers tell students the literal description of the nature of things, but a process in which students take the initiative to grasp them: questioning, exploring, inducing, deducing, experiencing situations, and so on. In short, students should establish a close spiritual connection with what they are learning. Only in this way, the essence of things will be revealed, and things will show their most vivid and lively style in front of students. Grasping the essence of

things requires students to have profound and flexible thinking quality, and this thinking quality is developed in the process of deep processing of learning objects and grasping the essence of things.

It is an important job for teachers to help students grasp the internal relationship and essence of knowledge. Some scholars have found that (Ma, 2011), the learning results are closely related to teachers' processing and organization of teaching content (that is, knowledge of teaching content), and the most important thing is teachers' presentation and processing of similarities and differences, changes and unchangeable contents in teaching (Liu & Guo, 2018). In order to help students grasp the essence of knowledge, teachers must design and provide abundant and typical non-standard positive examples or even counter examples in addition to standard positive examples of learning content. The so-called standard positive example is an ideal example of concepts and propositions, an example that embodies the typical characteristics of knowledge, and is close to the existing experience of students. Non-standard positive examples and even counterexamples mean that concepts and propositions are different or even quite different from general conventional cognition, such as "Penguin is a bird but can't fly" (non-standard positive example) and whale is not a fish (counterexample). Providing non-standard positive examples or even negative examples can enable students to understand, grasp, "discover" and "induce" the essential characteristics of knowledge in comparison. In this way, when students grasp the essence, they can cite "one" and draw inferences from the other, conjure up endless variations from the essence, and realize "transfer and application". More importantly, grasping the learning process of the essence of knowledge can enable students to "learn how to learn", form the awareness and ability of deep processing of learning objects, improve students' intelligence level, and strengthen the internal connection between students and knowledge.

(4) Transfer and application: simulating societal practices in teaching activities.

"Transfer and application" solve the problem of transforming knowledge into students' individual experience, that is, transforming the learned knowledge into students' comprehensive practical ability. "Migration and application" require students to have comprehensive ability and innovative consciousness. At the same time,

"migration and application" is a purposeful activity to cultivate students' comprehensive ability and innovative consciousness.

"Transfer" is an important indicator of learning, while "application" is one of the important representations of transfer and the best way to test learning results. If the learning activity is regarded as a closed-loop structure, then "migration" is in the closed place, which is the end point of both learning and learning. It "migrates" from other places, and then "migrates" from here to other places. The same is true of "application", which is not only the "application" of the learning results of the previous link here, but also the opening of new learning through "application". In this way, the systematic ness and structure of the learning content, the profundity and richness displayed with the deepening of the activities, and the initiative, enthusiasm and consciousness of students' learning are all manifested in the "transfer and application" and are cultivated and strengthened in the activities.

"Migration and application" is intrinsically related to "essence and variation". In a learning activity, we must grasp the essential relationship of things before we can "transfer and apply". "Migration and application" is the confirmation and test of "essence and variation". "Essence and variation" emphasize students' internalization of teaching content, while "transfer and application" emphasizes students' externalization of learning results. "Transfer and application" and "association and structure" are also corresponding. Only association can lead to transfer and structure can lead to application, and vice versa.

In deep learning, "transfer and application" is an important way of learning, not just a way to test the learning results. "Transfer" is the expansion and promotion of experience, and "application" is the process of externalizing and operationalizing internal knowledge. It is also the process of making indirect experience direct, transforming symbols into entities, and from abstract to concrete. It is the symbol of knowledge activation and the embodiment of students' learning achievements.

(5) Value and evaluation: the latent factors in the development of "human."

"Value and Evaluation" answers the question of the ultimate purpose and significance of teaching, that is, teaching is a social activity to cultivate people, with the aim of people's growth. All human activities imply "value and evaluation", and teaching activities are no exception. In-depth study will make the "value and

evaluation" of teaching self-conscious and clear, and consciously help students to form correct values and form the core literacy that is helpful for students' conscious development. Consciously guide students to judge the people, things and activities they encounter in a grounded way. "Value and evaluation" is not an independent learning stage or link of teaching, but runs through all links of teaching activities. Students' "value and evaluation" activities play an important role and significance in teaching: first, make students consciously think about the position and function, advantages and disadvantages, uses and limitations of what they have learned in the knowledge system; The second is to make students actively question, criticize and evaluate what they have learned and the learning process.

The activity of "value and evaluation" in teaching should enable students to develop the quality and consciousness of critical thinking and dialectical thinking: we should not only recognize the "power of knowledge", affirm the value of knowledge, but also be alert to the possible bondage and slavery brought by knowledge; We should actively internalize external knowledge into ourselves, keep an objective and calm attitude, and keep a certain distance from knowledge; We should not only take the initiative to carry out the learning process, but also hold a critical and reflective attitude towards the process and way of learning activities. Let students understand learning knowledge is to become the master of knowledge, not to be enslaved by knowledge; Learning process is not only a process of learning knowledge, but also a process of self-growth. In this sense, the learning content and learning methods must be the object of students' reflection. What and how to learn should be reflected and criticized, and they should not be taken for granted as objective facts that need not be questioned.

In particular, the awareness and ability to judge knowledge and its learning process are not naturally formed, but are formed in teaching activities, in the process of "participating" in the formation of knowledge, and in the process of critical knowledge and understanding. Therefore, judging the knowledge and its process is both a means and an end. Its ultimate goal is to cultivate students' conscious and rational spirit and correct values, and to form the core accomplishment of students' independent development. Of course, the cultivation of values and the formation of core literacy is a hidden, long-term and slow process, which needs special attention in teaching activities.

3 The significance and value of deep learning theory

Deep learning theory is not the theoretical deduction of a certain school, but the aggregation and refinement of excellent educational theoretical achievements and excellent teaching practice experience in history, and it is a realistic discussion of the general road of students' learning and development. The value of deep learning theory lies not only in overcoming the disadvantages of mechanical learning and shallow learning, but also in making students learn actively and actively. More importantly, we should overcome the long-standing binary opposition, make teachers, students and teaching contents (knowledge) highly unified, make the teaching contents (human history and culture, human cognitive achievements) realize their due value, make teachers and students achieve the greatest development in teaching, and enable students to form the core literacy that will contribute to the sustainable development in the future.

(1) A profound understanding of the fundamental purpose of teaching: moral education.

The ultimate goal of students' learning is not to master the existing knowledge (although mastering knowledge is a necessary way), but to be able to enter social and historical practice, participate in social and historical practice and create a better future life in the future. To this end, students must take the initiative, distinguish right from wrong, and practice with social history, and become a member of the society with ability, responsibility and sense of responsibility.

In deep learning, instead of translating, transmitting and instilling knowledge (human cognitive achievements) into students, teachers lead students into the situation and process of knowledge discovery, and guide and help students to become "participants" of knowledge discovery rather than bystanders. In other words, students do not wait to accept knowledge, but take the initiative to "enter" the process of knowledge discovery and development, and "personally" experience the process of (re) formation and (re) development of knowledge. Therefore, the process of learning is not only learning knowledge, but also learning knowledge, and even learning knowledge itself is only a means. The purpose is to enable students to "participate" (though simply and simulated) in the great historical practice of mankind as subjects, to understand and identify with the emotional attitudes and values behind knowledge, to enhance students' cultural level and spiritual realm, and to

make them have advanced social feelings, positive attitudes and correct values, social responsibility and courage to take responsibility.

In deep learning, students are the main body of learning, and teachers are the guides rather than the substitutes for students' learning. The teaching content is not static and objective knowledge that only needs students' memory, which is external to students, but knowledge that requires students to fully understand, comprehend, judge, experience and feel before they can "live" and "move".

(2) Re-recognize the value of teaching objectives

Teaching goal is the starting point and destination of teaching activities. Without teaching objectives, there is no basis for teaching activities to be carried out, and there is no basis for examining the quality. Under the theory of deep learning, the teaching goal is to unify the teaching content, students' development and teachers' activities, and become the basis for truly guiding teaching activities and implementing continuous teaching evaluation.

(3) Re-understanding the significance of teaching content

An important symbol of in-depth study is that the external teaching content can be transformed into students' inner spiritual strength. However, the teaching content cannot be directly transformed into students' spiritual strength. It must first be transformed into teaching materials that students can operate and process their thinking and become students' learning objects. The so-called "teaching materials" refer to the symbols or substantive materials provided by teachers, which contain teaching intentions and can reach the teaching content, such as symbols used to express knowledge, as well as teaching aids, audio-visual products, teachers' writing on the blackboard, diagrams and other concrete material entities. Teaching materials are not only the embodiment of human cognitive achievements, but also contain knowledge, thoughts, emotional attitudes and values. At the same time, they also contain the activity ways, paths, processes and links designed by teachers for students' learning activities. They are teachers' conscious planning and guidance for the formation of students' literacy. Teaching content is what students gain, experience and master after deep operation and processing of teaching materials. When the teaching content is transformed into teaching materials, the teaching content will be transformed from "hard" knowledge into a dynamic, rich and vivid process of human cognition, and become the object that can be operated and

processed by thinking, so that it can be transformed into students' spiritual strength in learning activities and guide students' growth and development. It is in this sense that when static knowledge is transformed into students' practical power, human cognitive achievements (knowledge) realize its own value and can continue to exist as cognitive achievements in human history.

(4) Re-recognize the value of teachers

In the information age, with the explosive growth of knowledge, the continuous expansion of learning time and space, and the diversification and enrichment of learning methods, teachers can no longer only exist as the transmitters of knowledge. It is the most fundamental reason and value of the existence of teachers to stimulate students' learning desire, guide their learning activities, help them learn quickly, happily and thoroughly, and inspire them to question, criticize and think deeply in the learning process. In-depth study attaches importance to the value of teachers, and it is difficult to arouse students' in-depth study without teachers' good teaching methods. In-depth learning requires teachers to consciously endow themselves with richer responsibilities, transform social expectations into students' personal wishes, transform teaching contents into teaching materials, guide students to experience the complex and rich ideological and emotional contents contained in teaching materials, and lead students to grow from comfortable individuals into masters of the future society with thoughts, abilities, advanced social feelings, positive attitudes and correct values.

In a word, the deep learning theory repositions and thinks about the teaching relationship between teachers, students, teaching content, etc. It holds that teachers and students, students and curriculum, human knowledge and children's experience, knowledge learning and ability cultivation, knowledge learning and character cultivation, knowledge learning and emotional needs are no longer separated from each other, but organically integrated, and teaching activities become a link that relates to students' whole and meaningful individual life.

Development, analysis framework and evaluation of blended teaching

Model generally refers to the theoretical logical framework of the research object, is an operable knowledge system between experience and theory, and is a theoretical simplified structure that reproduces reality. American scholars Joyce and

Weir (1972) first defined "teaching model" in their book "Teaching model" published jointly, and considered that "teaching model is a paradigm or plan that constitutes curriculum and homework, selects teaching materials, and prompts teachers' activities"(Ding et al., 1991). Chinese scholar Yang (2004) believes that "teaching model is a set of methodology system for organizing, designing and regulating teaching activities established on the basis of teaching practice. It consists of educational (philosophical) themes, functional objectives, structural procedures and operational essentials." From the above two definitions of" educational model ",it can be seen that the teaching model is a relatively stable structural framework and activity procedure of teaching activities, which is established under the guidance of certain teaching ideas or theories, and serves as a bridge for communication between teaching theory and teaching practice.

Blended teaching is a new teaching model that integrates modern educational theory and modern educational technology and deeply integrates with the Internet. From a worldwide perspective, it rose in the 1990s, and gained wide attention from educational theorists and positive promotion from educational practice in the first 20 years of the 21st century. At present, no matter educational researchers, teaching practitioners, or the government and educational institutions, they have basically reached a consensus that blended teaching will become the "new normal" of education in the 21st century (Norberg, A et al.,2011). Especially since the outbreak of the COVID-19 epidemic, under the background of "internet education", blended teaching has shown a spurt of development and has become an extremely important phenomenon and trend in the reform of university education. This paper will systematically analyze and sort out the development, conceptual characteristics and future trend of blended teaching.

1. The development of blended teaching and the evolution of concepts

Simply put, blended teaching is a teaching model that combines online learning with face-to-face teaching. Since the 1990s, with the continuous development of blended teaching practice, the concept of blended teaching has also experienced a process of constant change. In the early stage of the development of blended teaching, scholars mainly paid attention to the application of information technology in blended teaching from the perspective of technology, emphasizing the combination of online and face-to-face teaching. As for how to

combine it, there has not been much research. Sloan Consortium (2003) of the United States believes that blended teaching is the combination of traditional face-to-face teaching and online learning, which are two independent teaching models in history. At that time, blended teaching was mainly understood as a new way of learning, emphasizing the core role of technology in teaching and learning. Jones (2006) divided the blended teaching in this period into five levels according to the application model and depth of information technology in blended teaching: (1) pure face-to-face teaching without technical support; (2) Basic application of information technology; (3) Information technology promotes teaching; (4) information technology; (5) Pure online. It can be seen that at the beginning, scholars and practitioners regard blended teaching as a transitional stage between face-to-face teaching and online teaching, which is a simple combination of them based on information technology, and the application of technology becomes the key criterion.

With the development of practice and the deepening of research, the concept of blended teaching has become more and more clear. First, try to define the ratio of online and face-to-face teaching more clearly, and use it as an independent teaching model. Sloan (2007) believes that only 30%-79% of online teaching content can be called blended teaching. Means et al. (2013) said that more than 25% of the blended teaching should be online when it is included in the teaching content of the assessment part. Secondly, scholars begin to define and pay more attention to blended teaching from the perspective of teaching strategies and teaching methods and pay attention to instructional design under the blended learning environment of online and face-to-face instruction. Focus on "interaction", the changes brought about by the blended learning environment, and the corresponding changes in instructional design. The most representative definition is Bliuc et al. (2007): Blended learning describes a new learning method, which realizes the combination of face-to-face (on-site) interaction and online interaction between students and students, students and teachers, and students and resources. Therefore, Yen and Lee(2011) called blended teaching the fundamental change and redesign of teaching model and put forward three characteristics of blended teaching: (1) from teacher-centered to student-centered; (2) Enhancing the interaction between students and students, students and teachers, students and

content, and students and external resources; (3) Adopt the evaluation mechanism of combining formative evaluation with summative evaluation.

With the rapid development of Internet and mobile technology, especially the arrival of the "internet+education" era, in recent years, the concept of blended teaching has also made a new development, from "the mixture of online teaching and face-to-face teaching" to "the teaching situation based on the combination of mobile communication equipment, online learning environment and classroom discussion" (Wasoh,F., 2016). Blended teaching has been re-understood as a new "learning experience", and attention has been paid to the changes brought by blended learning and the support for students' learning. More and more scholars have pointed out that blended teaching is not a simple technology blending, but a truly highly participatory and personalized learning experience for students., emphasizing "student-centered". Goodyear (2015) emphasized that the so-called blending is not only the blending of face-to-face teaching and online teaching, but also the blending of teaching and tutoring in a "student-centered" learning environment.

Through the above combing, it can be seen that with the development of the times and the progress of technology, the academic circles' understanding of blended teaching has become richer and deeper. In the early stage of the development of blended teaching, they mainly paid attention to the application of technology, and regarded blended teaching as a transitional form between face-to-face teaching and online teaching, as an aid and supplement to online teaching or face-to-face teaching. In the middle and late stage of the development of blended teaching, blended teaching is regarded as an independent teaching model, which not only integrates the advantages of online teaching and face-to-face teaching, but also avoids the disadvantages of both, thus effectively improving the quality of classroom teaching and greatly improving the learning effect of students. Correspondingly, the concept definition also focuses more on the interaction between teachers and students in blended teaching and finally points to the development concept of "student-centered".

2. Analysis framework of blended teaching

According to the process of the occurrence and development of teaching, the analytical framework of blended teaching can be constructed from the aspects of

preparation, design, implementation and evaluation. In fact, researchers have also carried out theoretical research on blended teaching around these aspects.

2.1 Preparation of Blended Teaching

According to the research literature, the preparation of blended teaching mainly includes three aspects: the preparation of institutions, the preparation of teachers and the preparation of students, mainly involving two dimensions of attitude and ability.

2.1.1 Organizational preparation: attitude and ability

Under the strong advocacy of the government, around 2010, some universities in Europe and America took the lead in trying blended teaching reform. In 2011, the U.S. government set up a NGLC (Next Generation Learning Challenges) fund to encourage schools to develop blended teaching. Among them, 20 universities of the American Association of Colleges and Universities (AASCU) joined this project. After 2013, MOOCs has aroused the attention of all sectors of society to online teaching, and more institutions of higher learning have shown an open and positive attitude towards blended teaching. Online teaching and blended teaching make more traditional colleges and universities see the infinite possibility of expanding learning opportunities and university walls. However, most educational institutions are too optimistic about blended teaching, and they are not aware of the challenges brought by blended teaching, including the preparation and requirements for infrastructure, teachers, personnel, technical preparation and many other aspects needed by institutions to carry out blended teaching. Therefore, most educational institutions are not ready to carry out blended teaching. Graham et al (2013) divided the level of promoting blended teaching in educational institutions into three levels: awareness/inquiry, adoption/initial implementation, and mature development. Take the United States as an example, at present, most colleges and universities carrying out blended teaching reform are still at the stage of transition and transformation from the first level (consciousness/inquiry) to the second level (adoption/initial implementation). They are still in the early stage of blended teaching reform, far from mature development. Moreover, in this process, most colleges and universities have already faced problems and challenges caused by insufficient preparation for blended teaching (Porter et al., 2014).

2.1.2 Teachers' preparation: attitude and ability

The effect of blended teaching depends to a great extent on teachers' attitude and ability preparation, and on how teachers transition from the traditional face-to-face classroom role to the more complex role required by blended teaching. Compared with the positive and optimistic attitude of institutions and students towards blended teaching, as the main undertaker of blended teaching, most teachers hold a conservative attitude towards blended teaching. On the one hand, in terms of cognition, most teachers think that blended learning only improves teaching efficiency and convenience, but they are not aware of the importance of blended learning to support students to get a better learning experience; On the other hand, due to the technical problems, the integration of technology and curriculum, the problems of time and workload, etc., teachers' attitude towards blended teaching is slightly negative, which further affects the positive change of teachers' role in blended teaching (Comas-Quinn, A., 2011).

In fact, the more teachers who have experienced blended teaching, the more complicated their attitude towards blended teaching. They not only see the convenience brought by blended teaching supported by information technology, but also experience all kinds of difficulties caused by insufficient ability preparation (including psychological preparation) before. So, what abilities do teachers need to carry out blended teaching? What is the current situation of teachers' blended teaching ability? How should teachers do a good job of blending? Ability preparation for teaching? Researchers have started theoretical thinking on these three aspects.

Up to now, there are few research on the teacher's ability model of blended teaching, and scholars pay more attention to the ability model that teachers need in online teaching (Feng et al., 2017). However, many scholars emphasize that blended teaching should have its own unique teaching method, and teachers should not simply copy the traditional classroom teaching method but must have the specialized knowledge and ability to adapt to blended teaching in order to successfully carry out blended teaching (Garrison & Vaughan, 2013). King et al. (2012) have constructed the framework of teachers' competence in blended teaching, and put forward four competence requirements: curriculum preparation, curriculum design, communication and discussion, and motivation stimulation., which is operable and instructive.

As for the present situation of teachers' ability preparation for blended teaching, there are few special studies. The existing research results show that teachers' ability preparation for online teaching is generally insufficient, especially in teaching methods. Blended teaching is a new teaching method, which puts forward more complicated requirements for teachers' abilities and responsibilities. Due to the lack of blended teaching content in the curriculum system of pre-service education for teachers, teachers only have the knowledge and ability of traditional classroom teaching, but lack the theoretical framework, understanding of teaching method knowledge and practical experience of blended teaching (Keengwe & Kang, 2013). All these directly affect the enthusiasm and satisfaction of teachers in carrying out blended teaching.

How to help teachers prepare for blended teaching? With the vigorous development of blended teaching, since 2010, some researchers have begun to explore the models and strategies to help teachers prepare for blended teaching (Balatti et al., 2010; Richardson & Alsup, 2015; Mentis et al., 2016). Comparatively speaking, the British Open University has more mature experience in helping teachers prepare for blended teaching ability. British open universities require teachers to participate in professional mixed teaching skills training, which mainly includes two types: mandatory practical courses and non-mandatory and more comprehensive training courses (Comas-Quinn, 2011).

2.1.3 Students' preparation: attitude and ability

At present, there are many studies on students' attitude and acceptance of blended teaching. And most studies show that students, especially adult learners, have an open and positive attitude towards blended teaching and blended teaching environment (Osgerby & Julia, 2013; Llorente et al.,2016). Students' positive attitude, recognition and acceptance of blended teaching will affect students' learning participation and satisfaction (So & Brush, 2008). It is clear that what kind of learning effect and satisfaction learners can achieve in blended learning depends to a large extent on whether they are ready for blended learning. This kind of ability preparation includes: autonomous learning ability, practical management ability, maturity and sense of responsibility, ability to apply information technology, etc. (Cheon et al., 2012; Jia, 2017)

2.2 Design and implementation of blended teaching

To achieve good results in blended teaching, the key is to redesign the curriculum, create a positive and cooperative learning experience for students, and help students actively construct new knowledge cognition and experience through active participation in learning. From the teaching practice, according to the proportion of different learning styles, blended teaching can be divided into three categories: offline-oriented, online-oriented and completely integrated. Offline-oriented is mainly based on face-to-face on-site teaching, communication and discussion, with online learning and mobile learning as auxiliary; Online-oriented teaching is dominated by online teaching and mobile learning. Students complete most of their learning tasks through autonomous learning, and face-to-face on-site teaching mainly solves students' difficult problems. The complete integration type breaks the modular traces of online learning and face-to-face learning. According to the characteristics of learning content, the offline face-to-face teaching, online teaching and mobile learning are designed in a unified way, completely integrated and seamlessly connected.

The design and implementation of blended teaching needs a theoretical framework to guide. At present, the most influential theoretical framework in the field of blended teaching is Community of Inquiry, which was put forward by Garrison et al. based on their years of blended teaching practice in Athabasca University, Canada. They believe that the three key elements of blended teaching are social presence, teaching presence and cognitive presence. Only when these three kinds of telepresence reach a high level can effective learning take place (Garrison et al., 2001).

Social presence is defined as the learner's ability to identify with the community of curriculum learning. Learners can communicate meaningfully in an environment full of trust and develop interpersonal relationships through the full display of their individual characteristics (Garrison, 2009). Cognitive telepresence describes the process of learners' meaning construction and understanding through continuous reflection and discussion. The central element of this model is the sense of teaching presence, which means that teachers or some learners help learners to achieve personal meaning construction and educational learning results by designing and organizing teaching activities, promoting conversation and direct guidance. These

three senses of presence interact in the dynamic learning process, which can create a profound and meaningful learning experience (Akyol & Garrison, 2008).

After the Community of Inquiry model was put forward, it caused great repercussions in the academic circles. Many scholars verified the model based on their own teaching practice environment, which proved its effectiveness and became a theoretical model widely used to guide the design and implementation of blended teaching. Later, Professor Cleveland-Innes, one of the founders of the model, added the fourth element: Emotional Presence to the model, and verified it through empirical research (Cleveland-Innes & Campbell, 2012).

As for the implementation strategies of blended teaching, scholars try to explore and construct blended teaching strategies through case studies. Some studies have found that anonymous online discussion and collaborative learning is an effective strategy, which can reduce students' stress and fear and improve students' participation (Miyazoe & Anderson, 2011); Problem-Based Learning (PBL) strategy can help students to complete learning activities and construct meaning more effectively (Donnelly, 2010); Peer evaluation strategy is also helpful to improve students' learning interest and learning effect in blended teaching (Miyazoe & Anderson, 2011).

Generally speaking, although theoretical researchers and educational practitioners are very concerned about the implementation strategies of blended teaching, there are not many research results at present. Relatively speaking, the mature and systematic research results are the practical strategies developed by the Community of Inquiry model proposed by Garrison et al. Vaughan designed the blended curriculum with the framework of exploring the community model and concluded that the key strategy of blended teaching lies in "consciously integrating real-time and non-real-time learning" and creating meaningful connections in learning. Vaughan (2015) focused on the three stages of teaching and put forward the teaching strategies that teachers should adopt in the three stages: designing meaningful learning activities as trigger events (before synchronous learning); Listen to students' expressions and have a dialogue with them; Design students' "homework" centered on activities (after synchronous learning).

In addition, institutional and curriculum support is also an important factor that affects the implementation effect of blended teaching. From the

institutional point of view, we should provide support for blended teaching in terms of "information technology, teachers, continuous investment, training of senior managers and teachers" (Poon, 2013). Some scholars have more clearly summarized the support framework that educational institutions need to provide for blended teaching to ensure the successful implementation of blended teaching. The framework includes 3 first-level dimensions of "strategy, structure and support" and 10 sub-dimensions of "goal, publicity, concept, infrastructure, planning, management, evaluation, professional development, support and incentive system", with 11 supporting suggestions in total (Porter et al., 2014). This provides a practical theoretical framework and strategic guidance for the institutional support of blended teaching. From the curriculum level, according to the difficulties students encounter in blended teaching, they need to be supported in four aspects: teaching support, social interaction support, time management support and technical support (Chen & Feng, 2012).

2.3 Evaluation of blended teaching

2.3.1 Evaluation framework, methods and tools

Policymakers, practitioners and researchers all pay close attention to and emphasize the evaluation of blended teaching. Because objective and true evaluation data is the key factor to improve blended teaching. In the practice and research of blended teaching, systematic and long-term evaluation data collection is the basis of effective evaluation (Meredith Toth et al., 2008; Dziuban & Moskal, 2011). Some researchers try to apply different conceptual frameworks to evaluate blended teaching from different angles, such as classroom community awareness (Sorbet & Notar, 2022), student participation and interaction (Ghadirian et al.,2019), problem-based learning framework (Olive & Trigwell, 2005), activity theory (Keengwe & Kang, 2013), and so on.

At present, a mature and widely used hybrid teaching evaluation framework is the Community of Inquiry model. This framework can be used not only as a theoretical framework for the design and implementation of blended teaching, but also as an evaluation framework for blended teaching. Garrison et al. designed a concrete blended teaching evaluation framework based on the inquiry community model. Among them, Garrison, etc. further constructed the Practical Inquiry model for the evaluation of the most important cognitive presence and divided the

construction of cognitive presence in the blended learning environment into four levels: trigger, inquiry, integration and problem solving (Garrison et al., 2001). Based on this model, the level of cognitive telepresence in blended teaching was evaluated, and the corresponding evaluation indexes were formed (Garrison, 2007; Garrison et al., 2010). At present, the questionnaire method or content analysis method is mainly used to analyze the application of this framework in evaluating blended teaching.

2.3.2 Teaching effect evaluation

The evaluation of blended teaching effect mainly focuses on three aspects: (1) learning effect and cognitive level (Feng et al., 2016); (2) Interaction and social knowledge construction (Li et al., 2022); (3) Emotional attitude. From the perspective of curriculum, the effectiveness of blended teaching mainly depends on two dimensions: teaching guidance and learners. Among them, the dimensions of teaching guidance include the quality of teachers, the design and organization of learning activities, learning support and other key elements; The learner dimension emphasizes the key factors such as students' learning maturity, autonomous learning ability, and their expectations and needs for learning(Lim & Morris, 2009). In the field of higher education, the effect of blended teaching focuses on improving academic performance and passing rate, improving students' satisfaction and improving teaching efficiency. López-Pérez et al. (2011) collected a large number of cases of blended courses in the University of Granada, Spain, and found that blended teaching reduced the drop-out rate of students, improved the examination pass rate and students' academic performance; At the same time, blended teaching enhances students' learning motivation, self-efficacy and learning satisfaction. Akyol and Garrison (2008) investigated the learning performance of American graduate students in blended learning environment. The results show that students can obtain a higher level of cognitive presence and better learning results in online and blended learning environments. American scholars' surveys of tens of thousands of college students in six Florida universities also show that students' scores in blended courses are significantly higher than those in face-to-face courses and online courses(Garrison & Vaughan, 2013).

2.3.3 Satisfaction

Student satisfaction. A large number of studies have proved that students have high satisfaction with blended teaching. Some scholars have further explored the factors that affect students' satisfaction in blended teaching, pointing out that clear teaching guidance, teaching activities, face-to-face support and cooperation ability are all important factors that affect students' satisfaction with blended teaching (So & Brush, 2008). However, there are still different views on the influence of technology on students' satisfaction in blended teaching. Henrie et al. (2015) found that media technology has no direct impact on students' satisfaction. However, Kintu et al. (2017) thought that technology and online tools are the key influencing factors of students' satisfaction. Some researchers have built a model of students' satisfaction under the blended teaching environment by comprehensively investigating the blended teaching system. Among these models, teachers' professional skills, teachers' support, students' perceived task value, expectation of achievement goals, self-efficacy, learning environment and interaction are the key factors that affect students' satisfaction (Diep et al., 2017).

Teacher satisfaction. Compared with the differences of views on the influence of technology on students' satisfaction, the influence of technology on teachers is more obvious and important. Technical factors are the key factors that affect teachers' satisfaction with blended teaching. Technical problems, the integration of tools and courses, and teachers' anxiety about technology will greatly affect teachers' satisfaction with blended teaching (Huang et al., 2022). At the same time, teachers' personal innovation, the performance of blended teaching system, management support, incentive policies and training are also the key factors affecting teachers' satisfaction in blended teaching (Porter et al., 2014).

Connotation, cultivation, and evaluation of college students' critical thinking

1. What is critical thinking

Critical thinking consists of two words: critical and thinking, so the analysis of the concepts of "thinking" and "critical" is more helpful for us to understand the concept of critical thinking. "Thinking" is the advanced stage of people's cognition and a reflection of objective things by human brain. Thinking reflects the nature of things

and the regular relationship between things. The word "critical" comes from the Greek words "kritikos" and "krinein", in which "kritikos" refers to the ability of discrimination or judgment, and comes from the meaning of "judgment, decision" of "krinein". Therefore, from the etymological point of view, the original meaning of "critical" is to analyze and judge according to the standard, that is, to divide arguments, ideas and assertions into parts, explore the relationship between each part, and then judge their authenticity, merits and demerits according to the corresponding standard.

The modern concept of Critical thinking can be traced back to Dewey's "reflective thinking", that is, actively, continuously, and meticulously thinking about any belief or assumed knowledge form, and knowing the reasons supporting it and the conclusions it points to. Dewey's critical thinking (which he called "reflective thinking") means not deciding whether to accept or oppose a scientific hypothesis before actively, continuously and meticulously rationally exploring it: delaying judgment (Dewey J., 1910). Later, the concept of critical thinking was deeply studied in the process of "critical thinking movement" in the United States. With the discussion of the nature of critical thinking, there are still many differences in the definition of critical thinking in academic circles. So far, the definition of critical thinking is quite rich. According to incomplete statistics, there are more than 100 kinds. From the perspective of influence and scope of communication, the representative views mainly include the following:

(1) Edward Glaser (1941) expressed critical thinking as: people tend to think about problems and attitudes of people in the field of experience, knowledge of logical inquiry and reasoning methods, and some skills in applying these methods.

(2) Robert H. Ennis (1962), the pioneer of American critical thinking movement, analyzed the concept of "critical thinking" in detail, and expressed it as "critical thinking is rational and reflective thinking, whose purpose is to determine our beliefs and actions" (1987), which was further expressed in his article as "reasonable and reflective thinking for deciding what to believe or do" (1999)

(3) Wastson-Glaser (1980) put forward that critical thinking is a combination of attitude, knowledge, and skills. A critical thinking test must have a questioning attitude, clarify the knowledge that causes thought-provoking problems and the cognitive ability to analyze, synthesize and evaluate the results.

(4) In 1990, an international group of 46 recognized critical thinking experts made a cooperative study on the definition of critical thinking, and finally formulated the report of "Expert Consensus Statement" on critical thinking. The report points out that critical thinking is a purposeful and regular judgment process, which produces the interpretation, analysis, evaluation, reasoning and explanation of evidence, ideas, methods, standards, or contexts. Critical thinking is essentially a tool for exploration, and it is also a complex thinking process, involving many skills and attitudes.

(5) Richard Paul (1993), an internationally recognized authority on critical thinking and the director of the American Center for Critical Thinking Research, believes that critical thinking "is to evaluate thinking through certain standards and then improve thinking. Critical thinking is the process of actively and skillfully analyzing, applying, analyzing, synthesizing, and evaluating the information that governs beliefs and behaviors. This information is collected or generated through observation, experiment, reflection, reasoning and communication. "

(6) Brooke Noel Moore and Richard Parker defined critical thinking in the 9th edition of Critical Thinking: Taking You Out of Thinking Mistakes as: prudently applying reasoning to determine whether an assertion is true or not. Critical thinking is to evaluate the assertions we face, not whether the assertions are true or false. The main idea of critical thinking is thinking about thinking.

(7) Stella Cottrell, director of the Lifelong Learning Research Center of the University of Leeds in the UK, believes that critical thinking is a cognitive activity, which is linked with the application of thinking. To think in a critical, analytical and evaluative way, we need to use a variety of thinking activities, such as attention, classification, selection and judgment. Critical thinking is a complex thinking process, involving many skills and attitudes, including: distinguishing the positions, arguments and conclusions of others; Evidence for evaluating its viewpoints; Weigh the arguments and evidence of the opposing side fairly; Be able to read between the lines, see through the superficial phenomena, and identify false or unfair assumptions; Identify some persuasive skills, such as false logic and persuasive skills; Think about problems in a structured, logical and insightful way; Be able to judge whether the argument is valid and fair based on valid evidence and reasonable assumptions; Information integration-gather your judgment on the evidence to form your own new position; Introduce a point of view in a clear structure, rigorous reasoning and persuasive way.

From the above definitions of critical thinking, we can see that there are different understandings of critical thinking, which is based on their differences in perspective. However, we also find that there are many similarities among various definitions of critical thinking, which are mainly manifested in the following aspects: First, in terms of constituent elements, critical thinking is considered as a kind of thinking, which is applicable to all subject contents; Second, skill elements, including clarifying meaning, analyzing and demonstrating, evaluating evidence, judging whether a conclusion can be drawn, self-monitoring, etc. Third, the attitude of critical thinkers, including rational doubt and reflection, open-mindedness, fairness, willingness to consider different beliefs and willingness to revise beliefs.

Generally speaking, critical thinking has the following characteristics: First, the acquisition and application of knowledge. Critical thinking can determine the knowledge that accords with facts and beliefs and apply the knowledge to decision-making and action. The second is reflective. Critical thinking is thinking about thinking, reflecting on the thinking of others and us, and also reflecting on the rationality of standards and methods themselves. Reflection can strengthen creativity, cognition and growth and cultivate people's independence. The third is rationality. Critical thinking is rational thinking, that is, beliefs and actions should be based on reasonable grounds, with good reasons, methods and rules. The fourth is fairness. Critical thinking can't be biased and prejudiced when analyzing, evaluating and demonstrating, such as prejudice in ideas, beliefs, hobbies, etc. It should evaluate and demonstrate from different angles to be truly open, objective and fair. Fifth, it is constructive or creative. Critical thinking is not only used to find shortcomings, weaknesses, and negative things, but also includes positive and positive things. The purpose of critical thinking is to find correct ideas and knowledge. It is a conscious process of reviewing existing ideas and argumentation qualifications, a process of making decisions, and a process of exploration, that is, it is a process of critically reflecting on existing ideas, knowledge, and decisions, trying to find better ideas, advance knowledge and make reasonable actions by using experience and logic. Essentially, critical thinking is concerned with how we think and determining what is trustworthy.

To sum up, Critical thinking refers to an individual's judgment on the authenticity, accuracy, nature, and value of what he has learned. It is reasonable and

reflective thinking for deciding what to believe or do and plays a key role in decision-making and problem solving. Critical thinking consists of critical thinking skills and critical spirit. Critical thinking must be based on general thinking abilities (such as comparison, classification, analysis, synthesis, abstraction, and generalization), and at the same time have some specific critical thinking skills (such as questioning, reasonable argumentation and reflection). The critical spirit is the mental state, willingness, and tendency of conscious judgment. It can activate the individual's critical thinking consciousness, urge the individual to think in a certain direction, and look at problems with a critical eye. Specifically, the critical spirit includes the following six elements: independence; Full of confidence; Willing to think; Do not believe in authority; Open-minded; Respect others.

Therefore, the cultivation of critical thinking of college students must develop their critical spirit and critical thinking skills at the same time.

2. Cultivation of college students' critical thinking

As a thinking skill and high order thinking quality, critical thinking plays an important role in analyzing and solving problems, adapting to society and knowledge innovation. It is generally agreed that students' creative and critical thinking abilities can be cultivated through instruction and targeted practice, rather than disposed qualifications that education can do very little to develop (Robinson, 1987). Therefore, in the past 40 years, western developed countries, especially the United States and Britain, have listed the cultivation of critical thinking ability as an important task of higher education. The purpose is to "correct students' negative, conservative, error-prone and inefficient bad thinking habits through the teaching activities of critical thinking courses, and cultivate their ability to read, listen, observe, speak and write critically, so that students can calmly cope with various severe challenges in society in the future (Huang , 2010). The emphasis on the cultivation of college students' critical thinking ability has led to an endless stream of related research and theoretical achievements. Researchers come from various fields, mainly philosophy, psychology, and pedagogy. From the perspective of pedagogy, critical thinking teaching is highly valued in western countries represented by the United States. Critical thinking is a core skill of contemporary education, and many universities have incorporated critical thinking courses into their teaching plans. Effective strategies for critical thinking training have become an important topic of

concern to researchers. Selman (1989) summarized a couple of approaches of teaching critical thinking skills in his study, which include skills approach, The problem-solving approach, the logic approach, the information-processing approach, and the multi-aspect approach. Bacon, C.S., & Thayer-Bacon, B.J. (1993) studied the possibility of developing students' critical thinking through course talk; Paul et al. (1995) re-studied Socrates' question-and-answer method in critical thinking teaching; Gantt (1996) studied the case teaching method of critical thinking; Gallagher (1998) used the theory of Peery to study the development of students' critical thinking. Stephen D.Brookfield (2017) pointed out that group cooperative learning (social learning) can help college students to improve their critical thinking through more peer communication. Yakob, M. et al. (2020) found that multimedia teaching materials such as videos and animations have a greater impact on improving college students' critical thinking skills. Ye, H.C. et al. (2022) studied the role of reflective writing in cultivating college students' critical thinking ability.

Some researchers argue that the purpose of teaching critical thinking is to prepare students for thoughtful decision-making, effective problem-solving and lifelong learning in future. In order to make sure these skills become a part of students' daily behavior, students must be cultivated in an environment that promotes the transferability of these skills (Paul, 1992). Many scholars contend that critical thinking should be best developed as students grapple with specific content (such as reading, writing, social studies, literature and science) rather than taught exclusively as a separate set of skills (Brookfield, 1987; Wallace, 2003; Kurubacak, 2006; Pan, 2009).

According to the relationship between the teaching and training of critical thinking and the subject content of students, the teaching methods of critical thinking can be divided into four types: General Approach, Immersion Approach, Infusion approach and Mixed Approach (Alsaleh, 2020).

A. General approach. The so-called general method refers to the teaching of critical thinking by setting up special critical thinking courses. Its main purpose is to teach critical thinking, and it doesn't involve much specific subject content. The training focuses on the methods and principles of critical thinking that can be applied in different environments. The representative of this method is Ennis.

B. Immersion approach and infusion approach. These two methods emphasize the combination of subject content and combine critical thinking teaching with students' daily subject learning content for critical thinking teaching. However, they are different in their ideas. Immersion method tends to develop students' critical thinking subtly through subject knowledge teaching. This teaching method does not explicitly teach the general principles of critical thinking, but it tends to awaken students' critical thinking through daily subject teaching. The indoctrination method focuses on encouraging critical thinking in daily subject teaching content and teaching critical thinking by clearly explaining the general principles of critical thinking tendency and ability. Glaser prefers the indoctrination method, while McPeck favors the immersion method.

C. Blended approach. The so-called hybrid method is the combination of General approach, Immersion approach and infiltration approach in different degrees. Its typical form is to teach critical thinking alone for a period of time, and then combine critical thinking skills training with students' daily subject content teaching. Sternberg is the representative figure.

3. Evaluation of college students' critical thinking

Critical thinking is an essential core competence for talents in the 21st century. At present, under the background of China's innovation-driven high-quality economic and social development, high-level universities in China have set their sights on cultivating students' critical thinking ability, and strive to create a talent cultivation ecology with no boundaries for innovation and thinking (Qiao, 2020). In the process of promoting the teaching of critical thinking of college students, the evaluation of critical thinking plays a very important role, which is not only an vital process in the cultivation of critical thinking, but also an key basis for verifying the effectiveness of cultivation. Only by combining critical thinking teaching with scientific critical thinking evaluation can we really cultivate students' critical thinking (Abrami et al., 2015). From the content of evaluation, combined with the connotation of the concept of critical thinking, critical thinking evaluation can be divided into personality tendency evaluation, critical thinking skill evaluation and comprehensive evaluation. Personality tendency of critical thinking is a person's attitude, characteristics and tendency of critical thinking (Bensley et al., 2016). Some scholars believe that the personality tendency of critical thinking usually includes truth-seeking, openness,

systematic Ness, self-confidence, curiosity, cognitive maturity and so on (Facione & Facione, 1992). Common tools for evaluating critical thinking personality disposition include California Psychological Motivation Scale (CM3) and California Critical Thinking Disposition Scale (CCTDI). CM3 is mainly aimed at primary and secondary school students, and CCTDI is a widely used tool for evaluating the personality tendency of critical thinking of college students. There are six skills and 16 sub-skills of explanation, analysis, evaluation, reasoning, interpretation, and self-regulation put forward by *Delphi Report* of American Philosophical Association (Facione & Facione, 1992). According to the *Delphi Report*'s suggestion on critical thinking assessment, researchers developed the California Critical Thinking Skills Assessment Tool (CCTST). Comprehensive evaluation assumes that critical thinking is a multi-dimensional construct, which includes not only critical thinking skills, but also critical thinking personality tendency and meta cognition. HCT AES (Halpern Critical Thinking Assessment Using Everyday Situations), developed in 2006, evaluates college students' critical thinking from five dimensions: reasoning ability, argumentation and analysis ability, hypothesis testing ability, application ability, decision-making and problem-solving ability. The topic involves 25 daily life situations (Halpern, 2007).

As far as the research in recent years is concerned, the theoretical framework design of critical thinking evaluation has widely followed the *Delphi Report* of the American Philosophical Association, with clarification, analysis, inference, evaluation and explanation as the evaluation elements (Facione, 1990). At the same time, the evaluation tools are constantly changing, becoming more and more diversified, intelligent and personalized.

In order to clarify the core elements of critical thinking assessment for college students and the technical characteristics and development trend of assessment tools, this study takes the critical thinking assessment tools developed by domestic and foreign scholars or institutions in China as the research object, adopts content analysis method, extracts and analyzes the assessment elements adopted by each assessment tool, clarifies the core elements of critical thinking assessment for college students at different stages, combs the key technologies and methods of each assessment tool, and analyzes its development trend and technical characteristics of critical thinking assessment at different stages. In this study, the domestic research sample is based on "China Knowledge Network" (CNKI), Select Chinese articles

published in CSSCI journals., and the retrieval theme is "critical thinking assessment" or "critical thinking measurement". The foreign research samples are papers published in SSCI journals in English from "Web Of Science, Science Direct and Springer" databases. Based on the development characteristics of critical thinking assessment tools and the actual situation of this study, only articles published since 2010 are selected for English literature. The search keywords are "critical thinking", "critical thinking measure" and "critical thinking assessment". Five screening criteria are set in the retrieval process, specifically: the research method is experimental research or quasi-experimental research; The evaluation object is only students in higher education stage; The research content is to evaluate the critical thinking ability of the evaluation object; The research results have sufficient data information; Eliminate duplicate documents. Finally, 42 articles that meet the screening criteria were obtained in this study. By analyzing the contents of these papers, the evaluation elements adopted by each evaluation tool were extracted and analyzed, and the key technologies and methods of each evaluation tool were sorted out to clarify the technical characteristics and development trend of critical thinking evaluation. The results are as follows:

Table 2.1 Evaluation elements and techniques of critical thinking evaluation tools for college students

Evaluation tool	Compiler and Compilation time	Evaluation elements	Evaluation technology
Heighten+ Content Analysis	Claire,2021	Analyze and evaluate arguments, evaluate the credibility of evidence, understand implied assumptions and conclusions, form effective arguments, and understand causality and explanation.	Adaptive evaluation system

Table 2.1 (Continued)

Evaluation tool	Compiler and Compilation time	Evaluation elements	Evaluation technology
Critical Thinking Assessment Tool	Cortaza, 2020	Elaboration, analysis, reasoning, evaluation, demonstration, and meta-cognition.	Open Problems Based on Online Platform
Wind Turbine(WT)	Shavelson,2019	Identifying, relevance, evaluating and making decisions, identifying, and evaluating results, and writing efficiency.	Gamification evaluation
Critical Thinking Test	Trace, 2019	Collect information, identify hidden hypothesis, analyze situations, consider choices, infer, make decisions and reflect.	Construction of Automatic Composition Scoring System Based on WEAK Platform
National Assessment of Collegiate Capacity of Critical Thinking (China)	Dong Yu, 2019	Analyze, evaluate, demonstrate, and reason, identifying implicit hypothesis, clarify meaning, evaluate the deducible meaning of a certain information, evaluate the credibility of a statement, and analyze the demonstration structure.	Standardized test of online platform
Heighten Outcomes Assessment	ETS, 2016	Analysis and synthesis	standardized test of online platform
Critical Thinking Scale	Akpur, 2015	Reasoning, evidence-based decision-making, problem identification and information acquisition.	Standardized test

Table 2.1 (Continued)

Evaluation tool	Compiler and Compilation time	Evaluation elements	Evaluation technology
Critical Thinking Assessment Tool	Cortaza, 2020	Elaboration, analysis, reasoning, evaluation, demonstration, and meta-cognition.	Open Problems Based on Online Platform
Collegiate Learning Assessment+(CLA+)	Council for Aid to Education, 2013	Scientific and quantitative reasoning ability, ability to analyze and solve problems, writing efficiency, writing skills, critical reading and analysis ability, refuting ability.	Open tasks and problems of online platform and Value-added evaluation
Collegiate Assessment of Academic Proficiency Critical Thinking (CAAP)	American College Testing, 2012	Skills of analyzing argument elements, evaluating argument and expanding argument	Paper version standardization test
ETS Proficiency Profile Critical Thinking (EPP)	Educational Testing Service(ETS), 2012	Distinguish between rhetoric and argument, identify hypothesis and argument to explain the information presented, infer and explain the relationship between variables, and draw conclusions according to the information provided.	Standardized test of online platform
Halpern Critical Thinking Assessment (HCTA)	Diane, 2010	Language reasoning, analysis and demonstration, determination of possibility and uncertainty, decision-making and problem solving, hypothesis testing.	Open and closed problems of online platform based on life situation

From the results of comparative analysis, the assessment elements in the critical thinking assessment tool for college students reflect diversified characteristics, which not only adopt the assessment elements such as analysis, evaluation, argumentation and reasoning in the Delphi Report, but also appear the assessment elements such as decision-making, problem solving, writing ability and meta-cognition. For example, the Critical Thinking Scale developed by Akpur, the WT developed by Shavelson, and the HCTA developed by Diane all take decision-making as an evaluation element; DOT test developed by Danczak and HCTA developed by Diane all take problem solving as an evaluation element; CLA+ developed by CAE and WT developed by Shavelson all have elements of writing ability. Judging from the technical characteristics of critical thinking assessment for college students, all assessment tools basically design complicated open tasks or questions. For example, the Critical Thinking Assessment Tool sets 28 open questions based on videos, news articles and infographics; Based on the daily life situation of 25 people, HCTA has set up open questions and closed questions. CLA+ sets up expressive tasks, requiring students to play hypothetical roles and complete specific tasks by collecting information, analyzing and reasoning. Shavelson takes the wind turbine as a problem situation, requires students to cooperate and solve specific problems together, and evaluates students' critical thinking in the process of problem solving.

Judging from the test methods, there are both closed tests in the form of multiple-choice questions and Likert scale, and open tests in the form of questions and answers and compositions. Relatively speaking, closed testing requires less evaluation environment, is simple to operate, can obtain rich data in a short time, is easy to use on a large scale, and has high reliability and validity. However, the closed question is difficult to clarify the reasons why learners choose an option, and it can't fully reveal the learners' thinking process, so the evaluation results may lack comprehensiveness. Open assessment can provide students with more space to play, and reveal their thinking process to a certain extent. Paying attention to the assessment of writing ability, decision-making, problem-solving, etc., can evaluate college students' critical thinking more deeply, but it is limited to the requirements of the assessment environment, so it is difficult to carry out tests on a large scale, and it is difficult to effectively control the reliability and validity due to the influence of testers and objects during the testing process. However, overall, the evaluation of

college students' critical thinking ability will pay more attention to open testing and emphasize the connection with the real world (Lai, E.R., 2011).

In a word, critical thinking assessment is not only an important link in the process of cultivating critical thinking, but also an important basis for verifying the effectiveness of cultivating critical thinking ability. Therefore, it is necessary to scientifically design critical thinking assessment tools for college students according to the purpose of researchers, the teaching environment, and the actual situation of teaching objects.

Related research

1. Blended teaching and deep Learning

The Outline of the National Medium-and Long-Term Education Reform and Development Plan (2010-2020) (China) points out: "We should pay attention to the combination of learning and thinking, advocate heuristic, inquiry, discussion and participatory teaching, and help students learn how to learn", which reflects China's fundamental demand for deepening education and teaching reform and improving education and teaching quality in the new era. *China's Education modernization 2035* proposes to "speed up the educational reform in the information age. Build an intelligent campus and make overall plans to build an integrated intelligent teaching, management and service platform. Use modern technology to accelerate the reform of talent training model and realize the organic combination of large-scale education and personalized training". Undoubtedly, blended teaching is one of the key points for colleges and universities to use information technology to improve classroom teaching quality and build high-level undergraduate education in the new era. With the integration of "before-during-after-class" blended teaching model gradually becoming the mainstream of teaching reform in colleges and universities, how to systematically design blended teaching and make it play a greater role in promoting college students' thinking development and ability improvement has become the focus of the theory and practice of blended teaching. In addition, due the deep integration of blended teaching and information technology, the combination of deep learning and blended teaching becomes a reality. In other words, we should actively construct the blended teaching model in colleges and universities under the guidance of the deep learning concept and theory. Studies have shown that moving

from "shallow learning" to "deep learning" is a necessary way to improve the teaching quality in colleges and universities, and "blended teaching" provides methods and technical support for the realization of deep learning (Tan, 2019). In essence, blended teaching is not a physical "mix-and-match" of various online and offline teaching elements, but a chemical "fusion" with the aim of achieving the optimal deep learning effect (Liu et al., 2020). From the perspective of teaching philosophy, blended teaching model is a kind of teaching model based on one or more learning theories, which is supported by intelligent technology to realize online and offline integration and interaction, and promote students' deep learning. From the perspective of students' learning, blended teaching is the product of educational informatization, which mainly faces the process of students' deep learning and blended learning (Ma, 2019).

Some scholars believe that under the background of the surging new technological revolution, promoting the high-quality development of education has become the basic direction of China's educational development, which requires us to think deeply about the changes of the relationship between teaching and learning, teachers and students, to innovate the traditional educational and teaching ideas, to integrate information technology with professional construction, to integrate with talent training, to serve the new forms of curriculum development, teaching design, teaching implementation and teaching evaluation, and to better meet the needs of deep learning, personalized learning and blended teaching (Ren, 2022). From the perspective of peer feedback, some scholars have constructed a peer feedback framework to promote deep learning in blended teaching. The research found that peer feedback can promote the development of students' cognition, ability and emotional level, and trigger students' deep learning (Wang et al., 2021). By introducing the theory of deep learning, some scholars have constructed a "3*3 blended learning model" for deep learning from three levels: knowledge mastery, ability cultivation and emotional experience, including pre-class, in-class and after-class, and carried out three rounds of action research. The research results show that this model can significantly promote learners' knowledge mastery and ability cultivation, give learners a good emotional experience and effectively promote learners' deep learning (Huang et al., 2019). Based on revealing the "shallow" problem of blended teaching in colleges and universities, some scholars put forward the

blended teaching design based on four core elements: situation, interaction, experience and reflection, through the interpretation of the concept of deep learning (Li & Gao, 2021).

In a word, blended teaching advocates taking advantage of the information advantages of the Internet, giving full play to the role of teachers in guiding, inspiring and monitoring, while fully tapping the initiative, enthusiasm and creativity of students as subjects in the learning process. Its core is to pass on "appropriate" abilities to "appropriate" learners through the combination of "appropriate" learning techniques and "appropriate" learning styles at the appropriate time. While deep learning includes three stages of "information, method and cognition", following the life course of "knowledge acquisition (superficial understanding)-skill development (reflective and critical ability)-deep learning (concept formation, problem solving and innovative use)". Through the in-depth analysis of blended teaching and deep learning, it can be found that blended teaching and deep learning are closely in line with each other in the aspects of goal pursuit, activity process and learning process, etc. They depend on each other and help each other, which makes it possible to improve the teaching effect.

2. Blended teaching and cultivation of college students' critical thinking

At present, the deep integration of information technology and education has become a new trend of world education development. The rapid development of information technology based on Internet, big data, blockchain and artificial intelligence is shaping the pattern of education all the time, bringing new application scenarios and technical support to education and teaching. Blended teaching is the product of the integration of information technology and teaching, which brings a new idea, new thinking and new model to teaching. As far as college education is concerned, teaching is an important way to cultivate college students' thinking. Therefore, with the development and practice of blended teaching in colleges and universities, the cultivation of college students' critical thinking by blended teaching has attracted the attention of scholars for a long time, and the corresponding research has been carried out. Jeong (2003) investigated the situation of group interaction and critical thinking through online discussion, so as to determine which interaction form can promote the development of learners' critical thinking. Lee (2004) explored the promotional effect of individual learning and online collaborative

case study on undergraduates' critical thinking. He found that well-designed online collaborative case study can effectively improve undergraduates' critical thinking skills. Participating in online collaborative case study has developed students' higher-order thinking, reasoning skills, interpersonal skills, writing skills and various self-monitoring abilities. Wu (2014) used the quasi-experimental research method to explore the blended instructional design and its application effect. The results show that the blended instructional design based on problem-solving strategies can not only improve the critical thinking skills of college students, but also enhance their critical thinking tendency. The latest research also shows that the use of digital tools can have a positive impact on students' critical thinking (Akylbek Meirbekov et al., 2022). Using digital tools can help students develop their ability to set realistic goals, self-control, self-reflection, self-awareness, and collaboration (Saadati et al., 2021). In other words, blended teaching plays a positive role in improving students' self-regulation, self-control and personal responsibility. The online part of students' learning is mainly self-paced learning, and teachers often only stipulate learning objectives, tasks and deadlines. The whole learning process arrangement and learning methods and steps depend on students' own planning and regulation. In this way, blended teaching makes up for the shortcomings of both traditional classroom teaching and pure online teaching, which can make students' learning more effective and is more conducive to the cultivation of students' critical thinking.

Undoubtedly, the cultivation of college students' critical thinking needs to adopt more effective teaching methods. In other words, some teaching methods have been proved to be more conducive to the cultivation of college students' critical thinking. An American scholar summed up some effective ways to teach critical thinking through his own experience of teaching critical thinking to college students for more than 30 years. He believes that the cultivation of critical thinking ability should be integrated into specific subject courses. Of course, this must first ensure that teachers and students in different disciplines have a unified understanding of critical thinking. On this basis, he pointed out that social learning (group collaborative learning), critical discussion, critical reading and critical writing are more effective in cultivating critical thinking (Brookfield, 2017).

Chapter 3
Research Methodology

The methodology of this research was research and development (R&D). The research objectives were: 1) to investigate the current situation of college students' critical thinking in Guangxi Normal University. 2) to develop the blended teaching model based on deep learning theory to enhance college students' critical thinking. 3) to access the efficiency of the blended teaching model based on deep learning theory through comparing the college students' critical thinking ability before and after the implementation of teaching model.

There were 3 steps of research process: step 1 is the investigating the current situation of college students' critical thinking in Guangxi Normal University (OB1); step 2 is the development of the blended teaching model based on deep learning theory to enhance college students' critical thinking (OB2) and step 3 is the assessment the efficiency of the blended teaching model based on deep learning theory through comparing the college students' critical thinking ability before and after the implementation of teaching model (OB3) .

The details of this chapter were presented as follows.

Step 1 The investigating the current situation of college students' critical thinking in Guangxi Normal University.

The Population / The Sample Group

The Population

The population comprises approximately 7,000 sophomore students at Guangxi Normal University during the first semester of the academic year 2023.

The Sample Group

The sample group consists of 400 sophomores who participated in the questionnaire survey, used Krejcie and Morgan's table (Krejcie, R.V.and Morgan D.W., 1970) and were selected from the population of 7,000 sophomores at Guangxi Normal University in the first semester of the 2023 academic year. The sample group was selected based on purposive sampling, as shown in the following table 3.1.

Table 3.1 the sample group

Level	Major	Population	Sample
2nd year	liberal arts	3850 students	228 students
	Science and engineering	3150 students	172 students
	Total	7,000 students	400 students

Research Tools

Instruments

College Students' Critical Thinking Disposition Questionnaire.

The questionnaire reliability is found out by coefficient of Cronbach's (α) and its value is 0.83.

The development process of research tools

1) Studied about characteristics of college students' critical thinking.

2) Drafted the College Students' Critical Thinking Disposition Questionnaire. The questionnaire was designed using the 7-point Likert Scale format, from "strongly disagree" to "strongly agree", with a total of 7 levels, as follows:

Strongly disagree =1

Not agree=2

Not quite agree=3

Uncertainty=4

somewhat agree=5

Agree =6

Strongly agree=7

3) Verified/Checked the constructive validity of the College Students' Critical Thinking Disposition Questionnaire by the 3 professional scholars (List name in Appendix A) included curriculum and instruction exper, humanist specialist and psychology specialist through Index of Item-Objective Congruence (IOC) according to the criteria shown below.

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

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

-1 = The contents are not related to the topics

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

Studying process

1. Collected data about present situation of college students' critical thinking from 400 sophomores of Guangxi Normal University by using College Students' Critical Thinking Disposition Questionnaire.

2. Analyzed data about college students' critical thinking of Guangxi Normal University by finding frequency, percentage, mean and standard deviation. The researcher proposed a hierarchical classification of data analysis results in order to understand each other when providing the following information.

Criteria for research result interpreted

Scoring 1.00-1.50 means Very poor

Scoring 1.51-2.50 means Poor

Scoring 2.51-3.50 means Quite poor

Scoring 3.51-4.50 means Common

Scoring 4.51-5.50 means Good

Scoring 5.51-6.50 means Very Good

Scoring 6.51-7.00 means Excellent

3. Concluded and used to develop instructional model.

Step 2 The development of the blended teaching model based on deep learning theory to enhance college students' critical thinking.

Population: 3 expertise

Teaching model development: blended teaching model based on deep learning theory to enhance college students' critical thinking is developed as followed.

1. Determination of the components of the teaching model

1.1 Study, analyze and synthesize current situations in education management to promote critical thinking, then synthesize into information for teaching model development.

1.2 The synthesis of educational philosophies related to the promotion of critical thinking is linked to the current situation in education management to promote critical thinking.

1.3 Formulation of related theoretical concepts by studying and compiling ideas about relevant theoretical concepts, in this case, Blended teaching, Deep Learning Theory and Critical thinking.

1.4 Formulation of basic concepts of teaching model by analyzing the current situation in education management to promote critical thinking, educational philosophy and related theoretical concepts are synthesized into the basic concepts of the teaching model.

1.5 Determination of components of teaching model by analyzing the current situation in education management to promote critical thinking, educational philosophy related theoretical concepts and basic concepts of the teaching model and then synthesized them into components of the teaching model, principles, objectives, scope, teaching and learning activities, media, and evaluation.

2. Creating a teaching model

2.1 Take the elements of the teaching style that have been implemented in Step 1 to create a relationship with the teaching model and present it in the form of a teaching model chart.

2.2 Prepare a presentation document detailing each element of the teaching model by creating a presentation document of the teaching model.

2.3 Teachers are the embodiment of teaching style. Teachers' ability, quality and overall grasp of teaching environment, teaching resources and teaching elements are very important to the development of teaching model. We should fully understand and effectively grasp the influence of teachers' roles in the development of teaching model.

3. Documentation of the Teaching model by producing documents related to the teaching style is a teaching style manual

4. Examination of the quality of the teaching model by bringing various documents, including teaching model presentation document, supporting documents for the teaching model for experts to review, edit, and make suggestions.

5. Improvement of teaching model and documentation of the teaching model by taking the information obtained from the revision and recommendation of the experts to consider and improve in order to obtain a complete teaching style and documentation of the teaching model.

6 Assess the validity of the instructional model by 3 experts (List name in Appendix A) through Item-Objective Congruence (IOC) according to the criteria as shown below.

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

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

-1 = The contents are not related to the topics

The acceptable items must have the IOC values not less than 0.5. The IOC calculated from the validation measures 0.92.

Step 3 The assessment the efficiency of the blended teaching model based on deep learning theory through comparing the college students' critical thinking ability before and after the implementation of teaching model.

1. The Population / The Sample Group

1.1 The Population

The population comprises approximately 7,000 sophomore students at Guangxi Normal University during the first semester of the academic year 2023.

1.2 The Sample Group

The sample group comprises 50 sophomores who participated in a quasi-teaching experiment, Cluster random sampling selected from the 400 students who had previously taken part in the survey.

2. Research Tools

2.1 Instruments

1) Lesson plan according to the Blended Teaching model based on Deep Learning Theory.

2) Examination Paper of College Students' Critical Thinking Ability (P, r and KR-20 meet the requirements).

2.2 The process of development the research tools

1) Studied the instructional model.

2) Determined lesson plans elements:(1) concept;(2) contents;(3) learning processes, according to learning process of instructional model;(4) learning resources; and (5) evaluation and developed the lesson plans.

3) Drafted the Examination Paper of College Students' Critical Thinking Ability.

To study the difficulty, discrimination, and reliability of the examination paper, the researcher conducted a test involving 30 students to analyze the overall quality of the paper. The trial test, managed by the researcher with a class of 30 students, aimed to confirm the difficulty, discrimination, and reliability of the examination paper. The B-Index was used for analysis, revealing that the difficulty of the test items (p) ranged between 0.27 and 0.60. The power of discrimination (r) indicated item quality between 0.35 and 0.77. Furthermore, the reliability of the examination paper, assessed using KR-20, was found to be 0.96.

4) Verified /Checked the constructive validity of the lesson plan of the blended teaching model and the examination paper by the 3 professional scholars included curriculum experts from Thailand and modify according to suggestion.

5) Assess the validity of the lesson plan and the examination paper by 3 experts (List name in Appendix A) through Item-Objective Congruence (IOC) according to the criteria as shown below.

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

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

-1 = The contents are not related to the topics

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

3. Experimental and improvement process

3.1 Before using the teaching model, the undergraduates of Guangxi Normal University were tested by the Self-edited *Examination Paper of College Students' Critical Thinking Ability*.

3.2 Undergraduates of Guangxi Normal University developed the critical thinking ability by using the blended teaching model, five teaching plans are adopted, with 20 class hours, 5 weeks, and 180 minutes per week.

3.3 Researcher observe and interview undergraduates of Guangxi Normal University about the activities and gained after learning from lesson plan according to the instructional model.

3.4 Undergraduates of Guangxi Normal University were tested after using instructional model through the Self-edited *Examination Paper of College Students' Critical Thinking Ability.*

3.5 Analyzed data and improved instructional model according to data. By comparing the average and standard deviation of students' critical thinking ability scores before and after participating in the teaching experiment, and using t-test to verify whether there is a significant difference between pre-test and post-test scores, and on this basis to judge the effectiveness of the blended teaching model.

Chapter 4
Results of Analysis

The methodology of this research was research and development (R&D). The purpose of the research is: 1) to investigate the current situation of college students' critical thinking in Guangxi Normal University. 2) to develop the blended teaching model based on deep learning theory to enhance college students' critical thinking. 3) to access the efficiency of the blended teaching model based on deep learning theory through comparing the college students' critical thinking ability before and after the implementation of teaching model.

There were 3 steps of research process: step 1 is the investigating the current situation of college students' critical thinking in Guangxi Normal University; step 2 is the development of the blended teaching model based on deep learning theory to enhance college students' critical thinking and step 3 is the assessment the efficiency of the blended teaching model based on deep learning theory through comparing the college students' critical thinking ability before and after the implementation of teaching model.

Symbol and abbreviations

F   represents frequency

%   represents percentage

$\overline{X}$ represents for average value

S.D.   represents for standard deviation

df   represents the degree of freedom

t-test represents for t-test for dependent sample test.

Results of Data analysis

Result of Step 1 Analysis results to investigate the current situation of college students' critical thinking in Guangxi Normal University.

There are 3 parts to present analysis results using table and description as well as mean, standard deviation, interpretation (Level of Critical Thinking), and ranking of all factors in overview. After that, items of all dimensions are presented likewise.

1. Present Study Participants

The 400 sophomores from Guangxi Normal University participated in the survey in the semester 1 academic year 2023.

Table 4.1 Frequency and percentage of Common data of the respondent in overall

(n=400)

Common data of the respondents	Frequency	Percentage(%)
Gender		
1. Male	78	19.50
2. Female	322	80.50
Total	**400**	**100.00**
Major		
1. liberal arts	228	57.00
2. Science and engineering	172	43.00
Total	**400**	**100.00**
Nationality		
1. Han Nationality	276	69.00
2. minority nationality	124	31.00
Total	**400**	**100.00**
Education level of parents		
1. One parent has received higher education.	81	20.25
2. Both parents have received higher education	44	11.00
3. Neither parent has received higher education.	275	68.75
Total	**400**	**100.00**

From Table 4.1, the common data of the respondent in overall shows that most of the respondents are female, representing 80.50 percent of the total. From the perspective of majoring, it is relatively balanced, and the respondent of liberal arts is slightly higher, accounting for 57.00 percent. From the perspective of nationality, the respondent of Han nationality is relatively high, accounting for 69.00 percent. From the perspective of education level of parents, the respondent of

neither parent has received higher education is relatively high, accounting for 68.75 percent.

2. The result of questionnaire on college students' critical thinking in overview

The researcher proposed a hierarchical classification of data analysis results to understand each other when providing the following information. There are 7 dimensions in Critical thinking measurement presentation as table 4.2 - 4.8.

Table 4.2 Mean and standard deviation of data analysis on college students' critical thinking in seeking truth

Seeking truth	$\overline{\text{X}}$	S.D.	Interpret	Ranking
1. If there are four reasons to agree with something and only one reason to oppose it, students will choose to agree with it.	3.66	1.45	Common	5
2. Even if there is evidence that doesn't agree with students' idea, students will stick to their idea.	4.26	1.38	Common	4
3. It is impossible to be objective when students express their opinions.	4.68	1.50	Good	2
4. Students will only look for some facts that support their opinion, not some facts that oppose their opinion.	4.91	1.60	Good	1
5. Students don't know what standard should be used to measure most problems.	4.37	1.55	Common	3
Total	**4.38**	**1.56**	**Common**	

From Table 4.2, the general performance of college students' critical thinking level in Seeking truth is Common ($\overline{\text{X}}$ = 4.38). Considering each item separately, it is found that Student will only look for some facts that support his opinion, not some facts that oppose his opinion is the highest rank which is in the Good level ($\overline{\text{X}}$ =4.91),

followed by It is impossible to be objective when student expresses his opinion ($\overline{X}$ = 4.68), while If there are four reasons to agree with something and only one reason to oppose it, students will choose to agree with it is the lowest ($\overline{X}$ =3.66).

Table 4.3 Mean and standard deviation of data analysis on college students' critical thinking in openness

Openness	$\overline{X}$	S.D.	Interpret	Ranking
1. It's important for students to know what other people think about things.	5.33	1.28	Good	2
2. Students are trying to make less subjective judgments.	4.60	1.39	Good	5
3. Foreigners should learn Chinese culture, not ask Chinese to know their culture.	5.52	1.37	Very good	1
4. It's not that important to be open to different world views (e.g. evolution, theism).	5.08	1.56	Good	3
5. Everyone has the right to express their opinions, but students will ignore them.	4.89	1.57	Good	4
Total	**5.08**	**1.48**	**Good**	

From Table 4.3, the general performance of college students' critical thinking level in openness is good ($\overline{X}$ = 5.08). Considering each item separately, it is found that foreigners should learn Chinese culture, not ask Chinese to know their culture is the highest rank which is in the very good level ($\overline{X}$ =5.52), followed by It's important for students to know what other people think about things ($\overline{X}$ = 5.33), while Student is trying to make less subjective judgments is the lowest ($\overline{X}$ =4.60).

Table 4.4 Mean and standard deviation of data analysis on college students' critical thinking in analyticity

Analyticity	$\overline{X}$	S.D.	Interpret	Ranking
1. All students' beliefs must be supported by evidence.	5.09	1.38	Good	1
2. Students are logical persons.	5.01	1.09	Good	3
3. Students are good at dealing with problems in an orderly way.	5.02	1.10	Good	2
4. Students are not very logical persons, but students often pretend to be logical.	4.67	1.35	Good	5
5. When encountering problems, it is impossible to know which one is the better solution.	4.92	1.43	Good	4
Total	**4.94**	**1.29**	**Good**	

From Table 4.4, the general performance of college students' critical thinking level in analyticity is good ($\overline{X}$ = 4.94). Considering each item separately, it is found that all students' beliefs must be supported by evidence is the highest rank which is in the good level ($\overline{X}$ =5.09), followed by students are good at dealing with problems in an orderly way ($\overline{X}$ =5.02), while students are not very logical persons, but students often pretend to be logical is the lowest ($\overline{X}$ =4.67).

Table 4.5 Mean and standard deviation of data analysis on college students' critical thinking in systematization

Systematization	$\overline{X}$	S.D.	Interpret	Ranking
1. Students always analyze the key point of the question before they answer it.	5.25	1.09	Good	1
2. Students can easily organize their thoughts.	4.61	1.16	Good	4
3. Students are good at planning a systematic plan to solve complex problems.	4.64	1.21	Good	3
4. Students often think about right and wrong in practice and experience.	5.15	1.16	Good	2
5. People think that students hesitate when making decision.	3.71	1.49	Common	5
Total	**4.67**	**1.35**	**Good**	

From Table 4.5, the general performance of college students' critical thinking level in systematization is good ($\overline{X}$ = 4.67). Considering each item separately, it is found that students always analyze the key point of the question before they answer it is the highest rank which is in the good level ($\overline{X}$ =5.25), followed by students often think about right and wrong in practice and experience ($\overline{X}$ = 5.15), while people think that students hesitate when making a decision is the lowest ($\overline{X}$ =3.71).

Table 4.6 Mean and standard deviation of data analysis on college students' critical
thinking in self-confidence

self-confidence	$\overline{\text{X}}$	S.D.	Interpret	Ranking
1. Students appreciate their ability to think accurately.	4.33	1.31	Common	2
2. Tests that require thinking rather than answering by memory are more suitable for students.	4.59	1.43	Good	1
3. Students' curiosity and thirst for knowledge are appreciated by others.	4.30	1.21	Common	4
4. When faced with problems, because students can make an objective analysis, their peers will come to them to make decision.	4.14	1.34	Common	5
5. When making decision, others expect students to formulate appropriate guidelines for guidance.	4.31	1.28	Common	3
Total	**4.33**	**1.33**	**Common**	

From Table 4.6, the general performance of college students' critical thinking
level in self-confidence is common ($\overline{\text{X}}$ = 4.33). Considering each item separately, it is
found that tests that require thinking rather than answering by memory are more
suitable for students is the highest rank which is in the good level ($\overline{\text{X}}$ =4.59), followed
by students appreciate their ability to think accurately ($\overline{\text{X}}$ = 4.33), while when faced
with problems, because students can make an objective analysis, their peers will
come to them to make a decision is the lowest ($\overline{\text{X}}$ =4.14).

Table 4.7 Mean and standard deviation of data analysis on college students' critical
thinking in thirst for knowledge

Thirst for knowledge	$\overline{X}$	S.D.	Interpret	Ranking
1. Studying new things can enrich students' life.	5.60	1.01	Very good	1
2. Before facing an important choice, students will try their best to collect all relevant information.	5.55	0.96	Very good	2
3. Solving difficult problems is fun.	5.14	1.19	Good	3
4. Students like to find out how things work.	5.06	1.23	Good	4
5. Students will try to learn everything, even if they don't know when they are useful.	4.69	1.38	Good	5
Total	**5.21**	**1.21**	**Good**	

From Table 4.7, the general performance of college students' critical thinking
level in thirst for knowledge is good ($\overline{X}$ = 5.21). Considering each item separately, it is
found that studying new things can enrich students' life is the highest rank which is in
the very good level ($\overline{X}$ =5.60), followed by before facing an important choice,
students will try their best to collect all relevant information ($\overline{X}$ =5.55), while
students will try to learn everything, even if they don't know when they are useful is
the lowest ($\overline{X}$ =4.69).

Table 4.8 Mean and standard deviation of data analysis on college students' critical thinking in cognitive maturity

Cognitive maturity	$\overline{X}$	S.D.	Interpret	Ranking
1. The best arguments often come from the instant feeling of a certain problem.	3.10	1.33	Quite poor	5
2. The so-called truth is nothing more than personal opinions.	4.43	1.66	Common	3
3. Students firmly believe in what they believe.	4.28	1.41	Common	4
4. The best way to solve difficult problems is to ask others for answers.	5.20	1.33	Good	2
5. Decisions made by powerful people are correct decisions.	6.16	1.16	Very good	1
Total	**4.63**	**1.72**	**Good**	

From Table 4.8, the general performance of college students' critical thinking level in cognitive maturity is good ($\overline{X}$ = 4.63). Considering each item separately, it is found that decisions made by powerful people are correct decisions is the highest rank which is in the very good level ($\overline{X}$ =6.16), followed by the best way to solve difficult problems is to ask others for answers ($\overline{X}$ =5.20), while the best arguments often come from the instant feeling of a certain problem is the lowest ($\overline{X}$ =3.10). As the data analysis result shown above, it can be concluded about college students' critical thinking disposition from different dimensions as the table 4.9.

Table 4.9 Mean and standard deviation of data analysis on college students' critical thinking disposition from different dimensions overall.

Critical thinking disposition	$\overline{X}$	S.D.	Interpret	Ranking
1. Seeking truth (item1-5)	4.38	1.56	Common	6
2. Openness (item6-10)	5.08	1.48	Good	2
3. Analyticity (item11-15)	4.94	1.29	Good	3
4. Systematization (item16-20)	4.67	1.35	Good	4
5. Self-confidence (item21-25)	4.33	1.33	Common	7
6. Thirst for knowledge(item26-30)	5.21	1.21	Good	1
7. Cognitive maturity (item31-35)	4.63	1.72	Good	5
Total	4.75	1.46	Good	

From Table 4.9, college students' critical thinking level is generally good ($\overline{X}$ =4.75), and showing a relatively balanced state in seven dimensions. Considering each dimension separately, thirst for knowledge is the highest rank which is in the good level ($\overline{X}$ =5.21), followed by openness ($\overline{X}$ =5.08), while self-confidence is the lowest ($\overline{X}$ =4.33).

Result of Step 2 Analysis results to develop the blended teaching model based on deep learning theory to enhance college students' critical thinking.

The analysis result of this step is related information about the construction of the blended teaching model based on deep learning theory.

The blended teaching model based on Deep Learning Theory

After investigating the current situation of college students' critical thinking in Guangxi Normal University and studying Deep learning theory, the blended teaching model was constructed and was considered by three experts. The detail of the Blended Teaching Model based on Deep Learning Theory is presented as follows:

1. principle

Deep learning is a meaningful learning process, which can promote students' higher-order thinking. It requires that teaching design should be based on theme-based design, guide students to learn cooperatively and independently, and

be able to talk to textbooks, students and themselves through online and offline. The specific principles are as follows:

(1) Student center: put students at the core of learning, encourage them to actively participate and explore, and stimulate their autonomous learning ability.

(2) Practice-oriented: Through practical cases, problems and challenges, students can apply critical thinking skills to real-world situations.

(3) Cooperative learning: encourage cooperation, discussion and knowledge sharing among students to promote mutual interaction and learning.

(4) Technology integration: using technology tools and online resources to provide students with more learning opportunities and personalized learning experiences.

2.Objectives

This model aims to enhance college students' critical thinking, specific as follows.

Understand the essence, characteristics, and composition of critical thinking.

(1) Guide students to establish the spiritual qualities of critical thinking such as Seeking truth, openness, Analytical, Systematization, self-confidence, thirst for knowledge and Cognitive maturity.

(2) Cultivate students' critical thinking abilities, which include understanding of critical thinking, analyzing ability, reasoning ability, identifying implicit assumption's ability, evaluating arguments ability, decision-making ability, self-monitoring and reflective ability.

(3) Cultivate students' teamwork and discussion skills.

(4) Cultivate students' critical reading and writing skills.

3. Learning Process
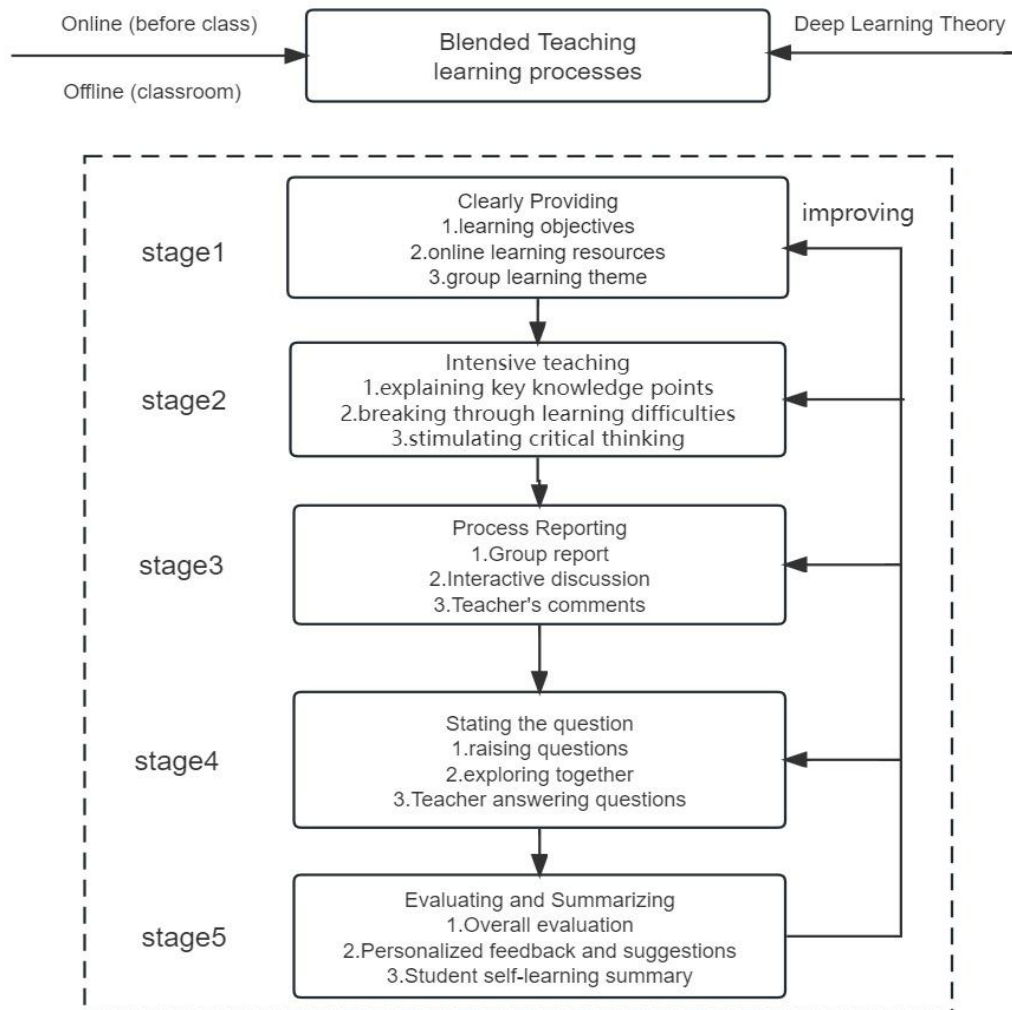
Figure 4.1 "CIPSE" blended teaching model based on deep learning theory

Stage 1 Clearly providing: guide students to understand the learning requirements and evaluation criteria, and conduct autonomous learning through online mode, so as to have a preliminary perception of the learning content of each unit, and record the doubts and difficulties in learning, so that offline classes can continue to discuss the learning content more deeply, and at the same time clearly provide students to the ways, objectives and basic requirements of group cooperative learning.

(1) Learning objectives. Provide clear learning objectives and learning requirements to ensure that students understand the core concepts and skills of the course.

(2) Online learning resources. The provision of online learning resources in blended teaching should be carefully selected according to learning objectives and unit teaching contents, reflecting the principles of personalized support, diverse content, interaction, easy access, and real-time update, aiming at promoting students' deep learning and cultivating critical thinking. Based on the teaching plan and content requirements of the course Critical Thinking Training, this study selected the relevant contents of an online course Critical Thinking on the platform of Zhihui Shu and an online course Logical Thinking and Writing on the platform of Learning to be a powerful country and picked out the materials in units as compulsory online courses for students' unit learning. Students' online learning data can be saved through online teaching platforms, and teachers can monitor students' learning situation and give timely feedback.

(3) Group learning theme. Delineate groups, each group is responsible for studying a specific learning theme and requires each group to carry out interactive learning and in-depth discussion.

Stage 2 Intensive teaching: in the initial stage of classroom teaching, teachers explain important knowledge points and difficulties clearly and thoroughly, but don't talk or talk less about general easy-to-understand knowledge points, so as to improve the efficiency and pertinence of teaching. The teacher first explains the key knowledge points of each unit's learning content to ensure that students have a clear understanding of the basic concepts and core content. Then, by breaking through the learning difficulties, help students overcome the problems and difficulties, so that they can build a deeper understanding on the basic knowledge. Finally, by stimulating critical thinking, students are encouraged to think and analyze deeply on the basis of existing knowledge, so as to improve their critical thinking.

(1) Explain key knowledge points. Through in-depth explanation, teachers explain important concepts, improve students' understanding and mastery of key contents, help students establish a solid learning foundation, and lay a solid foundation for further study.

(2) Break through learning difficulties. Through targeted explanation, guidance and counseling, teachers help students overcome the problems and difficulties encountered in learning, improve learning efficiency, and enhance students' confidence and ability in learning.

(3) Stimulate critical thinking. Provide case analysis and practical problems to stimulate students' interest and trigger critical thinking.

Stage 3 Process Reporting: The study group reports the process, content and reflection of theme learning to the whole class. Each study unit arranges two study groups to report to the whole class, and other students in the class can ask questions about the content of the group report for interactive learning. This process mainly includes the following three steps.

(1) Group report. Arrange study groups to report and share their learning process, main findings and critical thinking through PPT.

(2) Interactive discussion. After PPT presentation other students can ask questions, express their opinions and have an interactive discussion.

(3) Teacher's comments. Teachers act as guides, encourage in-depth thinking and critical evaluation, and help students broaden their horizons and understand different viewpoints.

Stage 4 Stating the question: Students sort out the difficulties and challenges encountered in online learning and send them to the intelligent learning platform. Teachers organize discussions to guide students to solve difficulties and challenges in learning together.

(1) Raising questions. Students will record the difficulties and challenges encountered in the online learning process and submit them to the intelligent learning platform or online discussion forum.

(2) Exploring together. Teachers organize discussions among students and encourage them to help each other and solve the difficulties and challenges submitted.

(3) Teacher answering questions. Teachers provide targeted guidance and solutions to guide students to think and try to solve problems.

Stage 5 Evaluating and Summarizing: Teachers evaluate and summarize online learning and classroom learning and ask students to personally summarize the online and offline learning effects in this unit's theme learning, so as to evaluate and reflect on the learning process.

(1) Overall evaluation. Teachers summarize and evaluate students' online learning and classroom learning performance, including learning achievement, participation and critical thinking ability.

(2) Personalized feedback and suggestions. Teachers provide personalized feedback and suggestions to help students further develop and enhance their critical thinking ability.

(3) Student self-learning summary. Teachers require students to write a written summary of this topic study, including a review of the learning process, an assessment of their critical thinking ability, reflections on difficulties and challenges, and plans and goals for future study.

4 Results

Through the blended teaching based on deep learning, learners can learn the content of related topics more deeply and meaningfully, and improve their critical thinking ability, detailed as follows:

(1) Students can have a deeper understanding of critical thinking.

(2) Students can better analyze problems.

(3) Students are able to better give reasoning.

(4) Students can better identify implicit assumptions.

(5) Students can better evaluate arguments.

(6) Students have better decision-making ability.

(7) Students have better self-monitoring and reflective ability.

The result of Step 3 Analysis results to assess the efficiency of the blended teaching model based on deep learning theory through comparing the college students' critical thinking ability before and after the implementation of teaching model.

1. Present study participants

50 sophomores from Guangxi Normal University participated in a teaching experiment during the first semester of the academic year 2023.

3.2 Present Results of the teaching experiment

Table 4.10 Common data of participants in teaching experiment

(n=50)

Common data of the participants	Frequency	Percentage(%)
Gender		
1. Male	15	30.00
2. Female	35	70.00
Total	**50**	**100.00**
Major		
1. liberal arts	28	56.00
2. Science and engineering	22	44.00
Total	**50**	**100.00**
Nationality		
1. Han Nationality	37	74.00
2. minority nationality	13	26.00
Total	**50**	**100.00**
Education level of parents		
1. One parent has received higher education.	14	28.00
2. Both parents have received higher education	5	10.00
3. Neither parent has received higher education.	31	62.00
Total	**50**	**100.00**

From Table 4.10, most of the participants in the teaching experiment are female, accounting for 70 percent of the total. From the perspective of majoring, relatively balanced, liberal arts participants are slightly higher, accounting for 56 percent. From the perspective of nationality, the Han participants are relatively high, accounting for 74 percent. Judging from the education level of parents, the number of participants who neither parent has received higher education is relatively high, accounting for 62 percent.

Table 4.11 Comparison of pre-test and post-test results of college students'
critical thinking ability in every dimension and total

Critical Thinking Ability	Pre-test		Post-test	
	$\overline{X}$	S.D.	$\overline{X}$	S.D.
1.Understanding of critical thinking (total 5 points)	3.56	0.58	4.70	0.58
2. Analyzing ability (total 5 points)	3.16	0.87	3.68	0.68
3. Reasoning ability (total 5 points)	3.52	0.86	3.74	0.69
4. Identifying implicit assumption ability (total 5 points)	3.08	1.03	3.60	0.70
5. Evaluating arguments' ability (total 5 points)	3.04	0.70	3.64	0.60
6. Decision-making ability (total 5 points)	3.80	0.53	4.84	0.37
7. Self-monitoring and reflective ability (total 5 points)	3.64	0.56	4.52	0.68
Total	3.40	0.76	4.10	0.68

From Table 4.11, total of college students' critical thinking ability has made great progress, mean from 3.40 ($\overline{X}$=3.40) in the pre-test to 4.10 ($\overline{X}$=4.10) in the post-test. From each specific dimension, the average score of post-test has all made obvious progress compared with the pre-test, among which understanding of critical thinking has made the greatest progress, while reasoning ability is the smallest. Judging from the pre-test data, it is found that decision-making ability is the highest ($\overline{X}$=3.80), followed by self-monitoring and reflective ability ($\overline{X}$=3.64), while evaluating arguments' ability is the lowest ($\overline{X}$=3.04). From the post-test data, it is found that decision-making ability is the highest ($\overline{X}$=4.84), followed by understanding of critical thinking ($\overline{X}$=4.70), while identifying implicit assumption ability is the lowest ($\overline{X}$=3.60).

Table 4.12 t-test for pre-test and post-test scores of college students' critical thinking
ability

(n=50)

	critical thinking ability	$\overline{X}$	S.D.	df	t	Sig.
1	Pre-test	3.40	0.76	49	27.631**	.000
2	Post-test	4.10	0.68			

**represents statistical significance at .01 level

      From Table 4.12, there are statistic significant differences at .01 level between
the pre-test and post-test overall scores of college students' critical thinking ability
(t=27.631, p=0.000<0.01), in which the mean of the pre-test scores is 3.40 and the
mean of the post-test scores is 4.10.

Chapter 5
Conclusion, Discussion and Recommendations

Critical thinking is one of the core qualities of talents in the 21st century, therefore enhancing college students' critical thinking has become an important goal of talent training in universities. Based on the above considerations, this study "The Development of Blended Teaching model Based on Deep Learning Theory to Enhance college students' critical thinking" is specially constructed. The purposes of the study are 1) to investigate the current situation of college students' critical thinking in Guangxi Normal University; 2) to develop the blended teaching model based on Deep Learning Theory to enhance college students' critical thinking; and 3) to access the efficiency of the blended teaching model based on deep learning theory through comparing the college students' critical thinking ability before and after the implementation of teaching model.

To achieve the expected results, this study first sampled 400 sophomores of Guangxi Normal University, and then selected 50 of them to enter the teaching experiment. The research tools of this study include (1) College Students' Critical Thinking Tendency Questionnaire; (2)"CIPSE" Blended Teaching model; (3) Examination Paper of College Students' Critical Thinking Ability, by finding f, %, $\overline{X}$, SD, df and t-test for data analysis. The conclusion, discussion and recommendations of this study are as follows:

Conclusion

In the study of "The Development of Blended Teaching model Based on Deep Learning Theory to Enhance college students' critical thinking", the research results are as follow:

1. College students' critical thinking level is good ($\overline{X}$ = 4.75). From the seven specific dimensions of critical thinking tendency, thirst for knowledge is the highest rank which is in the Good level ($\overline{X}$ =5.21), followed by Openness ($\overline{X}$ =5.08), while self-confidence is the lowest ($\overline{X}$ =4.33).

2. This study has developed a blended teaching model based on Deep Learning Theory named the "CIPSE" model. The "CIPSE" stands for the abbreviation of a five-stage teaching method employed during the instructional process: Clearly Providing, Intensive Teaching, Process Reporting, Stating the question, Evaluating and Summarizing. The "CIPSE" model comprises four key components: 1) Principles, 2) Objectives, 3) Learning Processes, and 4) Results. The model has been evaluated by three specialists and found to align with criteria of utility, feasibility, propriety, and accuracy.

3. After a planned 20-class teaching experiment on the "CIPSE" model, the data show that the critical thinking ability of 50 sophomores who participated in the teaching experiment has been obviously improved, and the overall average

Score has increased from 23.80 to 28.72. After the paired sample t-test, it is found that there are significant differences (t=27.631, p=0.000<0.01) in the pre-test and post-test scores of college students' critical thinking ability. This fully proves that the blended model based on Deep Learning Theory has obvious advantages and effects in cultivating college students' critical thinking ability.

Discussion

This study will discuss the conclusions according to the order of research purposes.

1. Discussion on the survey data of college students' critical thinking

1.1 From the investigation of the current situation of the critical thinking tendency of sophomores in Guangxi Normal University, we find that the overall performance of college students' critical thinking is good ($\overline{X}$ =4.75). Compared with the investigation of Facione (1997), there is still a certain gap in the results of this investigation, which is mainly due to the fact that China school education has paid more attention to the teaching of knowledge and neglected the cultivation of students' critical thinking ability for a long time. However, compared with Liu Yi and Zhao Juming (2010) survey of college students in China, the results of this survey are even better. There are two main reasons for this situation: First, the universities surveyed in this study have stronger comprehensive strength than those surveyed by Liu Yi and Zhao Juming, so the quality of students will be better; Second, Liu Yi and Zhao Juming's survey took place in 2010. In recent years, China's education has

gradually attached importance to the cultivation of students' comprehensive literacy, and accordingly students' critical thinking ability has been improved to a certain extent.

1.2 Further analysis shows that from the seven specific dimensions of critical thinking tendency, thirst for knowledge is the highest rank which is in the Good level ($\overline{X}$=5.21), which also confirms from the side that China's long-term emphasis on knowledge teaching and knowledge mastery has led to students' general desire and enthusiasm for knowledge. From the specific performance of each question, we found that students performed best in 35 questions "Decisions made by powerful people are correct decisions" ($\overline{X}$=6.16), which shows that after more than 40 years of reform and opening up in China, especially after joining the WTO in 2001, China has fully integrated into the world, and students' subjective consciousness has become stronger, and they are no longer blindly superstitious about authority, which reflects the great progress of society and conforms to the actual situation of social development in China.

2. Discussion on the "CIPSE" model

Based on the Deep Learning Theory, this study constructs the "CIPSE" model, also known as the five-stage teaching method of blended teaching: Stage 1 Clearly Providing, Stage 2 Intensive teaching, Stage 3 Process Reporting, Stage 4 Stating the question, Stage 5 Evaluating and Summarizing. The "CIPSE" model fully embodies the student-centered and practice-oriented, emphasizes the multi-interaction between students and students, students and teachers, students and content, and students and external resources, and comprehensively evaluates students' learning achievements by adopting the evaluation mechanism combining formative evaluation and summative evaluation. This teaching mode can fully promote the better development of college students' critical thinking, and make learning become an active and meaningful exploration process, which is no longer a simple one-dimensional knowledge infusion. This teaching model was fully affirmed by experts because of its advanced design concept, clear operation stages and reasonable evaluation method, and three external audit experts unanimously passed the IOC's recognition.

The "CIPSE" model is a novel teaching approach that blends modern educational theory with technology and seamlessly incorporates deep integration with the Internet. Blended teaching has been generally regarded as the "new normal"

of education in the 21st century (Norberg, A et al., 2011). Especially since the outbreak of the COVID-19 epidemic, blended teaching has shown a blowout development under the background of internet-enhanced education and has become an extremely important phenomenon and trend in the reform of university education. The "CIPSE" model is in line with the basic idea of the blended teaching model proposed by Yen J C and Lee C Y (2011), focusing on "interaction", emphasizing 1) the shift from teacher-centered to student-centered, 2) the interaction between students and students, students and teachers, students and content, students and external resources, and 3) the adoption of an evaluation mechanism combining formative evaluation with summative evaluation. Essentially, the "CIPSE" model is by no means a physical "mashup" of various online and offline teaching elements, but a chemical "fusion", aiming at achieving the optimal deep learning effect (Liu Hui et al., 2020).

3. Discussion on the effectiveness of "CIPSE" model by comparing the data before and after the teaching experiment

3.1 After implementing the teaching experiment of the "CIPSE" model to improve college students' critical thinking ability, the scores of 50 students who participated in the teaching experiment have been significantly improved, and the overall average score has increased from 23.80 to 28.72, which fully demonstrates the effectiveness of the "CIPSE" model. This also proves that the use of digital tools can have a positive impact on students' critical thinking (Akylbek Meirbekov et al.,2022), because the use of digital tools can help students develop their abilities of setting realistic goals, self-control, self-reflection, self-awareness, and cooperation (Saadati et al.,2021). In other words, blended teaching makes up for the shortcomings of traditional classroom teaching and pure online teaching, which can make students learn more effectively and is more conducive to the cultivation of students' critical thinking.

3.2 From the seven specific dimensions of critical thinking ability, it is evident that college students have shown improvement in each dimension of their critical thinking skills. Notably, there has been significant progress in their understanding of critical thinking, while their reasoning ability has shown comparatively slower growth. This suggests that the "CIPSE" model, being student-centered, interactive, and experience-oriented, has effectively increased

students' interest in learning and enhanced their grasp of critical thinking. Moreover, understanding critical thinking serves as the foundation for overall critical thinking ability and can be relatively quickly acquired with proper methods. On the other hand, reasoning ability entails a deeper comprehension, analysis, and inference of information, typically requiring prolonged training and practice. This also reminds us that we need to make a longer-term training plan for the deep-seated abilities of critical thinking, such as reasoning ability, identifying implicit assumption ability and reasoning ability, and we can achieve better results through systematic study, training and practice.

3.3 Deep learning pays attention to the deep participation of learners in the learning process and the construction and generation of students' existing experience in the learning process. In the blended instructional design, teachers' one-way orientation should be transformed into multi-directional demand, and multi-directional resources should be presented through the reconstruction of teaching time sequence, the transformation of teaching methods and the excavation of teaching content. The essence of this transformation actually requires teachers to emphasize "student-centered" in the blended instructional design, emphasizing the cultivation of students' critical thinking activities under the effective guidance of teachers by means of the advantages of information technology and the combination of online and offline teaching methods. Therefore, the ultimate goal of carrying out mixed teaching is not to use various online platforms, to construct digital teaching resources or to carry out innovative teaching activities, but to effectively enhance the depth of most students' learning and meet the realization of students' "multi-directional" needs, so that knowledge can meet the needs of learners with different experiences in the process of construction, and then personalized interpretation of knowledge can be generated, thus truly realizing students' learning center position (Ren Zhanying, 2022). The "CIPSE" model, based on Deep Learning Theory and designed in this paper, emphasizes the central position of students in their learning process. It encourages active studying and critical thinking, enabling students to become true masters of their learning and fostering enthusiasm for learning, ultimately leading to positive learning outcomes.

3.4 Based on in-depth post-class interviews, students generally report a positive experience with the "CIPSE" teaching mode. They believe that this approach

effectively utilizes teaching resources and aligns well with the requirements of personalized learning. A thorough analysis of the interview data reveals that students who demonstrate strong initiative and active participation tend to benefit more from the "CIPSE" teaching model, leading to enhanced development of their critical thinking abilities. Overall, students express a consensus that the "CIPSE" teaching mode significantly contributes to the improvement of critical thinking skills. However, it's worth noting that many students emphasize the importance of effective teacher guidance and a well-designed curriculum to fully leverage the benefits of the "CIPSE" teaching mode. This undoubtedly places higher demands on educators.

Recommendations

The findings from the present study bring twofold suggestions: applicability of the results and future research.

Applicability of the results

"CIPSE" model is a blended teaching model based on deep learning theory, which aims at comprehensively improving college students' critical thinking ability. The design of this model is the result of researchers' teaching research and teaching practice for many years, which conforms to the current development trend of university education and students' individualized learning needs. Through teaching experiments, this model has been proved to have obvious advantages and effects. It is not only helpful for promoting college students' critical thinking ability, but also suitable for other disciplines such as science, social science, and humanities. When considering adopting "CIPSE" teaching mode, please ensure that your educational environment and objectives are consistent with the characteristics and advantages of this model. To better apply this model, the following are specific suggestions for teachers and university administrators to maximize its effectiveness.

For teachers, in blended teaching, they should excel in guiding students' participation, assuming the role of facilitators and encouraging active engagement in discussions, questions, and problem-solving, fostering a supportive and open learning environment. Personalized support is paramount, necessitating an understanding of students' diverse learning needs and backgrounds and the provision of tailored guidance, suggestions, and evaluations based on individual circumstances. Furthermore, teachers should design courses that are clear and well-structured, with

precise objectives, and transparent requirements and evaluation standards. They should also provide specific and constructive feedback to help students promptly identify and rectify issues, thus enhancing their learning methods. Timely feedback allows students to make necessary adjustments during their learning journey. Undoubtedly, as the cornerstone of blended teaching, teachers should adeptly employ educational technology tools and continually enhance their digital literacy to support the blended teaching model effectively. These elements collectively constitute a successful blended teaching approach.

For university administrators, universities should actively support teachers in acquiring the essential skills required for blended teaching. This support can include offering training courses, facilitating resource sharing, and providing educational technology assistance. Additionally, there should be an emphasis on optimizing infrastructure and resources, such as ensuring high-speed internet access, creating smart classrooms, and establishing comprehensive online learning resources. These measures are essential for providing the necessary technical and resource support for effective blended teaching. Furthermore, a culture of innovation and the sharing of best practices should be promoted. This can be achieved by encouraging teachers to explore new teaching methods and technologies. Simultaneously, universities should incentivize educators and researchers to engage in in-depth studies of the most effective practices in blended teaching and to share their research findings widely.

Future Research

1. Further evaluate the effectiveness of the "CIPSE" model.

Through further research, we can evaluate the effect of the "CIPSE" model in different disciplines, grades and types of colleges and universities. This can cover a wider group of college students, because of fully understanding the influence of this model on different types of students.

2. Explore the relationship between deep learning and critical thinking.

Further explore the correlation between deep learning theory and the cultivation of critical thinking. By carrying out experiments or case studies, researchers can discuss how to best promote the development of college students' critical thinking in a blended teaching environment and understands the different effects of different deep learning methods on critical thinking.

3. Research on teacher training and support.

Through in-depth study of teachers' training and support when adopting the "CIPSE" model, we can investigate teachers' training needs, study different types of teacher training methods, and analyze the impact of these training on the implementation of the model. This will help to further improve the support system of educational institutions for blended teaching.

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Appendices

Appendix A

List of Specialists and Letters of Specialists Invitation for IOC Verification

List of Specialists and Letters of Specialists Invitation for IOC Verification

Name of Experts	Position/Office
Jittawisut Wimutthipan ya	Associate Professor Dr.Jittawisut Wimutthipanya Science Program, Bansomdejchaopraya Rajabhat University
Akadet kedcham	Assistant Professor Dr. Akadet Kedcham Educational Evaluation and Research Program, Bansomdejchaopraya Rajabhat University
Tanaput Chancharoen	Assistant Professor Tanaput Chancharoen Graduate College, Bansomdejchaopraya Rajabhat University

Appendix B

Official Letter

Ref. No. MHESI 0643.14/ 1020

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

31 August 2023

Subject Request for research tool validation
Dear Assoc. Prof. Dr. Jittawisut Wimutthipanya
Attachment Validation sheets

Regarding the thesis entitled "The Development of Blended Teaching model Based on Deep Learning Theory to Enhance college students' critical thinking" of Mr.Guozhonghua, a Ph.D. student majoring in Curriculum and Instruction Program at Bansomdej ChaoprayaRajabhat University code number 6373103129, Thailand under the supervision of Prof. Dr. Wirot Watananimitgul as major advisor and Assoc. Prof. Dr.Wichian Intarasompun as co-advisors, 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
Bansomejchaopraya Rajabhat University

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

Ref. No. MHESI 0643.1 **1021**

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

31 August 2023

Subject Request for research tool validation
Dear Asst. Prof. Dr. Akadet kedcham
Attachment Validation sheets

     Regarding the thesis entitled "The Development of Blended Teaching model Based on Deep Learning Theory to Enhance college students' critical thinking" of Mr.Guozhonghua, a Ph.D. student majoring in Curriculum and Instruction Program at Bansomdej ChaoprayaRajabhat University code number 6373103129, Thailand under the supervision of Prof. Dr. Wirot Watananimitgul as major advisor and Assoc. Prof. Dr.Wichian Intarasompun as co-advisors, 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
Bansomejchaopraya Rajabhat University

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

Ref. No. MHESI 0643.14.1022

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

31 August 2023

Subject Request for research tool validation
Dear Asst. Prof. Dr. Tanaput Chancharoen
Attachment Validation sheets

  Regarding the thesis entitled "The Development of Blended Teaching model Based on Deep Learning Theory to Enhance college students' critical thinking" of Mr.Guozhonghua, a Ph.D. student majoring in Curriculum and Instruction Program at Bansomdej ChaoprayaRajabhat University code number 6373103129, Thailand under the supervision of Prof. Dr. Wirot Watananimitgul as major advisor and Assoc. Prof. Dr.Wichian Intarasompun as co-advisors, 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.

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Sincerely,

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

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

Ref. No. MHESI 0643.14/**1023**

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

3| August 2023

Subject Request for permission to implement experiment

Dear President of Guangxi Normal University

Regarding the thesis entitled "The Development of Blended Teaching model Based on Deep Learning Theory to Enhance college students' critical thinking" of Mr.Guozhonghua, a Ph.D. student majoring in Curriculum and Instruction Program at Bansomdej ChaoprayaRajabhat University code number 6373103129, Thailand under the supervision of

Major Advisor : Prof. Dr. Wirot Watananimitgul

Co-advisor : Assoc. Prof. Dr.Wichian Intarasompun

The researcher needs to implement an experiment in compliance with approved methodology and collect data in terms of Questionnaires, experiments from 80 Sophomore of Guangxi Normal University during the 2nd 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 his thesis completion and further necessary publication as required by the Ph.D. course.

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

Sincerely,

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

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

Ref. No. MHESI 0643.14/ 1024

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

31 August 2023

Subject Request for evaluation of instructional model

Dear Assoc. Prof. Dr. Jittawisut Wimutthipanya

Attachment 1. The developed"CIPSE"model

2. The appropriateness evaluation form

Regarding the thesis entitled "The Development of Blended Teaching model Based on Deep Learning Theory to Enhance college students' critical thinking" of Mr.Guozhonghua, a Ph.D. student majoring in Curriculum and Instruction Program at Bansomdej ChaoprayaRajabhat University code number 6373103129, Thailand under the supervision of Prof. Dr. Wirot Watananimitgul as major advisor and Assoc. Prof. Dr.Wichian Intarasompun as co-advisors, the "CIPSE" 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 the instructional model. Knowing your experience in the field of Education, I would like to ask for your help in evaluating the said the 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 yours,

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

Tel. (662) 4737000
Fax. (662) 4737000

Ref. No. MHESI 0643.14/ 1025

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

3| August 2023

Subject Request for evaluation of instructional model

Dear Asst. Prof. Dr. Akadet kedcham

Attachment   1. The developed"CIPSE"model

2. The appropriateness evaluation form

Regarding the thesis entitled "The Development of Blended Teaching model Based on Deep Learning Theory to Enhance college students' critical thinking" of Mr.Guozhonghua, a Ph.D. student majoring in Curriculum and Instruction Program at Bansomdej ChaoprayaRajabhat University code number 6373103129, Thailand under the supervision of Prof. Dr. Wirot Watananimitgul as major advisor and Assoc. Prof. Dr.Wichian Intarasompun as co-advisors, the "CIPSE" 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 the instructional model. Knowing your experience in the field of Education, I would like to ask for your help in evaluating the said the 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 yours,

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

Tel. (662) 4737000
Fax. (662) 4737000

Ref. No. MHESI 0643.14/ 1026

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

31 August 2023

Subject Request for evaluation of instructional model

Dear Asst. Prof. Dr. Tanaput Chancharoen

Attachment 1. The developed "CIPSE" model
2. The appropriateness evaluation form

Regarding the thesis entitled "The Development of Blended Teaching model Based on Deep Learning Theory to Enhance college students' critical thinking" of Mr.Guozhonghua, a Ph.D. student majoring in Curriculum and Instruction Program at Bansomdej ChaoprayaRajabhat University code number 6373103129, Thailand under the supervision of Prof. Dr. Wirot Watananimitgul as major advisor and Assoc. Prof. Dr.Wichian Intarasompun as co-advisors, the "CIPSE" 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 the instructional model. Knowing your experience in the field of Education, I would like to ask for your help in evaluating the said the 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 yours,

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

Tel. (662) 4737000
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Appendix C

Research Instrument

Objective 1
College Students' Critical Thinking Disposition questionnaire

Dear students:

Critical thinking is one of the core qualities of college students in the 21st century. In recent years, improving college students' critical thinking has become an important training goal of college students. This study focuses on the cultivation of college students' critical thinking, and clarifying the current situation of college students' critical thinking is the starting point of the study. This survey is mainly around this goal. The data of this survey will only be used for academic research, and the authenticity of the data will have great reference value and significance for this study. Please objectively fill in the questionnaire according to the actual situation!

Thank you for your active support!

Graduate School

Bansomdejchaopraya Rajabhat University

Basic personal information

1. Your gender: ☐ male ☐ female;

2. Your discipline : ☐ liberal arts ☐ science and engineering;

3. Your nationality : ☐ Han ☐ minority;

4. Your parents' education level : ☐ both parents received higher education

☐ One of the parents has received higher education

☐ Neither of the parents has received higher education.

The research scale

No.	items	Level of appropriate						
		1	2	3	4	5	6	7
1	If there are four reasons to agree with something and only one reason to oppose it, I will choose to agree with it.							
2	Even if there is evidence that doesn't agree with my idea, I will stick to my idea.							
3	It is impossible to be objective when I express my opinion.							
4	I will only look for some facts that support my opinion, not some facts that oppose my opinion.							
5	I don't know what standard should be used to measure most problems.							
6	It's important for me to know what other people think about things.							
7	I am trying to make less subjective judgments.							
8	Foreigners should learn our culture, not ask us to know their culture.							
9	It's *not that* important to be open to different world views (e.g. evolution, theism).							
10	Everyone has the right to express their opinions, but I will ignore them.							
11	All my beliefs must be supported by evidence.							
12	I am a logical person.							
13	I am good at dealing with problems in an orderly							

No.	items	Level of appropriate						
		1	2	3	4	5	6	7
	way.							
14	I am not a very logical person, but I often pretend to be logical.							
15	When encountering problems, it is impossible to know which one is the better solution.							
16	I always analyze the key point of the question before I answer it.							
17	I can easily organize my thoughts.							
18	I am good at planning a systematic plan to solve complex problems.							
19	I often think about right and wrong in practice and experience.							
20	People think that I hesitate when making a decision.							
21	I appreciate my ability to think accurately.							
22	Tests that require thinking rather than answering by memory are more suitable for me.							
23	My curiosity and thirst for knowledge are appreciated by others.							
24	When faced with problems, because I can make an objective analysis, my peers will come to me to make a decision.							
25	When making a decision, others expect me to formulate appropriate guidelines for guidance.							
26	Studying new things can enrich my life.							
27	Before facing an important choice, I will try my best to collect all relevant information.							
28	Solving difficult problems is fun.							
29	I like to find out how things work.							
30	I will try to learn everything, even if I don't know when they are useful.							
31	The best arguments often come from the instant							

No.	items	Level of appropriate						
		1	2	3	4	5	6	7
	feeling of a certain problem.							
32	The so-called truth is nothing more than personal opinions.							
33	I firmly believe in what I believe.							
34	The best way to solve difficult problems is to ask others for answers.							
35	Decisions made by powerful people are correct decisions.							

Objective 2
The blended teaching model based on Deep Learning Theory

1. principle

Constructing a blended teaching model based on deep learning theory. Deep learning is a meaningful learning process, which can promote students' higher-order thinking. It requires that teaching design should be based on theme-based design, guide students to learn cooperatively and independently, and be able to talk to textbooks, students and themselves online and offline. The specific principles are as follows.

1.1 Student center: put students at the core of learning, encourage them to actively participate and explore, and stimulate their autonomous learning ability.

1.2 Practice-oriented: Through practical cases, problems and challenges, students can apply critical thinking skills to real-world situations.

1.3 Cooperative learning: encourage cooperation, discussion and knowledge sharing among students to promote mutual interaction and learning.

1.4 Technology integration: using technology tools and online resources to provide students with more learning opportunities and personalized learning experiences.

2. Objectives

This model aims to enhance college students' critical thinking, Specific as follows:

(1) Understand the essence, characteristics and composition of critical thinking;

(2) Guide students to establish the spiritual qualities of critical thinking such as Seeking truth, openness, Analytical, Systematization, self-confidence, thirst for knowledge and Cognitive maturity;

(3) Cultivate students' critical thinking abilities, which include understanding of critical thinking, analyzing ability, reasoning ability, identifying implicit assumptions ability, evaluating arguments ability, decision-making ability, self-monitoring and reflective ability;

(4) Cultivate students' teamwork and discussion skills;

(5) Cultivate students' critical reading and writing skills.

3.Learning Process

"CIPSE" Blended Teaching model Based on Deep Learning Theory

stage 1 Clearly Providing: guide students to understand the learning requirements and evaluation criteria, and conduct autonomous learning through online mode, so as to have a preliminary perception of the learning content of each unit, and record the doubts and difficulties in learning, so that offline classes can continue to discuss the learning content more deeply, and at the same time clearly provide students to the ways, objectives and basic requirements of group cooperative learning.

(1) **Learning objectives.** Provide clear learning objectives and learning requirements to ensure that students understand the core concepts and skills of the course.

(2) **Online learning resources.** Provide online learning resources, including learning materials, online discussion forums, interactive learning platforms, etc., to

support students' autonomous learning.

(3) **Group learning theme.** Delineate groups, each group is responsible for studying a specific learning theme, and requires each group to carry out interactive learning and in-depth discussion.

stage 2 Intensive teaching: in the initial stage of classroom teaching, teachers explain important knowledge points and difficulties clearly and thoroughly, but don't talk or talk less about general easy-to-understand knowledge points, so as to improve the efficiency and pertinence of teaching. The teacher first explains the key knowledge points of each unit's learning content to ensure that students have a clear understanding of the basic concepts and core content. Then, by breaking through the learning difficulties, help students overcome the problems and difficulties, so that they can build a deeper understanding on the basic knowledge. Finally, by stimulating critical thinking, students are encouraged to think and analyze deeply on the basis of existing knowledge, so as to improve their critical thinking.

(1) **Explain key knowledge points.** Through in-depth explanation, teachers explain important concepts, improve students' understanding and mastery of key contents, help students establish a solid learning foundation, and lay a solid foundation for further study.

(2) **Break through learning difficulties.** Through targeted explanation, guidance and counseling, teachers help students overcome the problems and difficulties encountered in learning, improve learning efficiency and enhance students' confidence and ability in learning.

(3) **Stimulate critical thinking.** Provide case analysis and practical problems to stimulate students' interest and trigger critical thinking.

stage 3 Process Reporting: The study group reports the process, content and reflection of theme learning to the whole class. Each study unit arranges two study groups to report to the whole class, and other students in the class can ask questions about the content of the group report for interactive learning. This process mainly includes the following three steps.

(1) **Group report.** Arrange study groups to report and share their learning process, main findings and critical thinking through PPT.

(2) **Interactive discussion.** After PPT presentation other students can ask questions, express their opinions and have an interactive discussion.

(3) **Teacher's comments.** Teachers act as guides, encourage in-depth thinking and critical evaluation, and help students broaden their horizons and understand different viewpoints.

stage 4 Stating the question: Students sort out the difficulties and challenges encountered in online learning and send them to the intelligent learning platform. Teachers organize discussions to guide students to solve difficulties and challenges in learning together.

(1) **Raising questions.** Students will record the difficulties and challenges encountered in the online learning process and submit them to the intelligent learning platform or online discussion forum.

(2) **Exploring together.** Teachers organize discussions among students and encourage them to help each other and solve the difficulties and challenges submitted.

(3) **Teacher answering questions.** Teachers provide targeted guidance and solutions to guide students to think and try to solve problems.

stage 5 Evaluating and Summarizing: Teachers evaluate and summarize online learning and classroom learning, and ask students to personally summarize the online and offline learning effects in this unit's theme learning, so as to evaluate and reflect on the learning process.

(1) **Overall evaluation.** Teachers summarize and evaluate students' online learning and classroom learning performance, including learning achievement, participation and critical thinking ability.

(2) **Personalized feedback and suggestions.** Teachers provide personalized feedback and suggestions to help students further develop and enhance their critical thinking ability.

(3) **Student self-learning summary.** Teachers require students to write a written summary of this topic study, including a review of the learning process, an assessment of their critical thinking ability, reflections on difficulties and challenges, and plans and goals for future study.

4 Results

Through the blended teaching based on deep learning, learners can learn the content of related topics more deeply and meaningfully, and improve their critical thinking ability, detailed as follows:

4.1 Students can have a deeper understanding of critical thinking.

4.2 Students can better analyze problem.

4.3 Students are able to better give reasoning.

4.4 Students can better identify implicit assumptions.

4.5 Students can better evaluating arguments.

4.6 Students have better decision-making ability.

4.7 Students have better self-monitoring and reflective ability.

Objective 3-1

Lesson plan

Course name: Critical thinking training, Time: 20 class hours

1) Rational and Background; 2) Behavioral Objectives; 3) Contents and Activities; 4) Learning processes according to deep learning theory;

5) Teaching Materials/resources; 6) Evaluation.

1. Rational and Background

Critical thinking is a key thinking ability in the 21st century. It helps students to think, analyze and evaluate information, and make independent and logical reasoning to decide what to believe or what to take. At present, China is pursuing the national strategy of innovation-driven development to promote the sustainable and high-quality development of economy and society, and critical thinking is the foundation of innovation. Therefore, it is an inevitable choice for China University to cultivate college students' critical thinking ability. Through the design of blended teaching model based on deep learning theory, this course aims to cultivate college students' critical thinking ability, improve their logical reasoning, evaluating arguments, problem solving and judgment, so as to make wise decisions in academic, professional and daily life.

2. Behavioral Objectives

(1) Understand the essence, characteristics and composition of critical thinking;

(2) Guide students to establish the spiritual qualities of critical thinking such as Seeking truth, openness, Analytical, Systematization, self-confidence, thirst for knowledge and Cognitive maturity;

(3) Cultivate students' critical thinking abilities, which include understanding of critical thinking, analyzing ability, reasoning ability, identifying implicit assumptions ability, evaluating arguments ability, decision-making ability, self-monitoring and reflective ability;

(4) Cultivate students' teamwork and discussion skills;

(5) Cultivate students' critical reading and writing skills.

3. Contents and Activities

Contents	Activities	lesson type	Hours
Unit 1 The Connotation, Essence and Characteristics of Critical Thinking	**stage 1 Clearly Providing:** (1) Learning objectives. he learning objectives of this unit are: to strengthen the understanding of the necessity and importance of critical thinking; Master the essence, characteristics and evolution of critical thinking. (2) Online learning resources. Before classroom teaching, students need to complete the online learning resource "*The Necessity and Essence of Critical Thinking*" provided by teachers. （3）Group learning theme. The teacher divided the whole class into groups in advance, and 50 students were divided into 10 groups, and two groups were designated to study the theme for the class teaching stage. The topics of this unit are **"why critical thinking is a liberating force in education"** and **"what is a real critical thinker and what is the key to becoming such a critical thinker"**. **stage 2 Intensive teaching：** (1) Explain key knowledge points. The teacher teaches two key knowledge points: the nature and characteristics of critical thinking and the influence of critical thinking on human development. (2)Break through learning difficulties. The learning difficulties in this unit are: the critical understanding of critical thinking and the reasonable application of "questioning". (3) Stimulate critical thinking.	Online and offline	4

Contents	Activities	lesson type	Hours
	The teacher guides students to think, "Why do all countries in the world attach great importance to the cultivation of students' critical thinking in the 21st century?" **stage 3 Process Reporting:** (1) Group Report. Each group reports the results and thoughts of topic learning to the whole class through PPT, and each group speaks for 15 minutes. The topics of this unit report are **"Why is critical thinking a liberating force in education"** and **"What is a real critical thinker and what is the key to becoming such a critical thinker"** (2) Interactive discussion. After PPT presentation other students can ask questions, express their opinions and have an interactive discussion. (3) Teacher's comments. The teacher acts as a guide, encourages in-depth thinking and critical evaluation, and helps students broaden their horizons and understand different viewpoints. **stage 4 Stating the question：** (1) Raising questions. Students will record the difficulties and challenges encountered in the online learning process and submit them to the intelligent learning platform or online discussion forum. (2) Exploring together. The teacher organizes discussions among students and encourages them to help each other and solve the difficulties and challenges		

Contents	Activities	lesson type	Hours
	submitted. (3)Teacher answering questions. The teacher provides targeted guidance and solutions to guide students to think and try to solve problems. **stage 5 Evaluating and Summarizing：** (1) Overall evaluation. The teacher summarizes and evaluates students' online learning and classroom learning performance, including learning achievement, participation and critical thinking ability. (2) Personalized feedback and suggestions. The teacher provides personalized feedback and suggestions to help students further develop and enhance their critical thinking ability. (3) Student self-learning summary. The teacher requires students to write a written summary of this topic study, including a review of the learning process, An assessment of their critical thinking, reflections on differences and challenges, and plans and goals for future study. In this unit, students should summarize and evaluate their learning and gains from the perspective of understanding critical thinking.		
Unit 2 Argumentation analysis and logical reasoning	**stage 1 Clearly Providing:** (1) Learning objectives. The learning objectives of this unit are: to realize that inquiry begins with the presentation and analysis of good questions; understand and master the comprehensive standards	Online and offline	4

Contents	Activities	lesson type	Hours
	and composition of argumentation; understand the relevance and sufficiency of reasoning and master several common forms of reasoning. （2）Online learning resources. Before classroom teaching, students need to independently complete the learning task of this unit's online learning resource *"Demonstration Analysis and Logical Reasoning"* provided by teachers; （3）Group learning theme. The teacher assigned two groups to study the topic for the presentation in the classroom teaching stage. The topics of this unit are **"How do bias and misleading in news reports come about? How can we identify and avoid them?"** and **"How are the differences in values and behaviors between different cultures formed? How can we avoid cultural misunderstanding and discrimination?** **stage 2 Intensive teaching：** (1) Explain key knowledge points. The teacher teaches two key knowledge points: the standard and composition of good argument; Relevance and sufficiency of reasoning. (2) Break through learning difficulties. The learning difficulties of this unit are: several effective forms of deductive reasoning; The validity of analogical reasoning. (3) Stimulate critical thinking. The teacher guides students to think about "how to construct a good argument effectively and how to grasp the		

Contents	Activities	lesson type	Hours
	three requirements of reasoning: the credibility of premise, the relevance of premise to conclusion and the sufficiency of support." **stage 3 Process Reporting:** (1) Group Report. Each group reports the results and thoughts of topic learning to the whole class through PPT, and each group speaks for 15 minutes. The themes of this unit report are **"How do bias and misleading in news reports come about? How can we identify and avoid them?"**and **"How are the differences in values and behaviors between different cultures formed? How can we avoid cultural misunderstanding and discrimination? "**(2) Interactive discussion. After PPT presentation, other students can ask questions, express their opinions and have an interactive discussion.(3)Teacher's comments. The teacher acts as a guide, encourages in-depth thinking and critical evaluation, and helps students broaden their horizons and understand different viewpoints. **stage 4 Stating the question：** (1) Raising questions. Students will record the difficulties and challenges encountered in the online learning process and submit them to the intelligent learning platform or online discussion forum. (2) Exploring together. The teacher organizes discussions among students and		

Contents	Activities	lesson type	Hours
	encourages them to help each other and solve the difficulties and challenges submitted. (3) Teacher answering questions. The teacher provides targeted guidance and solutions to guide students to think and try to solve problems. **stage 5 Evaluating and Summarizing：** (1) Overall evaluation. The teacher summarizes and evaluates students' online learning and classroom learning performance, including learning achievement, participation and critical thinking ability. (2) Personalized feedback and suggestions. The teacher provides personalized feedback and suggestions to help students further develop and enhance their critical thinking ability. (3) Student self-learning summary. The teacher requires students to write a written summary of this topic study, including a review of the learning process, An assessment of their critical thinking, reflections on differences and challenges, and plans and goals for future study. In this unit, students should summarize and evaluate their learning and gains from the aspects of improving their ability of argumentation and analysis and logical reasoning.		
Unit 3 Clarifying	**stage 1 Clearly Providing:** (1) Learning Objectives. The learning	Online and	4

Contents	Activities	lesson type	Hours
concepts and identifying implicit assumptions	objectives of this unit are to find the fallacies of words and concepts in the argument, and to identify various implied premises and assumptions in the argument. （2） Online learning resources. Before classroom teaching, students need to independently complete the learning task of the online learning resource *"Clarifying Concepts and Distinguishing Hypothesis"* provided by the teacher. （3） Group learning theme. The teacher assigned two groups to study the topic for the presentation in the classroom teaching stage. The themes of group cooperative learning in this unit are **"What is the root of poverty? What measures can we take to eliminate poverty and move towards common prosperity? "and" What are the ethical issues brought by artificial intelligence? How can we balance scientific and technological progress and human security?"** **stage 2 Intensive teaching：** (1) Explain key knowledge points. The teacher teaches two key knowledge points: what is a concept; the importance of concrete thinking. (2) Break through learning difficulties. The learning difficulty in this unit is: how to distinguish the implied premises and assumptions? (3) Stimulate critical thinking. The teacher guides students to think, "How can we find and avoid conceptual fallacies in	offline	

Contents	Activities	lesson type	Hours
	argumentation, and from what aspects can we distinguish various implied assumptions in argumentation? **stage 3 Process Reporting:** (1) Group Report. Each group reports the results and thoughts of topic learning to the whole class through PPT, and each group speaks for 15 minutes. The themes of this unit are **"What is the root of poverty and what measures can we take to eliminate poverty and move towards common prosperity?"** and**" What are the ethical issues brought by artificial intelligence? How can we balance scientific and technological progress and human security?"** (2)Interactive discussion. After PPT presentation, other students can ask questions, express their opinions and have an interactive discussion. (3)Teacher's comments. The teacher acts as a guide, encourages in-depth thinking and critical evaluation, and helps students broaden their horizons and understand different viewpoints. **stage 4 Stating the question：** (1) Raising questions. Students will record the difficulties and challenges encountered in the online learning process and submit them to the intelligent learning platform or online discussion forum. (2) Exploring together. The teacher organizes discussions among students and encourages them to help each other and		

Contents	Activities	lesson type	Hours
	solve the difficulties and challenges submitted. (3) Teacher answering questions. The teacher provides targeted guidance and solutions to guide students to think and try to solve problems. **stage 5 Evaluating and Summarizing：** (1) Overall evaluation. The teacher summarizes and evaluates students' online learning and classroom learning performance, including learning achievement, participation and critical thinking ability. (2) Personalized feedback and suggestions. The teacher provides personalized feedback and suggestions to help students further develop and enhance their critical thinking ability. (3) Student self-learning summary. The teacher requires students to write a written summary of this topic study, including a review of the learning process, An assessment of their critical thinking, reflections on differences and challenges, and plans and goals for future study. In this unit, students should summarize and evaluate their learning and gains from clarifying concepts and distinguishing implied assumptions.		
Unit 4 Critical reading	**stage 1 Clearly Providing:** (1) Learning Objectives. The learning objectives of this unit are: to understand the basic requirements and knowledge points of critical reading; Cultivate	Online and offline	4

Contents	Activities	lesson type	Hours
	students' basic critical reading skills.　（2） Online learning resources. Before classroom teaching, students need to independently complete the learning task of *Critical Reading*, an online learning resource provided by teachers. （3） Group learning theme. The teacher assigned two groups to study the topic for the presentation in the classroom teaching stage. The themes of group cooperative learning in this unit are **"Why do you need critical reading? How to effectively carry out critical reading? Please give an example for in-depth analysis"** and **"How to effectively improve the effect of college students' group cooperative learning"**. **stage 2 Intensive teaching：** (1) Explain key knowledge points. The teacher teaches two key knowledge points: the basic requirements of critical reading; Argumentation and analysis in critical reading. (2) Break through learning difficulties. The learning difficulty of this unit is consciously search and identify the hidden information in the text argumentation part? (3) Stimulate critical thinking. The teacher guides students to think: how can we consciously develop our critical reading skills? **stage 3 Process Reporting:** (1) Group Report. Each group reports the results and thoughts of topic learning to the whole class through PPT, and each		

Contents	Activities	lesson type	Hours
	group speaks for 15 minutes. The themes of this unit report are **"Why do you need critical reading? How to effectively carry out critical reading? Please give an example for in-depth analysis"** and **"How to effectively improve the effect of college students' group cooperative learning"**.(2)Interactive discussion. After PPT presentation, other students can ask questions, express their opinions and have an interactive discussion.(3)Teacher's comments. The teacher acts as a guide, encourages in-depth thinking and critical evaluation, and helps students broaden their horizons and understand different viewpoints. **stage 4 Stating the question:** (1) Raising questions. Students will record the difficulties and challenges encountered in the online learning process and submit them to the intelligent learning platform or online discussion forum. (2) Exploring together. The teacher organizes discussions among students and encourages them to help each other and solve the difficulties and challenges submitted. (3) Teacher answering questions. The teacher provides targeted guidance and solutions to guide students to think and try to solve problems. **stage 5 Evaluating and Summarizing:** (1) Overall evaluation. The teacher		

Contents	Activities	lesson type	Hours
	summarizes and evaluates students' online learning and classroom learning performance, including learning achievement, participation and critical thinking ability. (2) Personalized feedback and suggestions. The teacher provides personalized feedback and suggestions to help students further develop and enhance their critical thinking ability. (3) Student self-learning summary. The teacher requires students to write a written summary of this topic study, including a review of the learning process, An assessment of their critical thinking, reflections on differences and challenges, and plans and goals for future study. In this unit, students should summarize and evaluate their learning and gains from their understanding of critical reading and their mastery of critical reading skills.		
Unit 5 Critical writing	**stage 1 Clearly Providing:** (1) Learning objectives. The learning objectives of this unit are: to understand the basic requirements and knowledge points of critical writing; Cultivate students' basic critical writing skills. （2） Online learning resources. Before classroom teaching, students need to independently complete the learning task of *Critical Writing*, an online learning resource provided by teachers. （3） Group learning theme. The teacher assigned two groups to study the topic for the	Online and offline	4

Contents	Activities	lesson type	Hours
	presentation in the classroom teaching stage. The themes of group cooperative learning in this unit are **"How do universities create an environment for critical thinking to stimulate and cultivate college students' critical thinking?"** and **"In the era of short video, how to use short video to improve college students' critical thinking ability?"** **stage 2 Intensive teaching：** (1) Explain key knowledge points. The teacher teaches two key knowledge points: the basic requirements of critical writing; Toulmin's model of argument. (2) Break through learning difficulties. The learning difficulty of this unit is: the guidance of Toulmin's model to the idea of argumentation; (3)Stimulate critical thinking. The teacher guides students to think about "how to effectively use Toulmin model to improve the argumentation level of self-writing?" **stage 3 Process Reporting:** (1) Group Report. Each group reports the results and thoughts of topic learning to the whole class through PPT, and each group speaks for 15 minutes. The themes of this unit are **"How do universities create an environment for critical thinking to stimulate and cultivate critical thinking of college students?"** and **"In the era of short video, how to use short video to improve college**		

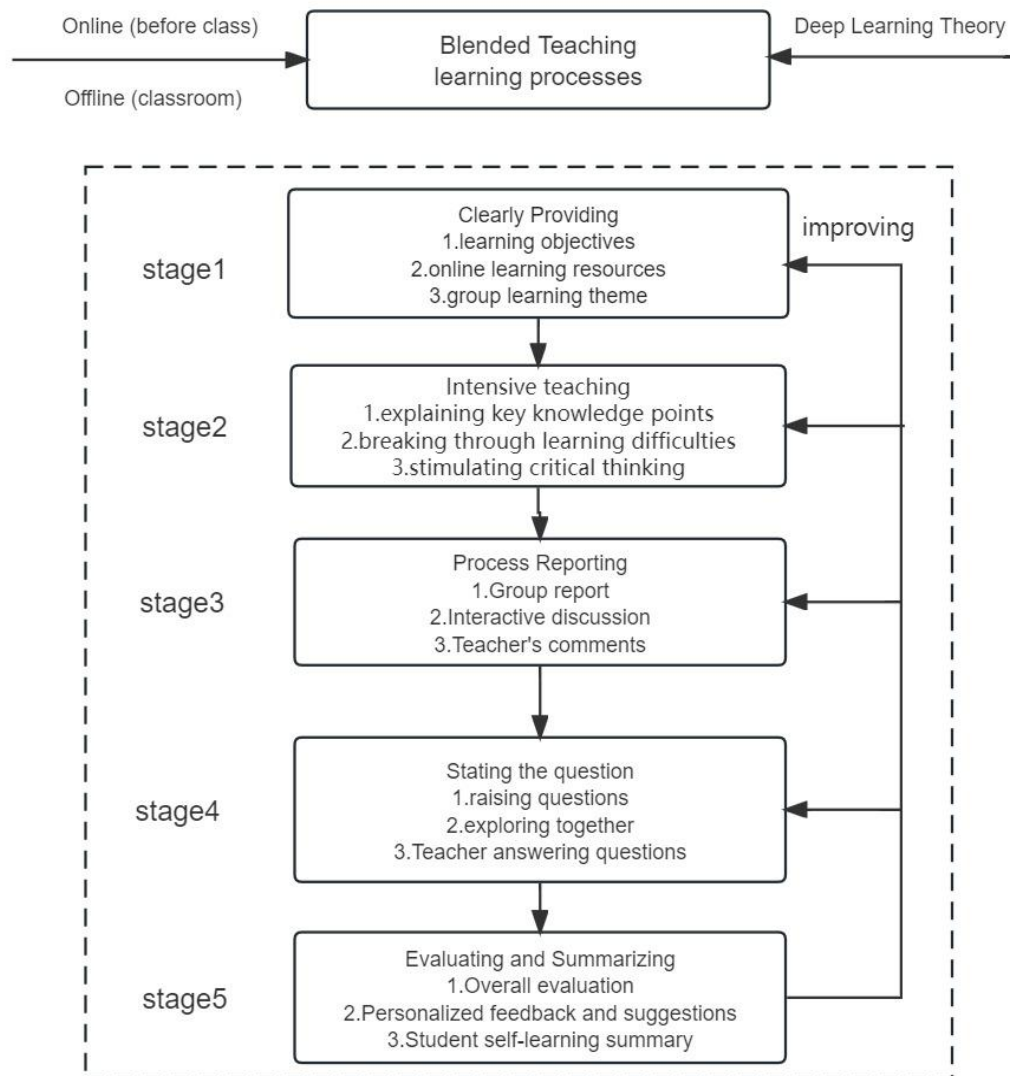| Contents	Activities	lesson type	Hours
	students' critical thinking ability?" (2) Interactive discussion. After PPT presentation, other students can ask questions, express their opinions and have an interactive discussion.(3) Teacher's comments. The teacher acts as a guide, encourages in-depth thinking and critical evaluation, and helps students broaden their horizons and understand different viewpoints. **stage 4 Stating the question：** (1) Raising questions. Students will record the difficulties and challenges encountered in the online learning process and submit them to the intelligent learning platform or online discussion forum. (2) Exploring together. The teacher organizes discussions among students and encourages them to help each other and solve the difficulties and challenges submitted. (3) Teacher answering questions. The teacher provides targeted guidance and solutions to guide students to think and tries to solve problems. **stage 5 Evaluating and Summarizing：** (1) Overall evaluation. The teacher summarizes and evaluates students' online learning and classroom learning performance, including learning achievement, participation and critical thinking ability. (2) Personalized feedback and suggestions.		

Contents	Activities	lesson type	Hours
	The teacher provides personalized feedback and suggestions to help students further develop and enhance their critical thinking ability. (3) Student self-learning summary. The teacher requires students to write a written summary of this topic study, including a review of the learning process, An assessment of their critical thinking, reflections on differences and challenges, and plans and goals for future study. In this unit, students should summarize and evaluate their own learning and gains from the basic requirements and argumentation points of critical writing.		

4.Learning process

"CIPSE" Blended Teaching model Based on Deep Learning Theory

stage 1 Clearly Providing: guide students to understand the learning requirements and evaluation criteria, and conduct autonomous learning through online mode, so as to have a preliminary perception of the learning content of each unit, and record the doubts and difficulties in learning, so that offline classes can continue to discuss the learning content more deeply, and at the same time clearly provide students to the ways, objectives and basic requirements of group cooperative learning.

(1) **Learning objectives.** Provide clear learning objectives and learning requirements to ensure that students understand the core concepts and skills of the course.

(2) **Online learning resources.** Provide online learning resources, including learning materials, online discussion forums, interactive learning platforms, etc., to support students' autonomous learning.

(3) **Group learning theme.** Delineate groups, each group is responsible for studying a specific learning theme, and requires each group to carry out interactive learning and in-depth discussion.

stage 2 Intensive teaching: In the initial stage of classroom teaching, teachers explain important knowledge points and difficulties clearly and thoroughly, but don't talk or talk less about general easy-to-understand knowledge points, so as to improve the efficiency and pertinence of teaching. The teacher first explains the key knowledge points of each unit's learning content to ensure that students have a clear understanding of the basic concepts and core content. Then, by breaking through the learning difficulties, help students overcome the problems and difficulties, so that they can build a deeper understanding on the basic knowledge. Finally, by stimulating critical thinking, students are encouraged to think and analyze deeply on the basis of existing knowledge, so as to improve their critical thinking.

(1) **Explain key knowledge points.** Through in-depth explanation, teachers explain important concepts, improve students' understanding and mastery of key contents, help students establish a solid learning foundation, and lay a solid foundation for further study.

(2) **Break through learning difficulties.** Through targeted explanation, guidance and counseling, teachers help students overcome the problems and difficulties encountered in learning, improve learning efficiency and enhance students' confidence and ability in learning.

(3) **Stimulate critical thinking.** Provide case analysis and practical problems to stimulate students' interest and trigger critical thinking.

stage 3 Process Reporting: The study group reports the process, content and reflection of theme learning to the whole class. Each study unit arranges two study groups to report to the whole class, and other students in the class can ask questions about the content of the group report for interactive learning. This process mainly includes the following three steps.

(1) **Group report.** Arrange study groups to report and share their learning process, main findings and critical thinking through PPT.

(2) **Interactive discussion.** After PPT presentation other students can ask questions, express their opinions and have an interactive discussion.

(3) **Teacher's comments.** Teachers act as guides, encourage in-depth thinking

and critical evaluation, and help students broaden their horizons and understand different viewpoints.

stage 4 Stating the question: Students sort out the difficulties and challenges encountered in online learning and send them to the intelligent learning platform. Teachers organize discussions to guide students to solve difficulties and challenges in learning together.

(1) **Raising questions.** Students will record the difficulties and challenges encountered in the online learning process and submit them to the intelligent learning platform or online discussion forum.

(2) **Exploring together.** Teachers organize discussions among students and encourage them to help each other and solve the difficulties and challenges submitted.

(3) **Teacher answering questions.** Teachers provide targeted guidance and solutions to guide students to think and try to solve problems.

stage 5 Evaluating and Summarizing: Teachers evaluate and summarize online learning and classroom learning, and ask students to personally summarize the online and offline learning effects in this unit's theme learning, so as to evaluate and reflect on the learning process.

(1) **Overall evaluation.** Teachers summarize and evaluate students' online learning and classroom learning performance, including learning achievement, participation and critical thinking ability.

(2) **Personalized feedback and suggestions.** Teachers provide personalized feedback and suggestions to help students further develop and enhance their critical thinking ability.

(3) **Student self-learning summary.** Teachers require students to write a written summary of this topic study, including a review of the learning process, an assessment of their critical thinking ability, reflections on difficulties and challenges, and plans and goals for future study.

5.Teaching Materials/resources

Course textbooks: critical thinking textbooks, logical reasoning textbooks, critical reading and writing textbooks, etc.

Multimedia resources: presentations, video clips, online resources, etc.

Exercises and cases: logical reasoning exercises, information evaluation cases, critical reading and writing exercises, etc.

Discussion activities: group discussion topics, cooperation projects, etc.

6.Evaluation

1)Evaluation methods: Combination of formative assessment and summative assessment.

Formative assessment: classroom exercises, group discussions, case studies, etc. are used to monitor students' learning progress and understanding in real time.

Summative assessment: the final project or exam requires students to comprehensively use critical thinking skills to analyze and solve a complex problem.

2)Evaluation tools: questions, paper, assignments, team project report.

3)Evaluation criteria:

The degree to which students understand the concept and importance of critical thinking.

The development of students' critical thinking spirit such as seeking truth, openness, analytical, systematization, self-confidence, first for knowledge and cognitive maturity;

The enhancement of students' critical thinking ability such as understanding of critical thinking, analytical ability, rational ability, identifying implicit assumption ability, evaluating argument ability, decision-making, self-monitoring and reflective;

Students' participation and contribution in teamwork and discussion;

The development of students' critical reading and writing skills.

Objective 3-2

Examination Paper of College Students' Critical Thinking Ability

Basic personal information

1. Your gender: ☐ male ☐ female;

2. Your discipline: ☐ liberal arts ☐ science and engineering;

3. Your nationality: ☐ Han ☐ minority;

4. Your parents' education level: ☐both parents received higher education

☐ One of the parents has received higher education

☐ Neither of the parents has received higher education.

There are 35 questions in this test paper, each of which is an objective multiple-choice question with 4 options, and each question has only one correct answer. You get 1 point for the right answer, and the wrong answer is 0 point.

1.What is critical thinking?

A) A process of questioning everything and accepting nothing.

B) A process of analyzing and evaluating information. (answer)

C) A process of memorizing information.

D) A process of accepting information at face value.

2.The understanding of critical thinking, the following is not correct.

A) Critical thinking is thinking about thinking, thinking about making correct decisions to decide what to believe or do.

B) Critical thinking aims to find out the mistakes of others' thoughts or behaviors rather than their own, which is a "fault-finding thinking" for others and not for themselves. (answer)

C) Critical thinking does not try to deny everything. After checking that there are reasonable reasons, it is bound to affirm certain ideas.

D) critical thinking is prudent, objective, fair and constructive.

3.Which of the following statements best exemplifies critical thinking?

A) Accepting information at face value without questioning its accuracy.

B) Evaluating the strengths and weaknesses of different arguments before drawing a conclusion. (answer)

C) Making assumptions based on one's personal beliefs without considering alternative perspectives.

D) Memorizing information without understanding its relevance.

4.When evaluating an argument, which of the following questions would be the most helpful to ask?

A) Does this argument support my pre-existing beliefs?

B) Is the person making the argument an expert in the field?

C) Are there any logical fallacies in the argument? (answer)

D) What emotions does the argument evoke in me?

5.Which of the following strategies is NOT a helpful way to improve one's critical thinking skills?

A) Engaging with a diversity of perspectives and ideas.

B) Seeking out and evaluating credible sources of information.

C) Making hasty judgments without considering all available evidence. (answer)

D) Considering the implications and consequences of different decisions.

6.A river in a city has been polluted recently, which has aroused widespread concern in society. The relevant departments conducted a preliminary investigation and found that the possible causes of pollution are as follows:

Industrial wastewater discharge: A large factory nearby is suspected of discharging industrial wastewater directly into the river, causing pollution.

Loss of agricultural fertilizers and pesticides: There are large areas of farmland along the river. Agricultural activities using fertilizers and pesticides may lead to the loss of these chemicals into the river and pollute the water quality.

Urban domestic sewage: There are insufficient sewage treatment facilities in urban areas, and some domestic sewage may flow into rivers without treatment or incomplete treatment.

Illegal dumping of garbage: some lawless elements illegally dumped garbage near the river, resulting in pollution of the river.

Based on the above survey results, what do you think is the main cause of the river pollution?

A) industrial wastewater discharge. (answer)

B) loss of agricultural fertilizers and pesticides.

C) urban domestic sewage.

D) illegal dumping of garbage.

7.When you search for information from the Internet, how do you judge whether the information is reliable?

A) Use the first answer provided by the search engine without judgment.

B) check the source and author of the information, and check the related information on other websites. (answer)

C) completely trust the information provided by the website, regardless of other information.

D) Ask other people's opinions directly without judging for yourself.

8.When reading an article, you find that the author's point of view is opposite to yours. What should you do?

A) Ignore the article directly and don't think about it.

B) refuse to accept the author's point of view and maintain your own point of view.

C) Think deeply and try to understand the author's point of view. (answer)

D) find out the mistakes in the article and refute the author's point of view.

9.Which of the following factors should not be considered when evaluating the credibility of an argument?

A) The source of the argument.

B) Presentation of the argument. (answer)

C) Logical structure of the argument.

D) the author of the argument.

10.You are a college student looking for a part-time job. You are now faced with two choices: Company A pays 20 yuan's salary every hour, but it takes you an hour to go to the company; Company B pays 15 yuan's salary every hour, but it's closer to your residence and only takes 30 minutes. Which company should you choose?

A) A company, because it pays a higher salary.

B) B company, because it is closer to your residence, you can save time.

C) more information is needed to make a decision.

D) it depends on whether you pay more attention to wages or the value of time. (answer)

11. Suppose all A's are B's and all B's are C's. According to this premise, which of the following reasoning is correct?

A) all a's are C. (answer)

B) all c's are B.

C) all B's are A's.

D) all c's are a's.

12. The sales of an enterprise have increased in the past three quarters. According to this fact, which of the following conclusions is the most reasonable?

A) the future sales of this enterprise will also increase. (answer)

B) The profit of this enterprise will also increase in the future.

C) The market share of this enterprise will also increase in the future.

D) the share price of this enterprise will also rise in the future.

13. In one city, the police announced that the crime rate had dropped. According to this information, which of the following conclusions is the most unreasonable?

A) In the perception of the city residents, the safety level of the city has improved.

B) In the perception of the city residents, the city's public security has been improved.

C) the decrease in crime rate is due to the police's more efficient crackdown on criminal activities. (answer)

D) in the perception of the city residents, the public safety of the city has been improved.

14.Which of the following is an example of logical reasoning?

A) All dogs have fur. This animal has fur. Therefore, it must be a dog. (answer)

B) All dogs have fur. This animal has fur. Therefore, it must be a cat.

C) All cats have fur. This animal has fur. Therefore, it must be a dog.

D) All dogs have fur. This animal has no fur. Therefore, it must be a cat.

15. Suppose there are four players A, B, C and D in a game, and their ranking will determine their rewards. If A is ranked between B and C, then D must be ranked last. If B's ranking is between A and C, then D's ranking must not be the last. If the ranking of C is between A and B, then the ranking of D must not be the first. If D is not ranked last, then A must be ranked before C. According to these conditions, which of the following ranking sequences is impossible?

A) A > C > B > D.

B) B > C > A > D.

C) C > A > B > D.

D) D > C > A > B. (answer)

16.Which of the following is an assumption?

A) The earth is round.

B) All dogs have fur.

C) The sun rises in the east.

D) People who wear glasses are smart. (answer)

17. No city-wall bricks were found at Hushan Great Wall Site except for a few residual bricks found at No.1 site. Hushan village and nearby villages have not removed city-wall bricks from the Great Wall for private houses. It can be inferred that there are very few bricks used in Hushan Great Wall.

Which assumption does the above speculation need to imply ()

A) No ancient brick kiln was found near the site of Hushan Great Wall.

B) The local county annals record that the Great Wall of Hushan is made of rammed earth.

C) The mountain here is high and steep, and it is difficult to transport the city-wall bricks in and out. (answer)

D)The soil here is extremely poor, and it is not suitable for firing bricks for the Great Wall.

18. A football coach taught his players this way: "Football matches are always about heroes based on results. In the football match, you are either a winner or a loser; In the eyes of fans, you are either brave or cowardly. Because all winners are brave in the eyes of fans, every loser is a coward in the eyes of fans. "
In order to make the football coach's argument stand, which of the following must be assumed ()

A) In the football match, the winner must be the brave;

B)The brave in the eyes of fans are not necessarily the real brave;

C) even on the court, winning or losing is not the only criterion to distinguish between bravery and cowardice;

D) in the eyes of fans, the brave on the court will win. (answer)

19.A company advertises that their product is "the best on the market" without providing any evidence to support this claim. What is the implicit assumption in this statement?

A) The product is the most affordable on the market.

B) The product is the most popular on the market.

C) The product is better than all other products on the market. (answer)

D) The product is the most widely available on the market.

20.A politician states that they will not accept donations from corporations or lobbyists. What is the implicit premise in this statement?

A) Corporations and lobbyists are inherently evil.

B) Donations from corporations and lobbyists are illegal.

C) Donations from corporations and lobbyists can influence political decisions. (answer)

D) Politicians who accept donations from corporations and lobbyists are more effective leaders.

21.Which of the following is an argument?

A) The sky is blue.

B) I love pizza.

C) You should eat vegetables because they are good for your health. (answer)

D) I don't like broccoli.

22.Which of the following is an example of a valid argument?

A) All birds can fly. Penguins are birds. Therefore, penguins can fly. (answer)

B) All birds can fly. Penguins are birds. Therefore, penguins cannot fly.

C) All birds can fly. Penguins cannot fly. Therefore, penguins are not birds.

D) All birds can fly. Penguins cannot fly. Therefore, birds cannot fly.

23.Which of the following is an example of a valid deductive argument?

A) All men are mortal. Socrates is a man. Therefore, Socrates is mortal. (answer)

B) All men are mortal. Some men are bald. Therefore, some bald men are mortal.

C) All cats have fur. My dog has fur. Therefore, my dog is a cat.

D) All humans have wings. I am a human. Therefore, I have wings.

24.Which of the following is an example of a faulty analogy?

A) Just like a car needs gasoline to run, the human body needs food to function.

B) Just like a hammer is used to build a house, a pencil is used to write a book.

C) Just like a computer virus can infect your device, negative thoughts can infect your mind. (answer)

D) Just like a tree needs water to grow, a student needs knowledge to learn.

25.Which of the following is an example of a strong argument?

A) Most people prefer chocolate to vanilla. Therefore, chocolate is better than vanilla. (answer)

B) Some people prefer chocolate to vanilla. Therefore, chocolate is better than vanilla.

C) Everyone I know prefers chocolate to vanilla. Therefore, chocolate is better than vanilla.

D) A few people I know prefer vanilla to chocolate. Therefore, vanilla is better than chocolate.

26.You're trying to decide whether to purchase a new smartphone or stick with your old one. What is an example of critical thinking in this situation?

A) Choosing the latest model of smartphone without further thought.

B) Researching the features and prices of different smartphone models. (answer)

C) Ignoring the issue and continuing to use your old smartphone.

D) Deciding based solely on the brand of the smartphone.

27.You're trying to decide which job offer to accept. What is an example of critical thinking in this situation?

A) Accepting the job that pays the most money without further thought.

B) Researching the job responsibilities and work culture of each offer. (answer)

C) Ignoring the issue and continuing with your current job.

D) Deciding based solely on the location of the job.

28.A college student is trying to choose a major, but is having trouble deciding. Which of the following is the most logically sound way to make a decision?

A) Choosing a major based solely on what their friends are studying.

B) Choosing a major based on which one seems the most fun.

C) Making a pros and cons list of each major and weighing the options. (answer)

D) Choosing a major at random.

29.You have been invited to a friend's party, but you also have a major exam the next day. What is the most critical factor you should consider before making a decision?

A) Your personal preferences.

B) Your friend's expectations.

C) The potential consequences of your decision. (answer)

D) The difficulty level of the exam.

30.You're trying to plan a surprise birthday party for your friend. What is an example of critical thinking in this situation?

A) Planning the party without further thought.

B) Considering your friend's preferences, budget, and schedule when planning the party. (answer)

C) Ignoring the issue and deciding not to have a party.

D) Deciding based solely on your own preferences for party planning.

31.When you find errors or biases in your thinking, what will you do?

A) Ignore these errors and biases.

B) Try to find other solutions.

C) Adjust your thinking and approach. (answer)

D) Consult with others and accept their guidance.

32.When you meet a new problem, what is your first reaction?

A) try to solve the problem immediately.

B) Find relevant information.

C) Analyze problems and formulate solutions. (answer)

D) Ask for help from others.

33.When you finish a task, how will you evaluate your performance?

A) Be satisfied with your own performance, without further reflection.

B) Seeing the problem and realizing the need for improvement

C) Carefully review your performance and look for potential improvement points. (answer)

D) Seek feedback from others to improve

34.What will you do when you find yourself in trouble when solving a problem?

A) Give up and ask for help from others.

B) Start over and solve the problem from scratch.

C) Try to find another way to solve the problem.

D) Analyze the problem and evaluate your own ability, and then decide whether you need to seek help. (answer)

35.When you encounter a problem, do you tend to try to solve it on your own first, or do you tend to seek help from others? Why?

A) I usually prefer to solve problems on my own because I think it is a more efficient and autonomous way.

B) I usually ask for help from others first because I believe it can help me solve the problem more quickly.

C) I will choose based on the situation, sometimes I will try to solve the problem on my own, and sometimes I will ask others for help. (answer)

D) I'm not sure because I've never thought about this question.

Appendix D

The Results of the Quality Analysis of Research Instruments

IOC – Questionnaire

Level 1 indicators	Question	Experts			$\overline{x}$	Validity
		NO 1	NO 2	NO 3		
Seeking truth (1-5)	1.If there are four reasons to agree with something and only one reason to oppose it, I will choose to agree with it.	1	1	1	1	Valid
	2.Even if there is evidence that doesn't agree with my idea, I will stick to my idea.	1	1	1	1	Valid
	3.It is impossible to be objective when I express my opinion.	1	1	1	1	Valid
	4.I will only look for some facts that support my opinion, not some facts that oppose my opinion.	1	1	1	1	Valid
	5.I don't know what standard should be used to measure most problems.	1	1	1	1	Valid
Openness (6-10)	6.It's important for me to know what other people think about things.	1	1	1	1	Valid
	7.I am trying to make less subjective judgments.	1	1	1	1	Valid
	8. Foreigners should learn our culture, not ask us to know their culture.	1	1	1	1	Valid
	9. It's not that important to be open to different world views(e.g. evolution, theism).	1	1	1	1	Valid
	10. Everyone has the right to express their opinions, but I will ignore them.	1	1	1	1	Valid
	11. All my beliefs must be	1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\overline{x}$	Validity
		NO 1	NO 2	NO 3		
Analytical (11-15)	supported by evidence.					
	12.I am a logical person.	1	1	1	1	Valid
	13.I am good at dealing with problems in an orderly way.	1	1	1	1	Valid
	14.I am not a very logical person, but I often pretend to be logical.	1	1	1	1	Valid
	15.When encountering problems, it is impossible to know which one is the better solution.	1	1	1	1	Valid
Systematization ability (16-20)	16. I always analyze the key point of the question before I answer it.	1	1	1	1	Valid
	17.I can easily organize my thoughts.	1	1	1	1	Valid
	18. I am good at planning a systematic plan to solve complex problems.	1	1	1	1	Valid
	19. I often think about right and wrong in practice and experience.	1	1	1	1	Valid
	20. People think that I hesitate when making a decision.	1	1	1	1	Valid
self-confidence (21-25)	21.I appreciate my ability to think accurately.	1	1	1	1	Valid
	22.Tests that require thinking rather than answering by memory are more suitable for me.	1	1	1	1	Valid
	23.My curiosity and thirst for knowledge are appreciated by others.	1	1	1	1	Valid
	24.When faced with problems, because I can make an objective analysis, my peers will come to me to make a decision.	1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\overline{\text{x}}$	Validity
		NO 1	NO 2	NO 3		
	25. When making a decision, others expect me to formulate appropriate guidelines for guidance.	1	1	1	1	Valid
thirst for knowledge (26-30)	26. Studying new things can enrich my life.	1	1	1	1	Valid
	27. Before facing an important choice, I will try my best to collect all relevant information.	1	1	1	1	Valid
	28. Solving difficult problems is fun.	1	1	1	1	Valid
	29. I like to find out how things work.	1	1	1	1	Valid
	30. I will try to learn everything, even if I don't know when they are useful.	1	1	1	1	Valid
Cognitive maturity (31-35)	31. The best arguments often come from the instant feeling of a certain problem.	1	1	1	1	Valid
	32. The so-called truth is nothing more than personal opinions.	1	1	1	1	Valid
	33. I firmly believe in what I believe.	1	1	1	1	Valid
	34. The best way to solve difficult problems is to ask others for answers.	1	1	1	1	Valid
	35. Decisions made by powerful people are correct decisions.	1	1	1	1	Valid

IOC - the blended teaching model

No.	Items	Experts			$\overline{x}$	Validity
		NO 1	NO 2	NO 3		
1	Principle	1	1	1	1	Valid
2	Objectives	1	1	1	1	Valid
3	Learning Process	1	1	1	1	Valid
4	Results	1	1	0	0.67	Valid

IOC – the Lesson plan

No.	Items	Experts			$\overline{\text{X}}$	Validity
		NO 1	NO 2	NO 3		
1	Rational and Background	1	1	1	1	Valid
2	Behavioral Objectives	1	1	1	1	Valid
	Objective(1)	1	1	1	1	Valid
	objective(2)	1	1	1	1	Valid
	objective(3)	1	1	1	1	Valid
	objective(4)	1	1	1	1	Valid
	objective(5)	1	1	1	1	Valid
	objective(6)	1	1	1	1	Valid
3	Contents and Activities	1	1	1	1	Valid
	Unit 1	1	1	1	1	Valid
	Unit 2	1	1	1	1	Valid
	Unit 3	1	1	1	1	Valid
	Unit 4	1	1	1	1	Valid
	Unit 5	1	1	1	1	Valid
4	Learning Process	1	1	1	1	Valid
	Step 1	1	1	1	1	Valid
	Step 2	1	1	1	1	Valid
	Step 3	1	1	1	1	Valid
	Step 4	1	1	1	1	Valid
	Step 5	1	1	1	1	Valid
5	Teaching Materials/resources	1	1	1	1	Valid
6	Evaluation	1	1	1	1	Valid
	(1)Evaluation methods	1	1	1	1	Valid
	(2)Evaluation tools	1	1	1	1	Valid
	(3)Evaluation criteria	1	1	1	1	Valid

IOC - Examination Paper

Level 1 indicators	Question	Experts			$\overline{\text{x}}$	Validity
		NO 1	NO 2	NO 3		

	1.What is critical thinking?
	  A) A process of questioning everything and accepting nothing.
	  B) A process of analyzing and evaluating information.(answer)
	  C) A process of memorizing information.
	  D) A process of accepting information at face value.
		1	1	1	1	Valid

understanding of critical thinking (1-5)	2.The understanding of critical thinking, the following is not correct.
	  A) Critical thinking is thinking about thinking, thinking about making correct decisions to decide what to believe or do.
	  B) Critical thinking aims to find out the mistakes of others' thoughts or behaviors rather than their own, which is a "fault-finding thinking" for others and not for themselves.(answer)
	  C) Critical thinking does not try to deny everything. After checking that there are reasonable reasons, it is bound to affirm certain ideas.
	  D) critical thinking is prudent, objective, fair and constructive.
		1	1	1	1	Valid

	3.Which of the following statements best exemplifies critical thinking? A) Accepting information at face value without questioning its	1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\overline{x}$	Validity
		NO 1	NO 2	NO 3		

	accuracy.
	  B) Evaluating the strengths and weaknesses of different arguments before drawing a conclusion.(answer)
	  C) Making assumptions based on one's personal beliefs without considering alternative perspectives.
	  D) Memorizing information without understanding its relevance.					

	4.When evaluating an argument, which of the following questions would be the most helpful to ask?
	  A) Does this argument support my pre-existing beliefs?
	  B) Is the person making the argument an expert in the field?
	  C) Are there any logical fallacies in the argument?(answer)
	  D) What emotions does the argument evoke in me?
		1	1	1	1	Valid

	5.Which of the following strategies is NOT a helpful way to improve one's critical thinking skills?
	  A) Engaging with a diversity of perspectives and ideas.
	  B) Seeking out and evaluating credible sources of information.
	  C) Making hasty judgments without considering all available evidence.(answer)
	  D) Considering the implications and consequences of different decisions.
		1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\bar{\text{x}}$	Validity
		NO 1	NO 2	NO 3		

analyzing ability (6-10)	6.A river in a city has been polluted recently, which has aroused widespread concern in society. The relevant departments conducted a preliminary investigation and found that the possible causes of pollution are as follows:
	  Industrial wastewater discharge: A large factory nearby is suspected of discharging industrial wastewater directly into the river, causing pollution.
	  Loss of agricultural fertilizers and pesticides: There are large areas of farmland along the river. Agricultural activities using fertilizers and pesticides may lead to the loss of these chemicals into the river and pollute the water quality.
	  Urban domestic sewage: There are insufficient sewage treatment facilities in urban areas, and some domestic sewage may flow into rivers without treatment or incomplete treatment.
	  Illegal dumping of garbage: some lawless elements illegally dumped garbage near the river, resulting in pollution of the river.
	  Based on the above survey results, what do you think is the main cause of the river pollution?
		1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\overline{x}$	Validity
		NO 1	NO 2	NO 3		
	A) industrial wastewater discharge.(answer) B) loss of agricultural fertilizers and pesticides. C) urban domestic sewage. D) illegal dumping of garbage.					
	7.When you search for information from the Internet, how do you judge whether the information is reliable? A) Use the first answer provided by the search engine without judgment. B) check the source and author of the information, and check the related information on other websites.(answer) C) completely trust the information provided by the website, regardless of other information. D) Ask other people's opinions directly without judging for yourself.	1	1	1	1	Valid
	8.When reading an article, you find that the author's point of view is opposite to yours. What should you do? A) Ignore the article directly and don't think about it. B) refuse to accept the author's point of view and maintain your own point of view. C) Think deeply and try to understand the author's point of view.(answer)	1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\overline{x}$	Validity
		NO 1	NO 2	NO 3		
	D) find out the mistakes in the article and refute the author's point of view.					

	9.Which of the following factors should not be considered when evaluating the credibility of an argument?
	  A) The source of the argument.
	  B) Presentation of the argument.(answer)
	  C) Logical structure of the argument.
	  D) the author of the argument.
		1	1	1	1	Valid

	10.You are a college student looking for a part-time job. You are now faced with two choices: Company A pays 20 yuan's salary every hour, but it takes you an hour to go to the company; Company B pays 15 yuan's salary every hour, but it's closer to your residence and only takes 30 minutes. Which company should you choose?
	  A) A company, because it pays a higher salary.
	  B) B company, because it is closer to your residence, you can save time.
	  C) more information is needed to make a decision.
	  D) it depends on whether you pay more attention to wages or the value of time.(answer)
		1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\overline{x}$	Validity
		NO 1	NO 2	NO 3		

reasoning ability (11-15)	11. Suppose all A's are B's and all B's are C's. According to this premise, which of the following reasoning is correct?
	  A) all a's are C.(answer)
	  B) all c's are B.
	  C) all B's are A's.
	  D) all c's are a's.
		1	1	1	1	Valid

	12. The sales of an enterprise have increased in the past three quarters. According to this fact, which of the following conclusions is the most reasonable?
	  A) the future sales of this enterprise will also increase.(answer)
	  B) The profit of this enterprise will also increase in the future.
	  C) The market share of this enterprise will also increase in the future.
	  D) the share price of this enterprise will also rise in the future.
		1	1	1	1	Valid

	13. In one city, the police announced that the crime rate had dropped. According to this information, which of the following conclusions is the most unreasonable?
	  A) In the perception of the city residents, the safety level of the city has improved.
	  B) In the perception of the city residents, the city's public security
		1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\bar{x}$	Validity
		NO 1	NO 2	NO 3		

	has been improved.
	  C) the decrease in crime rate is due to the police's more efficient crackdown on criminal activities.(answer)
	  D) in the perception of the city residents, the public safety of the city has been improved.					

	14.Which of the following is an example of logical reasoning?
	  A) All dogs have fur. This animal has fur. Therefore, it must be a dog.(answer)
	  B) All dogs have fur. This animal has fur. Therefore, it must be a cat.
	  C) All cats have fur. This animal has fur. Therefore, it must be a dog.
	  D) All dogs have fur. This animal has no fur. Therefore, it must be a cat.
		1	1	1	1	Valid

	15. Suppose there are four players A, B, C and D in a game, and their ranking will determine their rewards. If A is ranked between B and C, then D must be ranked last. If B's ranking is between A and C, then D's ranking must not be the last. If the ranking of C is between A and B, then the ranking of D must not be the first. If D is not ranked last, then A must be ranked before C. According to these conditions, which of the following ranking sequences is impossible?	1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\overline{x}$	Validity
		NO 1	NO 2	NO 3		
	A) A > C > B > D. B) B > C > A > D. C) C > A > B > D. D) D > C > A > B.(answer)					
identifying implicit assumptions ability (16-20)	16.Which of the following is an assumption? A) The earth is round. B) All dogs have fur. C) The sun rises in the east. D) People who wear glasses are smart.(answer)	1	1	1	1	Valid
	17.No city-wall bricks were found at Hushan Great Wall Site except for a few residual bricks found at No.1 site. Hushan village and nearby villages have not removed city-wall bricks from the Great Wall for private houses. It can be inferred that there are very few bricks used in Hushan Great Wall. Which assumption does the above speculation need to imply () A) No ancient brick kiln was found near the site of Hushan Great Wall. B) The local county annals record that the Great Wall of Hushan is made of rammed earth. C) The mountain here is high and steep, and it is difficult to transport the city-wall bricks in and out.(answer) D)The soil here is extremely poor, and it is not suitable for firing bricks	1	1	1	1	Valid

Level 1 indicators	Question	Experts NO 1	NO 2	NO 3	$\overline{x}$	Validity
	for the Great Wall.					

	18. A football coach taught his players this way: "Football matches are always about heroes based on results. In the football match, you are either a winner or a loser; In the eyes of fans, you are either brave or cowardly. Because all winners are brave in the eyes of fans, every loser is a coward in the eyes of fans. "
	  In order to make the football coach's argument stand, which of the following must be assumed ()
	  A) In the football match, the winner must be the brave;
	  B)The brave in the eyes of fans are not necessarily the real brave;
	  C) even on the court, winning or losing is not the only criterion to distinguish between bravery and cowardice;
	  D) in the eyes of fans, the brave on the court will win.(answer)
		1	1	1	1	Valid

	19.A company advertises that their product is "the best on the market" without providing any evidence to support this claim. What is the implicit assumption in this statement?
	  A) The product is the most affordable on the market.
	  B) The product is the most popular
		1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\overline{x}$	Validity
		NO 1	NO 2	NO 3		

	on the market.
	  C) The product is better than all other products on the market.(answer)
	  D) The product is the most widely available on the market.					

	20.A politician states that they will not accept donations from corporations or lobbyists. What is the implicit premise in this statement?
	  A) Corporations and lobbyists are inherently evil.
	  B) Donations from corporations and lobbyists are illegal.
	  C) Donations from corporations and lobbyists can influence political decisions.(answer)
	  D) Politicians who accept donations from corporations and lobbyists are more effective leaders.
		1	1	1	1	Valid

	21.Which of the following is an argument?
	  A) The sky is blue.
	  B) I love pizza.
	  C) You should eat vegetables because they are good for your health.(answer)
	  D) I don't like broccoli.
		1	1	1	1	Valid

	22.Which of the following is an example of a valid argument? A) All birds can fly. Penguins are birds. Therefore, penguins can	1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\overline{x}$	Validity
		NO 1	NO 2	NO 3		

evaluating arguments ability (21-25)	fly.(answer)
	  B) All birds can fly. Penguins are birds. Therefore, penguins cannot fly.
	  C) All birds can fly. Penguins cannot fly. Therefore, penguins are not birds.
	  D) All birds can fly. Penguins cannot fly. Therefore, birds cannot fly.					

	23.Which of the following is an example of a valid deductive argument?
	  A) All men are mortal. Socrates is a man. Therefore, Socrates is mortal.(answer)
	  B) All men are mortal. Some men are bald. Therefore, some bald men are mortal.
	  C) All cats have fur. My dog has fur. Therefore, my dog is a cat.
	  D) All humans have wings. I am a human. Therefore, I have wings.
		1	1	1	1	Valid

	24.Which of the following is an example of a faulty analogy?
	  A) Just like a car needs gasoline to run, the human body needs food to function.
	  B) Just like a hammer is used to build a house, a pencil is used to write a book.
	  C) Just like a computer virus can infect your device, negative thoughts
		1	1	1	1	Valid

Level 1 indicators	Question	Experts NO 1	NO 2	NO 3	$\overline{x}$	Validity
	can infect your mind.(answer) D) Just like a tree needs water to grow, a student needs knowledge to learn.					
	25.Which of the following is an example of a strong argument? A) Most people prefer chocolate to vanilla. Therefore, chocolate is better than vanilla.(answer) B) Some people prefer chocolate to vanilla. Therefore, chocolate is better than vanilla. C) Everyone I know prefers chocolate to vanilla. Therefore, chocolate is better than vanilla. D) A few people I know prefer vanilla to chocolate. Therefore, vanilla is better than chocolate.	1	1	1	1	Valid
decision-making ability (26-30)	26.You're trying to decide whether to purchase a new smartphone or stick with your old one. What is an example of critical thinking in this situation? A) Choosing the latest model of smartphone without further thought. B) Researching the features and prices of different smartphone models.(answer) C) Ignoring the issue and continuing to use your old smartphone. D) Deciding based solely on the brand of the smartphone.	1	1	1	1	Valid
	27.You're trying to decide which job	1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\overline{\text{x}}$	Validity
		NO 1	NO 2	NO 3		

	offer to accept. What is an example of critical thinking in this situation?
	  A) Accepting the job that pays the most money without further thought.
	  B) Researching the job responsibilities and work culture of each offer.(answer)
	  C) Ignoring the issue and continuing with your current job.
	  D) Deciding based solely on the location of the job.					

	28.A college student is trying to choose a major, but is having trouble deciding. Which of the following is the most logically sound way to make a decision?
	  A) Choosing a major based solely on what their friends are studying.
	  B) Choosing a major based on which one seems the most fun.
	  C) Making a pros and cons list of each major and weighing the options.(answer)
	  D) Choosing a major at random.
		1	1	1	1	Valid

	29.You have been invited to a friend's party, but you also have a major exam the next day. What is the most critical factor you should consider before making a decision?
	  A) Your personal preferences.
	  B) Your friend's expectations.
	  C) The potential consequences of
		1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\overline{\text{X}}$	Validity
		NO 1	NO 2	NO 3		
	your decision.(answer) D) The difficulty level of the exam.					

	30.You're trying to plan a surprise birthday party for your friend. What is an example of critical thinking in this situation?
	  A) Planning the party without further thought.
	  B) Considering your friend's preferences, budget, and schedule when planning the party.(answer)
	  C) Ignoring the issue and deciding not to have a party.
	  D) Deciding based solely on your own preferences for party planning.
		1	1	1	1	Valid

self-monitoring and reflective ability (31-35)	31.When you find errors or biases in your thinking, what will you do?
	  A) Ignore these errors and biases.
	  B) Try to find other solutions.
	  C) Adjust your thinking and approach.(answer)
	  D) Consult with others and accept their guidance.
		1	1	1	1	Valid

	32.When you meet a new problem, what is your first reaction?
	  A) try to solve the problem immediately.
	  B) Find relevant information.
	  C) Analyze problems and formulate solutions.(answer)
	  D) Ask for help from others.
		1	1	1	1	Valid

	33.When you finish a task, how will you evaluate your performance?	1	1	1	1	Valid

Level 1 indicators	Question	Experts			$\overline{x}$	Validity
		NO 1	NO 2	NO 3		
	A) Be satisfied with your own performance, without further reflection. B) Seeing the problem and realizing the need for improvement C) Carefully review your performance and look for potential improvement points.(answer) D) Seek feedback from others to improve					
	34.What will you do when you find yourself in trouble when solving a problem? A) Give up and ask for help from others. B) Start over and solve the problem from scratch. C) Try to find another way to solve the problem. D) Analyze the problem and evaluate your own ability, and then decide whether you need to seek help.(answer)	1	1	1	1	Valid
	35.When you encounter a problem, do you tend to try to solve it on your own first, or do you tend to seek help from others? Why? A) I usually prefer to solve problems on my own because I think it is a more efficient and autonomous way. B) I usually ask for help from others first because I believe it can	1	1	1	1	Valid

| Level 1 indicators	Question	Experts			$\overline{\text{X}}$	Validity
		NO 1	NO 2	NO 3		

	help me solve the problem more quickly.
	  C) I will choose based on the situation, sometimes I will try to solve the problem on my own, and sometimes I will ask others for help.(answer)
	  D) I'm not sure because I've never thought about this question.					

Item Analysis on Difficulty(p) and power of discrimination (r)
And KR-20 for reliability quality

Item	pindex	Interpret	rindex		Sig	Interpret	Conclusion
1	0.47	Accept	0.6828	*	0.0000	Accept	Selected it
2	0.43	Accept	0.5668	*	0.0011	Accept	Selected it
3	0.53	Accept	0.7403	*	0.0000	Accept	Selected it
4	0.53	Accept	0.4870	*	0.0063	Accept	Selected it
5	0.47	Accept	0.6003	*	0.0005	Accept	Selected it
6	0.40	Accept	0.5744	*	0.0009	Accept	Selected it
7	0.50	Accept	0.7385	*	0.0000	Accept	Selected it
8	0.50	Accept	0.6811	*	0.0000	Accept	Selected it
9	0.40	Accept	0.3520		0.0565	Accept	Selected it
10	0.33	Accept	0.3954	*	0.0306	Accept	Selected it
11	0.50	Accept	0.7257	*	0.0000	Accept	Selected it
12	0.37	Accept	0.4815	*	0.0071	Accept	Selected it
13	0.40	Accept	0.6001	*	0.0005	Accept	Selected it
14	0.50	Accept	0.7321	*	0.0000	Accept	Selected it
15	0.40	Accept	0.5552	*	0.0015	Accept	Selected it
16	0.60	Accept	0.7361	*	0.0000	Accept	Selected it
17	0.47	Accept	0.5687	*	0.0010	Accept	Selected it
18	0.33	Accept	0.4744	*	0.0081	Accept	Selected it
19	0.50	Accept	0.7321	*	0.0000	Accept	Selected it
20	0.43	Accept	0.6433	*	0.0001	Accept	Selected it
21	0.50	Accept	0.6811	*	0.0000	Accept	Selected it
22	0.27	Accept	0.3922	*	0.0321	Accept	Selected it
23	0.43	Accept	0.6050	*	0.0004	Accept	Selected it
24	0.30	Accept	0.3688	*	0.0449	Accept	Selected it
25	0.50	Accept	0.7321	*	0.0000	Accept	Selected it

Item	pindex	Interpret	rindex		Sig	Interpret	Conclusion
26	0.57	Accept	0.6817	*	0.0000	Accept	Selected it
27	0.50	Accept	0.7129	*	0.0000	Accept	Selected it
28	0.47	Accept	0.7275	*	0.0000	Accept	Selected it
29	0.47	Accept	0.6574	*	0.0001	Accept	Selected it
30	0.50	Accept	0.6557	*	0.0001	Accept	Selected it

Result of Item analysis

P	min	0.2667
	max	0.6000
r	min	0.3520
	max	0.7705
KR-20 Reliability		0.9592
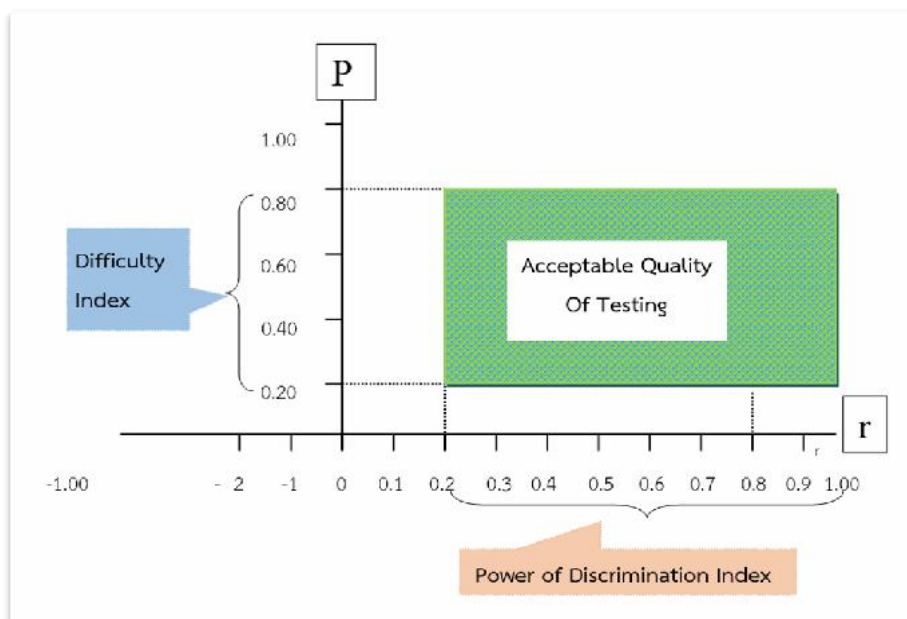
Appendix E
Certificate of English

BS RU BANSOMDEJCHAOPRAYA
RAJABHAT UNIVERSITY

This is to certify that

Mr.Zhonghua Guo

Achieved BSRU English Proficiency Test (BSRU-TEP) level

C2

Given on 13th February 2022

(Assistant Professor Dr Kulsirin Aphiratvoradej)

Director

Appendix F

The Document for Acceptance Research

Journal of Roi Kaensarn Academi

Modern Learning Development Centre

Modern Learning Development Co.,Ltd. 141 Village No.6 Banchai Sub-district, Ban Dung District, Udon Thani, Thailand, 41190

Phone number. +6694-7095636 ID Line. teekapko

Date : October 27, 2023

Acceptance Letter

Dear Author (S): Guo zhonghua, Wichian Intarasompun, Wirot Watananimitgul, and Areewan Iamsa-ard

Paper ID : 661143

PaperTitle : The Development of Blended Teaching model Based on Deep Learning Theory to Enhance college students' critical thinking

This is to enlighten you that above manuscript reviewed and appraised by the review committee member of Journal of Roi Kaensarn Academi by 3 assessors and it is accepted for the purpose of publication in Journal of Roi Kaensarn Academi at Group 1 of Thai journal citation Index Centre (TCI) with ISSN 2697-5033 (Online) Volume 8 Issue 11 November 2023 that will be available at https://so02.tci-thaijo.org/index.php/JRKSA/index

Sincerely

Teedanai Kapko

Dr.Teedanai Kapko

Editor Journal of Roi Kaensarn Academi

Full Paper : https://so02.tci-thaijo.org/index.php/JRKSA/article/view/266121/177975

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