Development of Problem-Based Learning Instructional Model to Enhance Critical Thinking Ability of Undergraduate Students

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Abstract

This study aims to (1) examine the factors influencing the critical thinking abilities of undergraduate students, (2) develop a problem-based learning (PBL) instructional model to enhance these abilities, and (3) assess the effectiveness of the PBL model in improving students' critical thinking. The research was conducted in three phases to address the stated objectives. In Phase 1, the study involved 150 undergraduate students enrolled in the College Students' Career Guidance course during the second semester of the 2023 academic year, as well as three lecturers from Guangxi University of Finance and Economics, Baise University, and Guangxi Minzu University. Phase 2 focused on the validation of the PBL instructional model, with input from three experts who confirmed its compliance with utility, feasibility, propriety, and accuracy standards. In Phase 3, a sample of 50 students

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enrolled in the same course during the first semester of the 2024 academic year participated in the intervention. The data collection instruments included (1) a student questionnaire and lecturer interviews, (2) a conformity assessment form for validating the instructional model, (3) lesson plans designed using the PBL framework, and (4) a scoring rubric to evaluate critical thinking abilities. Data were analyzed using descriptive statistics, including percentages, means, and standard deviations.

The results of the study are as follows:

1. The study identified both internal and external factors that affect the critical thinking abilities of undergraduate students. Internal factors included psychological or physiological conditions, attitudes, and cognitive skills or knowledge. External factors encompassed teaching methods, instructional materials, and the learning environment.

2. The problem-based learning instructional model developed to enhance critical thinking was assessed and confirmed by three experts as fully compliant with utility, feasibility, propriety, and accuracy standards. The model comprises five components: (1) Principles and rationale, based on the course content and the results from objective 1 of the research; (2) Objectives, derived from the second research objective; (3) Content, aligned with the course structure; (4) Teaching methods and materials, designed according to the PBL framework; and (5) Evaluation, using a scoring rubric to assess students' critical thinking skills.

3. Following the intervention, the results indicated that 18% of the 50 students demonstrated excellent critical thinking skills, 74% achieved a good level, and 8% reached a moderate level. These findings support the research hypothesis, which posited that over 80% of participants would exhibit critical thinking abilities at a good level after being taught through the PBL model.

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

Introduction

The College Students' Career Guidance course at Guangxi University of Finance and Economics is a compulsory foundational course designed to equip students with essential job search skills, including career goal setting, resume writing, interview preparation, and critical thinking. This course plays a pivotal role in preparing students for future career development by fostering practical problem-solving abilities and encouraging active engagement in the learning process.

Critical thinking is increasingly recognized as an essential competency for success in the 21st century. In an era characterized by rapid information growth and societal change, the ability to adapt, innovate, and solve complex problems is crucial (Zhan, 2021; Aycicek, 2021). At Guangxi University of Finance and Economics, students are expected to develop six key critical thinking skills: perception, analysis, reasoning, evaluation, problem-solving, and reflection. These skills are central to both academic achievement and career success, making their development a primary focus of the Career Guidance course.

To enhance critical thinking, this study explores the application of the Problem-Based Learning (PBL) instructional model. PBL is a student-centered approach that promotes active participation, collaborative problem-solving, and critical analysis (Gallow, 2001; Tiwari et al., 2006). By using real-world problems as context, PBL encourages students to engage

deeply with the material, fostering both cognitive and affective competencies (Lin & Lee, 2013; Masek & Yamin, 2011). PBL has been shown to improve critical thinking, problem-solving, and decision-making skills, while also promoting teamwork and lifelong learning (Cheaney & Ingebritsen, 2005). Furthermore, starting lessons with a problem or question, as in PBL, can stimulate curiosity and guide students in building their own knowledge through inquiry (Synder & Synder, 2008; Chin & Chia, 2006).

Research has demonstrated that PBL is an effective strategy for developing critical thinking, particularly in are as such as interpretation, analysis, evaluation, and inference (Bailin, 2002; Aswan et al., 2018). By encouraging students to solve real-world problems, PBL fosters self-directed learning, confidence, and higher-order thinking (Savery, 2015). Additionally, PBL enhances collaboration and the exchange of ideas, making learning more meaningful and improving students' ability to apply knowledge in practical contexts (Sari et al., 2018; Degama & Sumarmin, 2019). This approach has been shown to positively impact cognitive, emotional, and psychomotor outcomes, further supporting its role in developing critical thinking skills (Mayang et al., 2021; Matthew, 2011).

Given the compelling evidence for the effectiveness of PBL in fostering critical thinking, this research aims to develop a PBL instructional model tailored to enhancing the critical thinking abilities of undergraduate students in the Career Guidance course.

Research Objectives

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

2. To develop problem-based learning instructional model to enhance critical thinking ability of undergraduate students.

3. To study the results of problem-based learning instructional model to enhance critical thinking ability of undergraduate students.

Research Methods

The present study was divided into 3 phases with population and samples or key informants, research instruments, data collection and data analysis as follows.

Phase I – Exploring and analyzing the factors affecting students' critical thinking ability

Key Informants

The informants in this phase were divided into two groups. Group I consisted of 150 students of College Students' Career Guidance course in Semester 2 academic year 2023 from 3 colleges in Guangxi Province, 50 students from Guangxi University of Finance and Economics, 50 students from Baise University and 50 students from Guangxi Minzu Universityr. The sample size was deemed adequate and sufficient for this study, calculated according to Krejcie and Morgan's formula (Krejcie & Morgan, 1970, p. 608) for determining sample size of a known population.

This formula set the population proportion at 0.5, with a 95% confidence level and a 5% margin of error, ensuring statistically significant results with minimal errors. The other group consisted of 3 lecturers who are teaching College Students' Career Guidance course from 3 colleges in Guangxi Province: 1 Lecture from Guangxi University of Finance and Economics, 1 Lecture from Baise University, and 1 Lecture from Guangxi Minzu University.

Research Instruments

Five-point Likert scale questionnaire was employed to collect data from Group I informants. Its content validity was approved by the calculated Item-Objective Congruence (IOC) values of 0.85. The questionnaire covered the items regarding internal factors and external factors. An in-depth interview with IOC value of 1.00 was designed to collect data from lecturers in Group 2. It consisted of 10 questions corresponding to the internal and external factors related to problems in teaching critical thinking ability, opinions on method of instruction, development of learners' critical thinking ability.

Data Collection

In order to collect data from Group I effectively, the informants were allowed to answer the questionnaires independently. Then they were collected back by the researcher. Each informant was labeled, marked with numbers and sorted by the researcher. As for Group II, the researcher administered the semi-structured interviews. The answer record of each lecturer was labeled, coded with numbers and sorted by the researcher.

Data Analysis

Data obtained from Group I informants were quantitatively analyzed by descriptive statistics i.e., frequency, MEAN, and standard deviation along with interpretation of MEAN on basis of 5 ranges of attitude, 1.00 – 5.00, from the lowest to the highest agreement. The factors obtained from the students are interpreted by using MEAN interpretation criteria. The 5 levels of frequency were calculated by using the formula as detailed in Table 1.

Table 1 Mean range of five levels of frequency of questionnaire for students

Mean range	Interpretation
4.51-5.00	Strongly Disagree
3.51-4.50	Agree
2.51-3.50	Neutral
1.51-2.50	Disagree
1.00-1.50	Strongly Disagree

Besides, content analysis was used to analyze data collected from lecturers.

Phase II – Developing problem-based learning instructional model to enhance undergraduate students' critical thinking ability at Guangxi University of Finance and Economics

Key Informants

Three specialists in curriculum and instruction, particularly program evaluation were invited to evaluate the developed instructional model.

Research Instrument

A handout with details of problem-based learning instructional model was provided to the specialists as to introduce the components and functions of such a model based on instructional model development theories and factor outcomes obtained from phase I. Then, instructional model evaluation form was used by the specialists to approve to quality of the model before further implementation within 4 standards i.e., utility, feasibility, propriety, and accuracy. IOC value of both instruments measure 1.00.

Data Collection

After collecting data in phase I and designing handout and instructional model evaluation form, the handout and instructional model evaluation form were submitted to all 5 specialists and were collected by the end of the same month. The data of each specialist was labeled, coded with numbers, and sorted by the researcher.

Data Analysis

Frequency and percentage were employed to analyze dichotomy between 'Agree' and 'Disagree' among 5 specialists with 5 components of the model, namely principle/concepts, objectives, contents, methods of teaching and materials, and

evaluation. The accepted component must be agreed by specialists not less than 90%.

Phase III – Studying the results of implementing problem-based learning instructional model to enhance undergraduate students' critical thinking ability at Guangxi University of Finance and Economics

The implementation of the problem-based learning instructional model in this study aimed to enhance undergraduate students' critical thinking ability across six dimensions 1) Perception ability, 2) Analytical ability, 3) Reasoning ability, 4) Evaluation ability, 5) Problem-solving ability, 6) Reflective ability (Facione, 1990; Yang, Newby & Bill, 2005; Aswan, et al., 2018)

Population

The population included 150 sophomore students from 3 sections (A-C) with different levels of learning achievement beginner, intermediate, and advanced, who enrolled in College Students' Career Guidance Course at Guangxi University of Finance and Economics in semester 1 academic year 2024.

Samples

Since the present study was based on one-group pretest-posttest research design, 50 undergraduate students who enroll in College English Course students from section B of all three sections at Guangxi University of Finance and Economics in semester 1 academic year 2024 were obtained through simple random sampling.

Research Instrument

To implement the developed instructional model, lesson plans using problem-based learning instructional model were designed in line with the teaching material employed in College Students' Career Guidance course at Guangxi University of Finance and Economics in semester 1 academic year, 2024. Unit 3 Guidance on the job search process with total 16 hours was chosen for the experiment.

Data Collection

As for collecting students' critical thinking ability data, they were assigned to present complete critical thinking task by organizing teams to collect, categorize, extract and prioritize employment information.

Data Analysis

Students' performance was categorized according to rubric scoring criteria into their levels descriptor in terms of 6 items – perception ability, analytical ability, reasoning ability, evaluation ability, problem-solving ability, and reflective ability (See Appendix). Then, data were statistically analyzed by frequency and percentage to represent students' critical thinking ability at each development level ranging from poor up to excellent after the criteria as shown in table 2 and 3.

Table 2 Criteria of Each Item Evaluation

Score	Grade
9-10	Excellent
7-8	Good
5-6	Medium
3-4	Pass
Less than 3	Poor

Table 3 Criteria of All Item Evaluation

Score	Grade
49-60	Excellent
37-48	Good
25-36	Medium
13-24	Pass
Less than 13	Poor

Results

1) The Factors Affecting Undergraduate Students' Critical Thinking Ability

1.1 Students' Attitude Survey Results

This section presented the analysis results serving objective 1 using table and description in terms of MEAN, standard deviation, and interpretation (Level of Attitude) as shown in Table 3.

Table 3 The result of questionnaire from students in overview

Factors	$\bar{\mu}$	σ	Interpretation
Internal factors *(Psychology or physiology, Attitude, Knowledge or skills)*			
1. Students realize the importance of the College Students' Career Guidance course and firmly believe that critical thinking ability are of great help to future career choice and personal development.	4.31	.79	high
2. Students believe that good personality, stable mood and friendly way of getting along will contribute to collecting, identifying and processing career information, which improves their critical thinking ability.	4.47	.76	high

Table 3 The result of questionnaire from students in overview (Continued)

Factors	$\bar{\mu}$	σ	Interpretation
3. Students believe that it is very important for students to have a good learning attitude towards College Students' Career Guidance course. They consider that thinking positively in class and summing up meticulously after class for students in the course could help students to collect, identify and deal with career information and improve job-hunting skills, which will enhance critical thinking ability.	4.39	.72	high
4. Students believe that students can combine their personal interests, majors and values to effectively plan their future careers and enhance their job search competitiveness through College Students' Career Guidance course. Because when you participate in the interview, you can better show your own advantages, and conduct in-depth analysis of professional problems or phenomena.	4.32	.75	high

Table 3 The result of questionnaire from students in overview (Continued)

Factors	$\bar{\mu}$	σ	Interpretation
5. The significance of the prior knowledge is to help students build a bridge between new knowledge and that they have already in College Students' Career Guidance course. After learning theoretical knowledge, students acquire vocational knowledge through various online platforms and digital resources, which helps to improve students' vocational cognitive ability.	4.21	.75	high
6. Students believe that taking notes and participating in discussions in class can better understand and master new knowledge.	4.19	.76	high
Total Average of Internal factors	**4.32**	**.65**	
External factors (Method of teaching, Materials, Environment)			
7. Students believe that teachers adopt a variety of teaching methods such as case analysis, scenario simulation, role playing and group discussion in College Students' Career Guidance course, which can stimulate students' learning interest and promote the development of students' critical thinking ability.	4.29	.71	high

Table 3 The result of questionnaire from students in overview (Continued)

Factors	$\bar{\mu}$	σ	Interpretation
8.Students believe that teachers take the ability as the orientation, take the problem as the driving force, pay attention to the creation of situations, and guide students to think independently in College Students' Career Guidance course, which is conducive to improving their critical thinking ability.	4.31	.69	high
9. Students believe that teachers use rich digital teaching resources, such as digital education platforms, online teaching videos, to achieve diversified learning in College Students' Career Guidance course, which helps improve their critical thinking ability.	4.27	.72	high
10. Students believe that teachers choice of teaching materials around their critical thinking skills training objectives, and providing cases and training materials closely related to their study life and future career can help promote the development of students' critical thinking ability.	4.27	.71	high

Table 3 The result of questionnaire from students in overview (Continued)

Factors	$\bar{\mu}$	σ	Interpretation
11. Students believe that appropriate class size, relaxed classroom atmosphere, full use of social resources and experiential education in College Students' Career Guidance course, which can help them improve their critical thinking ability in employment practice.	4.33	.68	high
12. The campus can access the Internet anytime and anywhere, the classroom is clean and bright, the desks and chairs are warm and comfortable, and the multimedia equipment is complete, which facilitates the teaching process. Such conditions could improve students' problem-solving ability and critical thinking ability.	4.29	.67	high
Total Average of External Factors	**4.29**	**.61**	**high**
Total Average of All Factors	**4.30**	**.63**	**high**

Table 3 reported the results of the factors affecting students' critical thinking ability. They were generally found at the high level (μ=4.30). The internal factors affecting critical thinking ability are found to be at a high level (μ=4.32).

From the perspective of each item, it was found that No.2 has highest mean (μ=4.47), followed by No.3 (μ=4.39), while No.6 has lowest mean (μ=4.19).

For external factors affecting the critical thinking, the overall level is found to at a high level (μ=4.29). From the perspective of each item, it was found that No.11 has highest mean (μ=4.39), followed by No.8 (μ=4.31), while No.9 has lowest mean (μ=4.27).

1.2 Teachers' Interview Results

Following interviews with seven lecturers, the factors influencing critical thinking ability among undergraduate students can be summarized as follows:

Internal Factors

Lecturers emphasized the critical role of teachers' psychology and attitudes in fostering students' critical thinking. Teachers' positive emotions and enthusiasm create a safe, engaging learning environment, encouraging student participation, creativity, and motivation. Teachers passionate about their profession tend to develop strong teacher-student relationships, fostering open communication and collaboration. Broad knowledge and advanced teaching skills further enable instructors to guide students in analyzing problems from multiple perspectives and making informed decisions. Continuous professional development ensures teachers remain equipped to address evolving career challenges, design innovative activities, and improve students' reasoning abilities.

External Factors

Teaching Methods

Diverse instructional strategies, including problem-driven tasks, group cooperation, and role-playing, stimulate critical thinking by encouraging students to explore multiple perspectives. However, reliance on traditional methods can limit engagement. Integrating ICT and online resources enriches learning by providing real-world scenarios, personalized tools, and collaborative platforms.

Materials

Varied teaching resources, such as industry reports, workplace videos, and simulation platforms, enable students to analyze industry trends, assess their strengths, and learn from professionals' experiences, enhancing their adaptability and competitiveness.

Environment

An interactive, resource-rich learning atmosphere supports critical thinking. Small class sizes ensure personalized instruction and active participation, while access to extensive resources fosters independent exploration. Universities can further enhance outcomes by investing in innovative and vocational education practices, preparing students for complex career challenges.

By addressing these factors, Career Guidance courses can significantly strengthen students' analytical and decision-making skills for their professional futures.

2) Confirming the appropriateness of problem-based learning instructional model to enhance undergraduate students' critical thinking ability at Guangxi University of Finance and Economics

To serve objective 2, the collected data from 5 specialists of confirming the appropriateness of 5 components of instructional model prior to further implementation were analyzed within 4 areas of standards i.e., utility, feasibility, propriety, and accuracy, and were presented by frequency and percentage of the specialists as shown in the table 4 below.

Table 4 Frequency and percentage of conformability of utility, feasibility, propriety, and accuracy of the instructional model components in 5 areas by specialists

Components of Instructional Model of project-based learning instructional model to enhance undergraduate students' creativity ability	Assessment							
	Utility		Feasibility		Propriety		Accuracy	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
I. Principle & Rationale	5	100	5	100	5	100	5	100
II. Objectives	5	100	5	100	5	100	5	100
III. Contents	5	100	5	100	5	100	5	100
IV. Methods of teaching & Materials	5	100	5	100	5	100	5	100
V. Evaluation	5	100	5	100	5	100	5	100

From Table 4 above, all 5 components of the problem-based learning instructional model on students' academic English reading comprehension were 100% confirmed to be appropriate by 5 specialists. These results confirmed the appropriateness of the developed instructional model for further implementation (≥90%).

3) Studying the effectiveness of the problem-based learning instructional model on undergraduate students' critical thinking ability at Guangxi University of Finance and Economics

The following table 5 was the results of overall students' critical thinking ability before and after implementing problem-based learning instructional model for the sample group students at Guangxi University of Finance and Economics.

Table 5 Summary the level: Critical thinking ability over all 12 standards

Development level	Frequency	Percentage
Excellent	9	18.00
Good	37	74.00
Medium	4	8.00
Pass	0	0.00
Poor	0	0.00

Figure 1 Students' critical thinking ability level through problem-based learning instructional model

Table 5 shows that after implementing the problem-based learning instructional model, most of the students (92%) showed a good or excellent level of critical thinking ability. Among them, 9 were excellent (18%), 37 were good (74%), 4 were medium (8%), there were no student at a pass or poor development level of critical thinking ability. Overall, according to figure 1, after implementing the problem-based learning instructional model, the critical thinking ability of most students (92%) has been improved. This result is consistent with the research hypothesis that after implementing the problem-based learning instructional model, students' critical thinking ability will increase by 80% overall (Good level or higher). Therefore, we can conclude that the problem-based learning instructional model is effective for enhancing undergraduate students' critical thinking ability.

Discussions

The present study highlights various factors influencing critical thinking development. Internal factors, such as students' psychology, attitudes, and knowledge, play a significant role. Motivation and interest are crucial drivers, encouraging learners to independently improve their perception, analytical, and reasoning abilities (Fitrianti & Nur, 2018; Chamidy et al., 2023). These elements provide the foundation for adopting problem-based learning (PBL) methods, which are effective in cultivating critical thinking skills.

External factors, including teaching methods, materials, and the learning environment, also significantly influence students' critical thinking. PBL, in particular, facilitates mastery of knowledge and problem-solving skills through interactive and collaborative learning activities (Liu, 2023; Bai et al., 2022). Furthermore, a supportive teaching environment, enriched with resources and infrastructure, fosters innovation and enhances critical thinking outcomes (Gao & Abidin, 2023).

The PBL instructional model developed in the study consists of five components: principles, objectives, content, teaching methods, and evaluation. Rooted in Constructivist and Humanistic theories, this model emphasizes clear objectives, logically organized content, and engaging teaching methods to effectively promote critical thinking. Experts unanimously endorsed the model for its practicality, feasibility, and alignment with instructional goals. Its evaluation mechanisms, such as rubrics, ensure targeted feedback and continuous improvement.

Experimental results revealed significant enhancements in students' critical thinking across various dimensions. Perception ability improved for 90% of students, exceeding expectations. Analytical and reasoning skills also saw substantial growth, with 86% of participants demonstrating proficiency, enabling better problem-solving readiness (Nasution et al., 2023; Sappaile et al., 2023). Evaluation skills, essential for drawing sound conclusions, improved in 82% of students (Quansah et al., 2024). Problem-solving ability also showed

positive outcomes, with 84% of students excelling in real-world application (Ningsih et al., 2024). Reflective ability, critical for continuous learning and self-improvement, was strengthened in 86% of participants (Doron et al., 2022). These findings confirm that the PBL instructional model substantially enhances critical thinking by addressing essential internal and external factors. Its robust framework equips students with the skills needed for academic and professional success, fostering lifelong learning and adaptability.

Recommendations

The study *Development of Problem-Based Learning Instructional Model to Enhance Critical Thinking Ability of Undergraduate Students* concludes with recommendations for students, lecturers, and school administrators, as well as suggestions for future research directions.

For students, the researcher emphasizes the importance of fostering learning interest, enthusiasm, and autonomy. Assignments should be both engaging and practical, with problem-based learning (PBL) tasks requiring individual and group efforts to build foundational knowledge and skills. Active participation in diverse learning activities is recommended to enhance employability and critical thinking through collaborative problem-solving and result-sharing. Additionally, students are encouraged to explore interdisciplinary learning and leverage emerging technologies to refine their critical

thinking and problem-solving processes. By systematically addressing real-world challenges, students can acquire the necessary skills to confront future crises effectively.

For lecturers, the focus is on integrating critical thinking training into their teaching practices. Lecturers should enhance their competency in applying PBL methods, which provide students with opportunities for deep thinking, individual practice, and teamwork. Continuous professional development and self-training are essential for lecturers to model logical and rigorous critical thinking. Encouraging students to freely express their ideas and propose diverse solutions is critical in fostering an open learning environment. Moreover, lecturers should guide students in utilizing advanced tools, such as app-based platforms, for personalized learning and praise innovative approaches. Group collaboration within the PBL framework is highlighted as a highly effective strategy for improving critical thinking.

For universities, optimizing talent development goals and curriculum structures is crucial. Schools should align their programs with professional characteristics while prioritizing the cultivation of critical thinking abilities. Investments in teaching platforms, modern equipment, and simulated environments such as VR and AR can significantly enhance teaching and learning experiences. Additionally, universities must support faculty by offering training in innovative teaching methods to ensure the successful implementation of PBL.

Future research is proposed in several areas: developing PBL models to enhance other skills, exploring alternative instructional models for critical thinking, assessing the effectiveness of PBL in diverse professional courses, and expanding its application to students at different educational levels. These efforts aim to deepen the understanding of PBL's impact and refine its implementation across varied contexts.

In summary, the application of PBL is pivotal to advancing critical thinking and career readiness in higher education. Future studies should focus on designing more effective teaching programs that foster student engagement, enhance learning outcomes, and equip graduates with the skills needed to thrive in complex professional environments.

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