The Development of Issue-centered Teaching Model based on Radical Constructivism Theory to Improve Students' Critical Thinking Ability

Chen Meng, Wichian Intarasompun,
Wirot Watananimitgul and Areewan Iamsa-ard
Bansomdejchaopraya Rajabhat University, Thailand
Corresponding Author, Email:252919847@qq.com

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Abstracts

The purposes of this study are 1) investigate the current situation of critical thinking among college students; 2) Developing issue-centered teaching model based on radical constructivism theory to enhance critical thinking among college students; 3) Evaluate the effectiveness of teaching models. The population groups for this study are: 1) 15000 students from Guangxi Arts University, 2) 3000 senior students. The sample groups for this study are: 1) 478 students who participated in a questionnaire survey, 2) 32 senior students who participated in a quasi-experimental study. The research tools are 1) the Critical Thinking Disposition Scale for College Students, 2) the "PCE" model lesson plan, 3) the test paper for the critical thinking ability of college students.

The research results found that: 1) College students' critical thinking tendency is at fair level ($\bar{X}$=3.21); 2) Developed issue-centered teaching model based on radical constructivism theory, named "PCE" model; 3) After teaching experiments, the students' pre-test score was 15.75, and the post-test score was 18.44. There was a significant difference in pre-test and post-test scores (t=2.809, Sig.=0.007), indicating that the "PCE" model has a significant role in cultivating critical thinking abilities of college students.

Keywords: Issue-centered Teaching Model; Critical Thinking Ability; Radical Constructivism Theory**;** Guangxi Arts University.

Introduction

Critical thinking ability is an important ability for the development of students' core competencies in the 21st century. Countries in the international community hope to enhance their competitiveness and innovation in the new era through the cultivation of critical thinking. Guangxi Arts University is one of the eight comprehensive undergraduate art colleges in China. The university has listed cultivating critical thinking among college students as one of its educational goals, and teachers have realized the importance of cultivating critical thinking. However, the current teaching model for cultivating critical thinking has certain limitations, and teachers still do not know how to cultivate it. The root cause of many problems lies in the operational teaching model of cultivating critical thinking. Therefore, it is urgent to construct a teaching model of cultivating critical thinking. (Wu Yajie, Chen Li, and Zhao Hong, 2014: 71-77)

For college students, mastering and understanding existing human knowledge is important, but more importantly, it is necessary to criticize and question this knowledge, and propose new knowledge hypotheses based on it. Without the awareness and ability to criticize and question, they are easily trapped in the trap of existing knowledge, forming a habit of

* Received: October 20, 2023; Revised: October 26, 2023; Accepted: October 27, 2023

blindly following, leading to the inability to innovate knowledge. Conducting a survey on the current situation of critical thinking tendencies among students at Guangxi Arts University is an important basis for understanding the current situation of critical thinking among art students. When considering the concept of issue-centered teaching in a targeted manner, it is found that this is a method that can promote the development of critical thinking abilities. Therefore, analyzing the current critical thinking tendencies and abilities of college students, and addressing them in a targeted manner in teaching, is an important method for cultivating critical thinking among college students.

Research Objectives

1. To investigate the current situation of critical thinking ability of Guangxi Arts University.

2. To develop an issue-centered teaching model based on radical constructivism theory to improve students' critical thinking ability.

3. By comparing the critical thinking ability of students before and after the implementation of the teaching model, this paper discusses the effectiveness of the issue-centered teaching model based on the radical constructivism theory.

Research Methodology

The methodology of this research was research and development (R&D), The research process is divided into three steps: the first step is to study the current situation of critical thinking tendencies among college students in Guangxi Arts University; The second step is to develop issue-centered teaching model based on radical constructivism theory to improve students' critical thinking ability; The third step is to compare the critical thinking abilities of college students before and after implementing the teaching model, and understand the effectiveness of the issue-centered teaching model based on radical constructivism theory.

1. Studying the current situation of critical thinking tendencies among college students in Guangxi Arts University.

1.1Population group

The population is 15000 students who study at Guangxi Arts University.

1.2Sample Group

A purposive random sampling method was used, with a sample group of 478 students studying at Guangxi Arts University. Use the Krejcie and Morgan table to determine the sample size.

1.3 Research Tools

The Critical Thinking Disposition Scale for College Students

1.4 Development process of research tools

1.4.1 Researchers studied testing methods and structures, introductory courses, learning management activities, and critical thinking abilities.

1.4.2 Construct a questionnaire on critical thinking tendencies among college students, consisting of 7 dimensions, with 10 questions for each dimension and a total of 70 questions. Using a 5-point Likert scale format, from 'strongly disagree' to 'strongly agree', a total of 5 levels.

1.4.3 Test three experts to consider consistency in testing. The results indicate that the consistency index is between 0.67 and 1.00.

1.4.4 Conduct an experimental test on 40 students in a school to confirm the difficulty, discernment, and reliability of critical thinking test papers. The results showed that the difficulty index was between 0.20 and 0.80, the discriminant index was between 0.20 and 1.00, and the reliability (KR-21) was between 0.70 and 1.00.

2. Developing issue-centered teaching model based on radical constructivism theory to improve students' critical thinking ability.

2.1 Determine the components of the teaching model

2.1.1 Research, analyze, and integrate educational management policies to promote critical thinking, and then integrate information developed for teaching models.

(1) On August 14, 2019, the General Office of the Central Committee of the Communist Party of China and the General Office of the State Council issued the "Several Opinions on Deepening the Reform and Innovation of Ideological and Political Theory Courses in Schools in the New Era", proposing that education and teaching work should comply with educational laws and students' physical and mental development characteristics, face all students, teach and educate people, organically integrate moral education, intellectual education, physical education, aesthetic education, and other education activities, and focus on cultivating students' independent thinking ability Innovative and practical abilities, promoting students' comprehensive development.

(2) The Ministry of Education has clearly stipulated in the teaching management of the "2021 Standard for the Construction of Ideological and Political Theory Courses in Higher Education Institutions" that we should deepen curriculum reform and innovation, adhere to the unity of constructive and critical thinking, actively explore teaching method reform and optimize teaching methods.

(3) According to the education development plan of Guangxi Arts University, the curriculum focuses on improving learners' thinking abilities, setting a common mission, and cultivating learners' skills and abilities in the thinking process.

2.1.2 Integrate and develop educational concepts related to the issue- centered teaching model based on radical constructivism theory to enhance students' critical thinking abilities.

The 2022 version of the Curriculum Standards for Ethics and Rule of Law proposes to actively explore various teaching methods such as issue based, experiential, and project-based, guide students to participate in the experience, and promote comprehension and construction. We should adopt methods such as hot spot analysis, role-playing, situational experience, and simulation activities to guide students to engage in independent and cooperative exploration, and help them understand society.

2.1.3 By learning and organizing relevant theoretical concepts, form relevant theoretical concepts. In this case, use issue-centered teaching, radical constructivist theory, and critical thinking.

2.1.4 Formulation of Basic Concepts of Teaching Model: By analyzing the current situation of education management, promoting critical thinking, and integrating educational philosophy and related theoretical concepts into the basic concepts of teaching model.

2.1.5 Determination of the Elements of Teaching Model: By analyzing the current situation of promoting critical thinking in educational management, relevant theoretical

concepts of educational philosophy, and basic concepts of teaching model, it is synthesized into the elements, principles, objectives, scope, teaching activities, media, and evaluation of teaching model.

2.2 Creating a teaching model.

2.2.1 Use the teaching style elements implemented in step 1 to create a relationship with the teaching model and present it in the form of a teaching model chart.

2.2.2 Create a presentation document for the teaching model, prepare the presentation document, and provide a detailed explanation of each element of the teaching model.

2.3 Recording teaching model by generating files related to teaching styles is a teaching style manual.

2.4 Check the quality of teaching model with various documents, including teaching model demonstration files and teaching model support files for expert review, editing, and suggestions. Evaluation of teaching model. After the drafting of the teaching model was completed, the researchers invited three experts to evaluate the compliance of the teaching model. The specific content is as follows:

2.4.1. Evaluation purpose of teaching model

The purpose of evaluating teaching models is to evaluate their applicability and consistency. By considering the components of the course, namely principles, objectives, standards, subject categories, and subject content. The content structure and time guide of learning management. The measurement and evaluation of media and learning resources. How is the applicability and consistency of learning management plans.

2.4.2 Population

This course evaluation consists of three experts who will evaluate the applicability of the teaching model.

2.4.3 Research tools

The tool used for data collection consists of two parts.

The evaluation of the appropriateness of teaching models in Part 1 is based on a 5-level evaluation scale, which includes maximum, maximum, medium, minimum, and minimum.

The second part of the teaching model compliance evaluation uses the index of Objective consistency (IOC) as the consideration standard.

At the end of each section, there is a space for experts to write suggestions that can help improve the teaching model.

3. Comparing the critical thinking abilities of college students before and after implementing the teaching model, and understanding the effectiveness of the issue-centered teaching model based on radical constructivism theory.

3.1. Population

The population used in this study is 3000 senior college students from Guangxi Arts University in the second semester of the 2023 academic year.

3.2 Sample Group

The sample group consists of 32 students in a class of music education major in a senior year of Guangxi Arts University randomly selected from the second semester of the 2023 academic year.

3.2 Research Tools

3.2.1 Instrumentation

1) Lesson plan

2) College students critical thinking ability test

3.2.2 Development process of research tools

(1) Develop lesson plans. 6 learning units, 18 hours, with appropriate social issues set according to the course content for students to learn and discuss. By introducing appropriate content and aligning it with course objectives, it can be used to organize learning activities and promote learners' ability to think critically. Teachers should create issues and situations that meet teaching needs, guide students to discuss these situations, and in learning management, pay attention to learners' critical thinking abilities, namely 1) the ability to discover problems, 2) the ability to collect information, 3) the ability to think rationally about information, and 4) the ability to draw reasonable conclusions.

(2) College students critical thinking ability test. Using the development of issue-centered teaching model based on radical constructivism to enhance students' critical thinking abilities. This is a multiple-choice test with 4 options and 30 items, which includes the steps to create a tool as shown below

1) Determine the purpose of creating a test to measure critical thinking ability.

2) Research documents related to exam design.

3) Research topics that are suitable for testing purposes.

4) Design a test to measure your ability to think critically. Multiple choice questions have 4 options and 30 questions, created for practical exams.

5) Submit the created test to an expert to check the consistency index, with the following standards.

Combine the considered results with expert opinions to obtain a consistency index and select the IOC value for the exam. The IOC value tested is 0.80 or higher, which can be considered effective in terms of content.

6) Conduct tests among students. A prediction was conducted in a natural class of Guangxi Arts University, which was not a sample of 32 people to determine the quality of each item in the exam. The difficulty (p) of the exam ranged from 0.36 to 0.75, and the discriminant power(r) ranged from 0.22 to 0.72.

7) After analyzing each quality, a total of 30 tests were conducted to analyze the quality of the entire paper. By analyzing the confidence level of Kuder Richardson's KR-20 formula, the formula is 0.83.

8) Conduct critical thinking ability tests on student samples. A class of 32 students from Guangxi Arts University cultivates critical thinking skills before and after using the issue-centered teaching model.

3.3 Conduct Tests

This study is an experimental study. Using a pre-test and post-test design, the following experimental designs were conducted:

Group	Pre-test	Implementation courses	Post-test
R	O1	X	O2

The meaning of symbols used in experimental design:
R stands for random sampling
X represents the implementation course
O1 indicates pre-test
O2 indicates post-test

4.Data Collection

The researchers collected data according to the following steps.

4.1 Distribute a questionnaire on critical thinking tendencies among college students. 478 students from Guangxi Arts University measured the status of critical thinking tendencies among college students using a questionnaire created by researchers.

4.2 Organize an 18-hour learning activity for the course. There are 6 lesson plans.

4.3 Test the critical thinking ability of college students. Before the implementation of the teaching model, a critical thinking ability test was conducted on 32 senior students majoring in music education at Guangxi Arts University to obtain pre-test data. After implementing the issue-centered teaching model, the critical thinking ability test for college students was conducted again to obtain the post-test data.

4.4 Using Critical Thinking Ability Test Results. Compare students before and after the test.

Research Findings

In the study of "The development of issue-centered teaching model based on radical constructivism theory to improve students' critical thinking ability", the researcher got the following results.

1. Investigating the current situation of critical thinking of college students in Guangxi Arts University.

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

The result of questionnaire on critical thinking of college students in overview

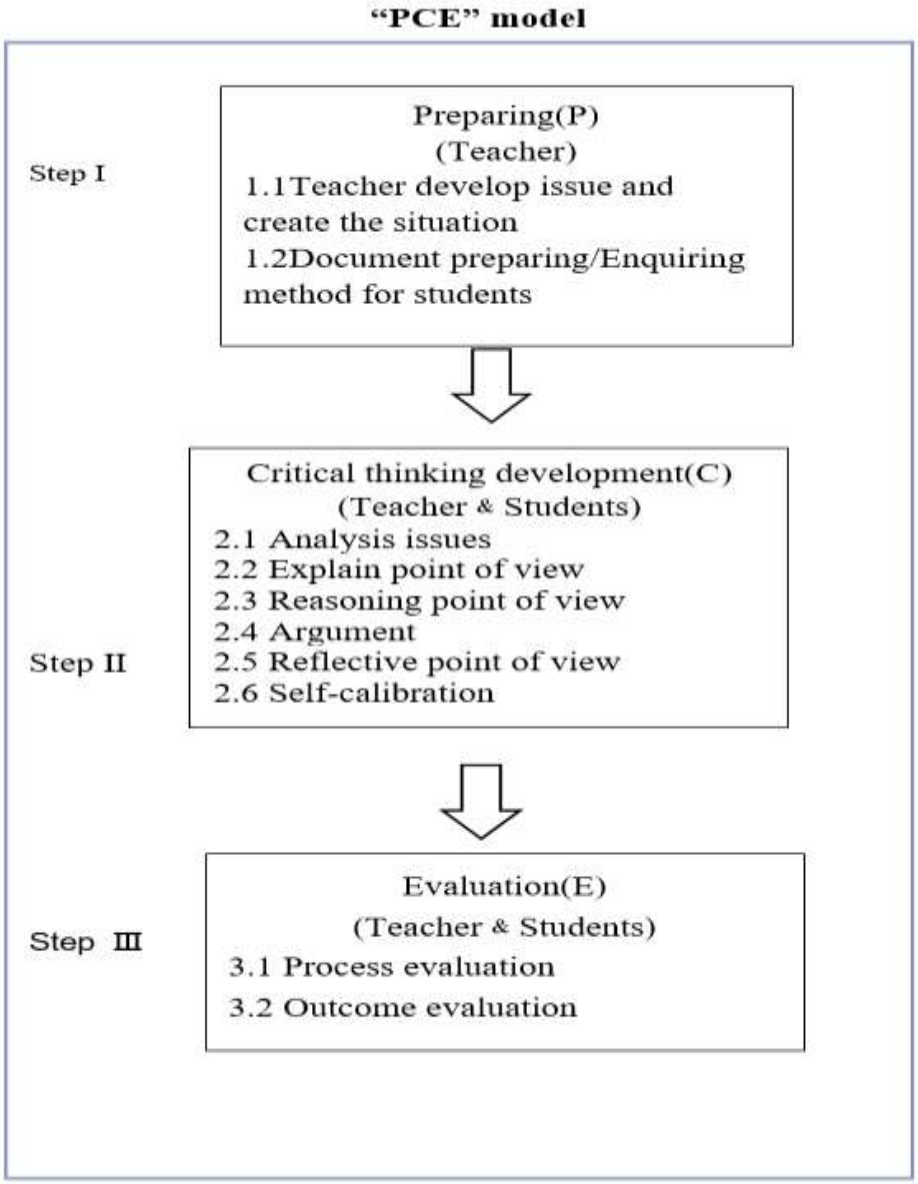
Table1 mean and standard of data analysis on critical thinking of college students overall

Critical thinking tendency dimensions	$\overline{X}$	**SD.**	**Interpret**	**Ranking**
1.Search for truth	2.99	0.56	fair	7
2.Open mind	3.22	0.40	fair	4
3.Skills of analyze	3.38	0.41	fair	2
4.Systems thinking	3.08	0.34	fair	5
5.Self-confidence	3.30	0.49	fair	3
6.Thirst for knowledge	3.43	0.45	fair	1
7.Cognitive maturity	3.07	0.54	fair	6
Total	**3.21**	**0.26**	**fair**	

From Table 1， We found that college students' critical thinking is generally fair($\bar{X}$ =3.21), showing a relatively balanced state in all dimensions, among which the thirst for knowledge is the highest ($\bar{X}$=3.43) which is fair level, followed by the Skills of analyze($\bar{X}$ =3.38), whereas the Search for truth($\bar{X}$=2.99) is the lowest which is fair level.

2. Developing the issue-centered teaching model based on Radical Constructivism theory to enhance university students' critical thinking.

Combining the important significance of issue-centered teaching in cultivating critical thinking, this study constructs an issue-centered teaching model for the cultivation of critical thinking, called the “PCE” model, which is divided into three steps: Preparing(P), Critical thinking development(C), and Evaluation(E). Among them, step Ⅰ Preparing (P) includes teacher develop issue and create the situation, document preparing/enquiring method for students; step Ⅱ Critical thinking development (C) includes six steps: analysis issues, explain point of view, reasoning point of view, argument, reflective point of view, and self-calibration; step Ⅲ Evaluation(E) includes process evaluation and outcome evaluation. The “PCE” teaching model is shown in the following figure:



3. Comparing the college students' critical thinking ability before and after the implementation of teaching model.

There are two parts in total, using tables and descriptions as well as mean, standard deviation, and explanation to present the analytical results (critical thinking level) serving objective 3, as well as the ranking of all projects. Afterwards, all dimensions are presented in the same way, and conduct a single sample t-test.

3.1 Current Teaching Experiment Results

Table 2 Comparison of pre-test and post-test scores of students' critical thinking ability

Critical thinking	Pre-test		Post-test	
	$\bar{X}$	SD.	$\bar{X}$	SD.
1.Analysis	3.41	1.07	3.69	1.00
2.Explain	2.50	1.16	2.56	1.41
3.Reasoning	1.28	0.92	2.16	0.99
4.Argument	2.75	1.11	3.09	1.06
5.Reflect	2.56	0.95	3.12	0.94
6.self-calibration	3.25	1.22	3.81	1.20
Total	**15.75**	**4.03**	**18.44**	**3.61**

From Table 2, it can be seen that the specific performance of college students' critical thinking ability before test is poor ($\bar{X}$ =15.75), the performance after test is to pass ($\bar{X}$ =18.44).

From various specific dimensions, the average score of each dimension after the test has made significant progress compared to before, with critical thinking showing the greatest improvement in Reasoning, followed by Argument and Self-calibration, and Explain being the smallest.

From the data before the test, it can be seen that students' Analysis ($\bar{X}$=3.41) is the best, followed by Self-calibration ($\bar{X}$ =3.25), rated average, with Explain ($\bar{X}$ = 2.50), Reasoning ($\bar{X}$=1.28), Argument ($\bar{X}$=2.75), Reflect ($\bar{X}$=2.56) All ratings are poor.

From the data after testing, it can be seen that the self-calibration ($\bar{X}$= 3.81) The highest score is good, followed by Analysis ($\bar{X}$=3.69), rated as medium, with Argument ($\bar{X}$ =3.09) and Reflect ($\bar{X}$=3.12) has increased to pass, with Explain ($\bar{X}$= 2.56) and Reasoning ($\bar{X}$= 2.16) Poor.

Table 3 T-test of critical thinking ability of college students before and after the test

	test	$\bar{X}$	SD.	t	df	Sig.
Critical Thinking Ability	Pre-test	15.75	4.03	2.809	62	0.007**
	Post-test	18.44	3.61			

** represents statistical significant at .01 level

From Table 4.11, it can be seen that through independent sample t-test, there is a significant difference in the scores of college students' critical thinking ability before and after the test (t=2.809, Sig.=0.007) statistical significant at .01 level, with an average value of 15.75 before the test and 18.44 after the test.

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 current survey of critical thinking tendencies among students at Guangxi Arts University, we found that the overall performance of critical thinking among college students is fair ($\overline{X}$=3.21). Consistent with the survey results of Liang Chunxiao. Qing Gen, and Shen Hong (2023 : 29-37), the study found that the critical thinking ability of Chinese college students is at a moderate to low level, and also consistent with the research results of Xia Huanhuan and Zhong Binglin (2017 : 67-76). The study found that the overall level of critical thinking among college students is the same, with weak deep reasoning ability, and generally insufficient development of problem awareness, questioning attitude, and critical spirit. The above research results are due to the following reasons: firstly, although China has initiated basic education curriculum reform since the beginning of the 21st century in 2001, gradually emphasizing the cultivation of students' core competencies, due to the emphasis on further education and scores in education evaluations at all levels, teachers still pay more attention to imparting students' knowledge in teaching, while neglecting the training of students' skills and the cultivation of critical thinking. Over time, students who have been trained naturally exhibit average levels of critical thinking; Secondly, in general universities in China, the cultivation of critical thinking ability among college students has long been neglected, which has also led to difficulties in effectively improving the critical thinking level of Chinese college students. The survey results of Liang Chunxiao. Qing Gen, and Shen Hong (2023 : 29-37) found that, the background and research experience of "prestigious colleges" are related to higher critical thinking abilities. This study also confirms this conclusion. Because Guangxi Arts University is only an ordinary college of art colleges, students' cultural scores in the college entrance examination are generally lower than those of ordinary college students. As an art university, the school mainly focuses on artistic creation aimed at cultivating artistic talents, such as music performance and art creation. The school's research funding is not high, and research activities are relatively few. Therefore, due to the lack of a "prestigious school" background and more research funding, Guangxi Arts University has fewer opportunities for students to receive critical thinking training, resulting in a lower overall level of critical thinking among students. This is meaningful for designing targeted teaching models in this context to improve the critical thinking abilities of college students.

1.2 Further analysis reveals that from the seven specific dimensions of critical thinking tendencies, college students perform best in the thirst for knowledge ($\overline{X}$=3.44) dimension, with a level of average. This also indirectly confirms that China's long-term emphasis on knowledge teaching and mastery in basic education has led to students generally being more eager and enthusiastic about knowledge. From the specific performance of each question, we found that students performed best on question 26, "When dealing with difficult problems, the first thing to do is to understand the crux of the problem." ($\overline{X}$=3.77), indicating that after more than 40 years of reform and opening up in China, students' problem awareness has become stronger, and they are no longer simply superstitious about authority. This is in line with the actual situation of China's social development. From the above analysis, it can be seen that the survey data on the current situation of critical thinking among college students has high reliability and validity, which is in line with the actual situation. In subsequent research, it is also possible to further verify which demographic variables affect the various

dimensions of critical thinking tendencies among college students. Because there are significant personality differences within the group of college students in China, different personality traits may affect the formation of critical thinking tendencies among college students. At the same time, students' family background, educational experience, and social practice activities may have different consequences for the development of critical thinking tendencies among college students.

2. Discussion of the "PCE" model

Based on the theory of radical constructivism, this study combines the important significance of issue-centered teaching in cultivating critical thinking, and constructs an issue-centered teaching model that focuses on cultivating critical thinking, called the "PCE" model. It is divided into three steps: Preparation, Critical thinking development, and Evaluation. Among them, step 1 Preparation (P) includes teachers preparing issues and creating scenarios; Step 2: Critical thinking development (C) includes six steps: Analysis issues, Explain point of view, Reasoning point of view, Argument, Reflective point of view, and Self-calibration. Students can freely engage in discussions around the issues, think independently, collaborate on exploration, and critically reflect and question; Step 3 Evaluation(E) includes process evaluation and outcome evaluation. The "PCE" model makes learning an active and meaningful exploration process, no longer a simple one-way knowledge infusion. In the 6 steps of analysis, explanation, reasoning, argument, reflective, and self-calibration, students change their passive role as knowledge receivers. They discuss controversial issues with group members and share their opinions. At the same time, the team leader serves as the host, guiding members to take turns speaking according to the 6 steps of analysis, explanation, reasoning, argument, reflective, and self-calibration, showcasing the results of each member's thinking in the group. During this process, it is necessary to listen to the opinions of other group members or accept questions from other group members. Finally, the group will send representatives to report the conclusion of the issue. The "PCE" teaching model not only enhances students' oral expression ability and collaborative learning ability, but most importantly, it enhances students' ability to think from different perspectives and respect others' perspectives, improves their critical thinking ability, and thus enhances their understanding and inclusiveness of the entire social phenomenon. The teaching model has been fully recognized by experts due to its advanced design concept, clear operational steps, and reasonable evaluation methods. Three experts unanimously passed the IOC's recognition.

The "PCE" model aims to stimulate and encourage students to express different ideas, which is in line with the basic idea of the issue-centered teaching model. Its core purpose is to cultivate citizens with insight and critical spirit in a democratic society. It emphasizes that (1) public issues have an impact on individual life, which should become the content of school curriculum. (2) knowledge is no longer absolute truth, but can be tested and questioned; (3) As facilitators, teachers should inspire students to make strong arguments about their personal stance; (4) Students actively engage in reflective learning and approach their surroundings with caution (Ochoa Becher, A. S. 1996 : 6-13) Essentially, this study is similar to the research of Liu Dehua and Hang Ran (2020 : 3-10) and the research result of Intarasompun, W., Muangnual, P., and Punchatree, N. (2022 : 108-118), who believe that issue-centered teaching should start from controversial social public issues and comprehensively use various teaching methods such as discussion and exploration. In a free and open teaching atmosphere, students are encouraged to consider social issues from different perspectives based on their own life

experiences and interdisciplinary knowledge. The "PCE" model abandons traditional teaching methods and allows students to truly participate in the teaching process. With students as the main body, it creates independent thinking situations for students, allowing them to truly enter the classroom and learn to think independently, dare to question, and express their ideas, cultivating critical thinking. This study also shares similarities and differences with the research of Shi Yuchen, Liu Zhinan, and Cao Shu (2023 : 72-79). The study found that by designing high-quality issues based on real situations, rich and diverse teaching activities are carried out around the issues, and students are "introduced" into specific learning activities, including collecting information, raising questions, verifying hypotheses, negotiating plans, debating viewpoints, etc, It helps to promote the development of students' metacognitive abilities such as self-reflection and mutual evaluation.

3. Evaluate the effectiveness of the "PCE" model by comparing the changes in critical thinking abilities of college students before and after the implementation of the teaching mode

After implementing the "PCE" model, the scores of the 32 students participating in the teaching experiment showed a significant improvement, with the overall pre-test score increasing from 15.75 to 18.44, which fully proves the effectiveness of the "PCE" model in improving students' critical thinking ability. This result is consistent with the research findings of Zhang Qinggen and Tang Huanli (2021 : 79-88), which found that undergraduate students' critical thinking ability can only be improved through systematic training. The study of critical thinking courses is an important means to promote the development of undergraduate students' critical thinking abilities. By imparting basic skills or methods of critical thinking, and combining them with subject or professional knowledge for training, guidance, and reinforcement, undergraduate students' critical thinking abilities will be improved. In addition, consistent with the research findings of Wang Xiaoyu and Huang Yongliang (2023 : 38-47) specifically targeting foreign language majors, the study found that both research on foreign language teaching methods reform and foreign language curriculum reform can have a positive impact on the cultivation of critical thinking skills or critical thinking among English major students. The theory of radical constructivism focuses on the deep participation of learners in the learning process, emphasizing the construction and generation of students' existing experiences during the learning process. The "PCE" teaching model designed in this research project highlights students' central learning position, promotes them to actively learn and think, makes them truly masters of learning, stimulates their enthusiasm for learning, and achieves good learning results and improves their critical thinking ability.

3.2 From the six specific dimensions of critical thinking ability, there are significant differences in reasoning and reflective abilities among college students, while there is no significant difference in the four dimensions of analysis ability, explain ability, argument ability, and self-calibration before and after. The possible reasons are: (1) Reasoning and reflective abilities can be quickly acquired through short-term and intensive training, especially the "PCE" model, which can effectively improve the causes and consequences of students' reasoning situations through discussions on various issues, and provide feedback based on existing clues. (2) Analytical and explanatory abilities are the results of an individual's long-term cognitive development, which are related to their age, long-term educational experience, epistemological beliefs, etc. (Xia Huanhuan and Zhong Binglin, 2017 : 67-76). However, students majoring in music education tend to focus more on the learning and improvement of music skills during their long-term education, while neglecting the analysis and explanation of

the development process for the formation of basic knowledge. Furthermore, in the current context of education in China, the acquisition of analytical and explanatory abilities is not something that can be improved overnight, and requires continuous accumulation through long-term learning. (3) Argument ability and self-calibration ability are deep level critical thinking abilities that require long-term training plans and systematic learning to achieve better results.

Recommendations

The findings of this study bring dual recommendations: applicability of the results and future research

Applicability of the results

The "PCE" model is an issue-centered teaching model developed based on the theory of radical constructivism, aimed at comprehensively improving the critical thinking ability of college students. The design of this model is the result of years of teaching research and practice by researchers, which is in line with the current trend of university education and teaching and the personalized learning needs of students. Through teaching experiments, this model has been proven to have obvious advantages and effects, It’s not only helps to enhance the critical thinking ability of college students, but its student-centered flexibility is also applicable to other disciplines such as science, social sciences, and humanities. When considering adopting the "PCE" teaching model, please ensure that your educational environment and goals align with the characteristics and advantages of the model. To better apply this model, the following are some specific suggestions for teachers and university managers to help maximize its effectiveness.

(1) For teachers, the key to cultivating critical thinking ability is to inspire and guide undergraduate students to actively engage in "critical" thinking. This requires teachers to be able to apply teaching methods such as discovery, inquiry, immersion, and dialectics to stimulate students' sense of participation and enthusiasm, and promote their independent critical learning. A study has found that assigning challenging tasks to students, engaging in curriculum related interactions with students, using cooperative learning techniques in the classroom, emphasizing high-level cognitive activities, emphasizing the motivation of students to participate in learning activities, and working in a good campus atmosphere or culture have a significant impact on the appreciation of students' critical thinking abilities. To achieve this, teachers need to design clear courses or teaching models. The structure and objectives of each course unit should be clear and specific to help students better understand the course, and the steps of each teaching model should also be logically clear to develop students' critical thinking. Secondly, this study focuses on the issue, so teacher select issue is one of the important preparations. When selecting issue, teachers should, on the one hand, consider which social issues are currently the hot issue of social discussion, and may also be the issue that students are concerned about. On the other hand. Teachers also need to consider whether the choice of issue is controversial. Because the more controversial an issue is, the more it can inspire students to think from different perspectives. After experiencing conflict situations, students may experience cognitive imbalance, and through continuous thinking and reconstruction of viewpoints, they become new knowledge, which helps students improve their critical thinking ability. Finally, after determining the issue, it is necessary to choose a suitable social context to enter, so that students can further understand the issue through the context and stimulate

their interest.

(2) For university administrators, the first step is to actively support the development of teachers. Universities should help teachers master the skills required for issue-centered teaching, including training courses, resource sharing, and educational technology support. Secondly, how to improve the supporting system and introduce or train outstanding teachers with outstanding critical thinking teaching abilities and professional qualities is a problem that must be solved in the construction of the teaching staff in universities. Once again, it is important to encourage innovation and promote the sharing of best practices, which can be achieved by encouraging teachers to try new teaching methods and technologies. At the same time, universities should encourage teachers and researchers to delve into the best practices of issue-center teaching and share their research findings.

Future research

1. Further evaluate the effectiveness of the "PCE" model. In this teaching plan, due to limitations in manpower, material resources, and time, the researcher only designed 6 issues to complete the research process during the research period. In addition, the teaching class of the researchers is only a class of 32 fourth year students, and it is not possible to conduct research comparisons for more students. Moreover, the research time is only 18 hours, so the inference of the research results is still limited. In the future, more in-depth research can be conducted to evaluate the effectiveness of the "PCE" model in different majors, grades, and types of universities. Therefore, it is recommended that future research should analyze and study more students from different backgrounds to understand the improvement effect of the issue - centered teaching model on college students in different grades and majors.

2. Research methods can enhance the credibility of research by adding quantitative research tools and subjective qualitative research. This study is an implementation of the issue centered teaching model, which evaluates the changes in students' critical thinking ability through pre-test and post-test. In the future, it is suggested to add quantitative questionnaire data such as student evaluation forms and qualitative research tools such as teacher observation, teaching reflection, and student interviews to explore how to best promote the development of critical thinking among college students in the issue-centered teaching environment, making the research results more accurate.

3. Research on teacher training and support. By conducting in-depth research on the training and support required by teachers when adopting the “PCE” model, we can investigate their 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 further improve the support system of educational institutions for issue-centered teaching.

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