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THE DEVELOPMENT OF AN INSTRUCTIONAL MODEL BASED ON RESEARCH-BASED LEARNING AND ARGUMENTATION APPROACHES TO ENHANCE CRITICAL THINKING SKILLS FOR UNDERGRADUATE STUDENTS

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ABSTRACT

This study aimed to develop and evaluate the effectiveness of an instructional model integrating research-based learning and argumentation approaches to enhance critical thinking skills among undergraduate students. The research process consisted of two phases: (1) developing the instructional model and (2) studying its effectiveness. The target group consisted of 18 undergraduate students from a private higher education institution in Thailand, selected via purposive sampling. Data were analyzed using content and descriptive analyses. The findings indicated that the developed instructional model included four main components: (1) objectives, (2) principles, (3) instructional procedures, and (4) assessment and evaluation guidelines. The instructional procedures were organized into six stages: (1) problem identification, (2) solution exploration, (3) reception of arguments, (4) evidence augmentation, (5) verification process, and (6) structuring and discussion. The effectiveness study revealed a significant improvement in students' critical thinking skills after participating in the instructional model, with a significance level of .01. These results underscore the potential of integrating research-based learning and argumentation approaches to enhance critical thinking among undergraduate students.

Keywords: Critical thinking skill; research-based learning; argumentation approach; instructional model

1. INTRODUCTION

In the BANI (Brittle, Anxious, Non-linear, Incomprehensible) era, the younger generation faces complex and diverse anxieties. The rapid and uncertain changes in social, economic, and environmental conditions contribute to a heightened sense of vulnerability, overwhelming pressure, and constant anxiety

(Menaria, 2024). This persistent state of unease can escalate into serious mental health issues, including depression and feelings of helplessness (Baskoro, 2023). Furthermore, information overload and the complexity of modern social issues hinder the younger generation's ability to make rational and effective decisions.

Critical thinking is identified as a crucial tool for coping with increasing challenges and complexities, particularly for undergraduate students who will soon become key members of the workforce, driving both personal and national economies (Jiracheewewong, 2023). This skillset empowers individuals to analyze complex information and make reasoned decisions in uncertain situations within fragile and unpredictable environments (Kusuma & Sarma, 2023).

Research by Thampi et al. (2024) on Thai higher education students revealed a disparity in their comprehension of critical thinking. While students demonstrated a strong understanding of the importance of critical thinking skills, as evidenced by a mean score of 79.45%, their grasp of essential thinking dispositions was considerably lower, averaging 58%. Moreover, when assessed on their ability to identify critical thinking skills and dispositions, scores dropped to 51%. This finding indicates that although students acknowledge the significance of critical thinking, they struggle to identify and articulate the characteristics of this cognitive capability.

Therefore, to enhance critical thinking skills among undergraduate students, who will become the nation's future human capital, and to provide an alternative to traditional learning contexts, the study aims to develop a targeted instructional model. This development is based on fundamental concepts derived from literature reviews and related research, specifically the research-based learning approach. This pedagogical approach is grounded in the Inquiry Teaching Method, which emphasizes student-driven investigation, experimentation, and self-discovery of answers, focusing on the process of inquiry and knowledge verification. Ultimately, this approach cultivates enthusiasm for learning, analytical thinking, and reasoning.

Research-based learning closely aligns with Constructivism and Constructionism learning theories, which posit that individuals construct knowledge through the interaction between new experiences and existing knowledge schemas. This process occurs internally, involving accommodation between prior knowledge and new environmental stimuli to gradually build personal cognitive structures. In this approach, learners engage in hands-on practice and authentic problem-solving. Concurrently, instructors serve as motivators and academic mentors, enabling students to construct knowledge and produce tangible outcomes independently.

Furthermore, to enhance the comprehensiveness of the instructional model, the researchers incorporated argumentation as a foundational element of the model. This approach aims to foster logical reasoning, information synthesis from diverse perspectives, and evidence-based decision making. As these skills are essential components of critical thinking, the integration of argumentation ensures that students can draw conclusions that are validated by references and thorough consideration.

Recognizing these issues and the importance of critical thinking skills for undergraduate students, the researchers developed an instructional model integrating research-based learning and argumentation in order to enhance critical thinking skills among undergraduate students. The present study has two main objectives:

1. To develop an instructional model based on research-based learning and argumentation approaches to enhance critical thinking abilities in undergraduate students.
2. To study the effectiveness of the instructional model in promoting critical thinking ability, utilizing research-based learning and argumentation approaches for undergraduate students.

2. LITERATURE

2.1 Critical thinking

Scholars have defined critical thinking in various ways across different periods. Dewey (1910) conceptualized critical thinking as requiring active and persistent examination of beliefs or claimed knowledge by evaluating their supporting evidence and potential implications. Paul and Elder (1992) defined critical thinking as a systematic process encompassing analytical and evaluative approaches to thought, ultimately aimed at enhancing cognitive capabilities. Ennis (1997) asserted that critical thinking represents a reasonable and reflective cognitive process focusing on beliefs and actions.

Various scholars have defined the components of critical thinking ability differently, yet most of these definitions share significant overlap. Dressel and Mayhew (1957), identified five dimensions: (1) Problem definition ability, (2) Ability to select relevant information for problem-solving, (3) Ability to identify basic assumptions, (4) Ability to formulate and select hypotheses, and (5) Ability to evaluate outcomes. Similarly, Watson and Glaser (1964) proposed that critical thinking ability consists of five dimensions: (1) Inference ability, (2) Recognition of assumptions, (3) Deduction ability, (4) Interpretation ability, and (5) Evaluation of

arguments. These align with Kneedler (1987, as cited in Office of the National Education Commission, 1997), who categorized critical thinking into three domains: (1) Problem definition, (2) Judgment of information relevance, and (3) Problem-solving. Additionally, Nekamanurak (1994) classified critical thinking components into seven dimensions: (1) Problem identification, (2) Information gathering, (3) Evaluation of source credibility, (4) Data characteristic identification, (5) Hypothesis formulation, (6) Data interpretation, and (7) Evaluation. Examining these diverse perspectives, this study synthesized the components of critical thinking ability into four elements: (1) Logical reasoning ability, (2) Information gathering and connection ability, (3) Systematic problem management ability, and (4) Decision-making and conclusion-drawing ability.

2.2 Research-based learning

Research-based learning (RBL) has been widely adopted in education to bridge theory and practical implementation. Arora et al. (2017) explain that RBL integrates theoretical knowledge with appropriate data collection and analysis procedures to verify or study specific phenomena. The engagement in such inquiries is required for the development of research competencies of future professionals. Similarly, Susiani et al. (2018) describe RBL as a learning model centered around high-level cognitive processes such as analysis, synthesis, and evaluation, which enables learners and instructors to enhance their assimilation and application of knowledge. RBL is grounded in constructivism and encompasses four key aspects: learning that builds students' understanding, learning that develops prior knowledge, knowledge involving social interaction, and achieving meaningful learning through real-world experiences. Ultimately, this research plays a crucial role in improving the quality of learning.

Pre-existing research demonstrates that RBL can develop a variety of skills. Luanganggoon (2012) noted that RBL enhances three key areas: (1) cognitive skills, including situational analysis, theory application, and problem-solving; (2) interpersonal skills, such as teamwork, responsibility, independent planning, and learning; and (3) numerical analysis, communication, and IT skills, particularly the ability to use technology and communicate data effectively. This is consistent with findings from Sota and Peltzer (2017), who similarly observed that RBL supports cognitive, ethical, social, and communication skills. Moreover, Dafik et al. (2019) found that RBL significantly assists with the development of metacognitive skills.

2.3 Argumentation approaches

Toulmin (2003) defines argumentation as the process of substantiating thoughts with appropriate reasoning. This aligns with Jiménez-Aleixandre and Erduran's (2007) definition, which frames argumentation as the explanation of knowledge through theory, reasoning, and empirical evidence. Argumentation functions as individual meaning-making in thought, writing, or discourse, utilizing evidence and reasoning to evaluate and judge claims. Moreover, it serves as social meaning-making, involving interpersonal dialogue aimed at persuasion within specific contexts. Jiménez-Aleixandre and Erduran (2007) further suggests that argumentative environments constitute a constructivist learning approach as they emphasize the critical evaluation of knowledge claims. This concept supports the perspective that learning is a process where learners construct understanding through interaction, engagement in discussion, and analysis of different viewpoints, thereby enhancing deeper content comprehension.

3. METHOD

This study employed a Research and Development (R&D) methodology and was conducted in two phases.

3.1 Phase 1

This phrase focused on the development and examination of the quality of the instructional model based on research-based learning and argumentation approaches to enhance critical thinking abilities for undergraduate students. It included the following steps:

1. Examined the problem context and reviewed academic literature and relevant research regarding the critical thinking abilities of undergraduate students.

2. Synthesized the components of critical thinking, which included four key elements: (1) logical reasoning, (2) information gathering and synthesis, (3) systematic problem-solving design, and decision-making and conclusion-drawing.

3. Reviewed foundational theories and concepts required for the development of the instructional model. The concepts used in this model development research are research-based learning and argumentation.

4. Synthesized and integrated these concepts into the instructional model's framework. The developed instructional model comprises four components: objectives, principles, instructional procedures, and assessment guidelines.

5. Assessed the quality of the instructional model by five experts in curriculum and instruction. A 5-point Likert scale was used to determine model suitability. Three experts in education measurement pre-validated the suitability assessment forms, applying the Index of Item-Objective Congruence (IOC: 0.67–1.00).

6. Developed research instruments to assess the model's effectiveness and developed a test for critical thinking and a rubric-based assessment. The critical thinking ability test was designed as an open-ended, scenario-based assessment and was validated by five experts, yielding an Item-Objective Congruence (IOC) index ranging from 0.60 to 1.00. The scoring rubric utilized a 4-point scale for each component of critical thinking. Score reliability was assessed through inter-rater consistency, yielding a value of 0.91.

7. Conducted a pilot study of the instructional model to test a sample group of 15 senior students from a Bachelor of Chinese Language Teaching program at a higher education institution. The pilot study was conducted over 24 hours.

3.2 Phase 2

This phrase focused on the study of the effectiveness of the instructional model, grounded in research-based learning and argumentation approaches to enhance critical thinking abilities for undergraduate students. It was conducted as follows:

1. A quasi-experimental research plan was designed by utilizing a one-group pretest-posttest design. The instructional model was implemented over a total duration of 60 hours. The specific activities are detailed in Table 1.

Table 1: Learning topics in the instructional model

No.	Learning topic
1	Contemporary Concepts and Perspectives in Chinese Language Teaching
2	Understanding the Structure of Chinese Language Lesson Planning
3	Factors Influencing Learning Atmosphere and Environment
4	Considering the Appropriateness of Instructional Media for Chinese Language Teaching
5	Selecting Strategies for Developing Chinese Language Skills in Various Contexts
6	Approaches to Interpreting Learning Outcomes and Assessing Chinese Language Proficiency

The instructional model spanned a total of 60 hours, distributed equally across the six learning topics, (10 hours a topic). The learning process for every topic adhered to a uniform pedagogical structure comprising six steps: Problem Identification (approximately 1.5 hours), Solution Exploration (approximately 2 hours), Reception of Arguments (approximately 2 hours), Evidence Augmentation (approximately 2 hours), Verification Process (approximately 1.5 hours), and Structuring and Discussion (approximately 1 hour).

2. Data were analyzed with both quantitative and qualitative approaches. Quantitative data were assessed using descriptive statistics and the Wilcoxon signed-rank test, while qualitative data were examined through content analysis.

3. The Instructional model was refined and finalized, based on research-based learning and argumentation approaches, to promote critical thinking skills in undergraduate students.

3.2.1 Participants

The target group for the research consisted of 18 junior students from a Bachelor of Chinese Language Teaching program at a higher education institution in Nonthaburi Province, Thailand, enrolled during the first semester of 2024. The inclusion criteria required students to have completed the Teaching Professional Practicum coursework to ensure they possess a sufficient understanding of their field of study. Participants whose attendance rates drop below 80% in the experimental sessions are removed from the study.

3.2.2 Research instruments

The research instruments included: the instructional model, a suitability evaluation form, a critical thinking ability test, and a rubric-based assessment for evaluating critical thinking skills.

3.2.3 Data analysis

The quality of the instructional model was assessed through content analysis by five experts. Descriptive analytics were employed to evaluate research data. Students' critical thinking skills were analyzed by scoring responses against the rubric and comparing the mean scores between pre-test and post-test results using the Wilcoxon signed-rank test, with a significance level of .01.

4. RESULTS

4.1 Phase 1: Results of Development and Quality Assessment of the Instructional Model

The development and quality assessment of the instructional model are detailed through its key components: (1) The objectives of the instructional model, (2) The principles of the instructional model, (3) The instructional procedures, and (4) The assessment and evaluation guidelines.

Five experts evaluated the quality of the developed model. The assessment results indicated a high level of suitability, with an overall score of 4.50. The individual components of the instructional model received ratings ranging from 4.00 to 5.00. The specifics are as follows:

1) The objective of the instructional model:

The instructional model aimed to enhance the critical thinking abilities of undergraduate students.

2) Six principles were considered:

2.1 Learning that identifies and clarifies key issues and questions while encouraging student participation and ownership of questions serves to foster motivation and meaningful engagement.

2.2 Exploring and discovering diverse answers promotes out-of-the-box and alternative thinking and creates opportunities for constructing new knowledge, and encourages students to seek creative options.

2.3 Engaging in argumentation with others, presenting agreements, disagreements, and differing viewpoints, thereby encourages learners to prioritize evidence, compare and analyze data, and draw reasoned conclusions to address various questions and problems.

2.4 Gathering additional information to confirm or revise conclusions enables students to explore further, reflect on data, and manage ambiguous ideas, thereby improving their ability to link facts to evidence for sound decision-making.

2.5 Testing or evaluating approaches or knowledge through various methods helps students understand differences and engage with reality, which may require appropriate adjustments before making decisions or solving problems. This is part of creating cognitive conflict, which leads to self-constructed knowledge.

2.6 Presenting and discussing knowledge is essential for synthesizing and interpreting self-generated knowledge in concrete terms and exchanging ideas. This process not only strengthens learning but also promotes further application and development.

3) The instructional procedures contained six steps (Figure 1):

Step 1: Problem Identification

In this phase, the instructor presents an open-ended problem or inquiry situated within a specific scenario for students to critically analyze, comprehend, and discuss. The objective is to foster collaborative exploration of concepts, formulating of connections to potential solutions or responses to the given scenario.

Step 2: Solution Exploration

Students investigate potential solutions or responses to the key inquiries by sourcing information from diverse academic and credible resources. Subsequently, they synthesize and present this gathered data as prospective solutions or explanations for the assigned problem or scenario.

Step 3: Reception of Arguments

The instructor initiates constructive argumentation, employing probing questioning to elicit new perspectives or encourage learners to explore broader or more complex cognitive pathways. This process may involve the instructor introducing counterarguments or suggesting more plausible alternatives. Consequently, learners are provided with opportunities to present evidence and reasoning to defend or revise their initial position.

Step 4: Evidence Augmentation

This stage succeeds the analysis, synthesis, and deliberation of information obtained through the argumentation process. It provides an opportunity for students to pursue supplementary data and evidence to synthesize conclusive problem-solving approaches or address the focal inquiry. This process may result in in either the reinforcement or refinement of their proposed solutions or responses.

Step 5: Verification Process

This phase entails learners engaging in a systematic verification of their synthesized conclusions or proposed methodologies. The verification process is conducted through two modalities:

First, Empirical Testing: Where applicable, learners conduct experimental trials or field tests to validate their hypotheses or solutions.

Second, Expert Evaluation: Learners subject their findings to critical assessment by relevant domain experts, a process facilitated by the instructor.

Step 6: Structuring and Discussion

This final phase involves learners synthesizing and organizing their verified findings into a cohesive framework for comprehensive reporting and discursive presentation. This presentation is substantiated by empirical evidence and validation outcomes, and a critical discussion of potential implications and future applications.

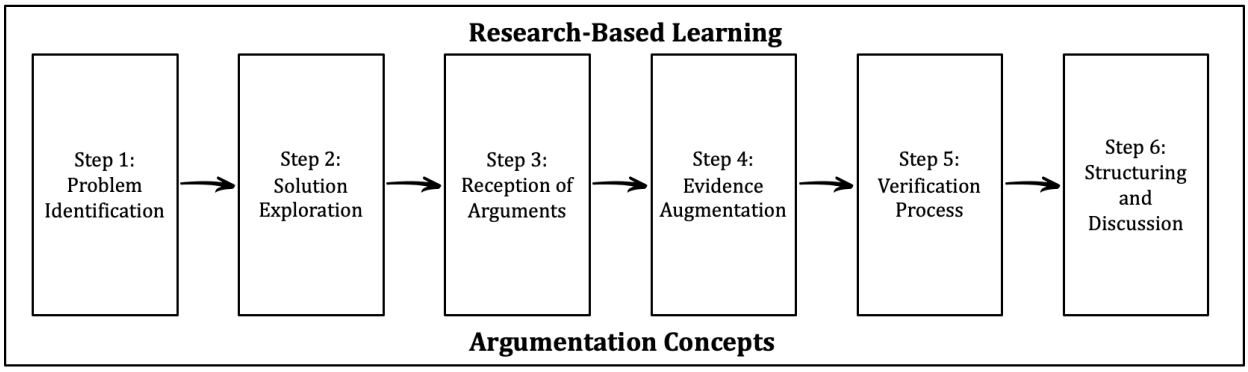

Figure 1: The instructional procedures

4) Assessment and evaluation guidelines

The assessment framework of this instructional model employs a multidimensional approach to measure critical thinking abilities. First, it utilizes a Scenario-Based Assessment, a situational test designed to evaluate discrete components of critical thinking skills. Second, it incorporates Rubric-Based Assessment, which facilitates a standardized evaluation of critical thinking performance across various cognitive dimensions.

4.2 Phase 2: Results of Instructional Model Effectiveness

The analysis of the mean scores of critical thinking abilities of undergraduate students was conducted. The analysis encompassed both aggregate scores and individual component metrics before and after the implementation of the instructional model. The results are presented in Table 2.

Table 2: Comparison of pre-test and post-test mean scores in undergraduate students' critical thinking abilities developed through research-based learning and argumentation approaches

	Testing	Full score 20		z	p-value
		$\bar{x}$	S.D.		
Critical thinking abilities	**Pre-test**	10.05	2.39	3.728	.000**
	Post-test	14.28	2.72		

**p < .01

The analysis of the data presented in Table 2 reveals that students demonstrated a statistically significant improvement in their aggregate critical thinking abilities from pre-test to post-test (p < .01).

Table 3: Comparison of mean pre-test and post-test scores for each component critical thinking abilities developed through research-based learning and argumentation approaches

	Components of Critical Thinking Abilities	Scores	Pre-test		Post-test		z	p-value
			$\bar{x}$	S.D.	$\bar{x}$	S.D.		
1	**Logical Reasoning Proficiency Ability**	5	2.64	.80	3.47	.76	3.332	.001**
2	**Information Synthesis and Integration Ability**	5	2.42	.77	3.58	.77	3.552	.000**
3	**Systematic Problem-Solving Ability**	5	2.58	.77	3.72	.79	3.649	.000**
4	**Decision-Making and Inferential Reasoning Ability**	5	2.42	.52	3.50	.86	3.427	.001**

**p < .01

Analysis of the data presented in Table 3 indicates that students exhibited statistically significant improvements across all individual components of critical thinking abilities from pre-test to post-test (p < .01).

5. DISCUSSION

5.1 Development and Quality Assessment of the Instructional Model

Based on the examination and quality improvement of the instructional model, the findings indicate that the developed instructional model was validated by five experts, yielding Index of Item-Objective Congruence (IOC) values ranging from 0.80 to 1.00 across its various components. The distinctive instructional procedures that characterize the model's quality are as follows:

1) In Step 1: Problem Identification, the teacher presents issues or open-ended questions embedded within scenarios for learners to analyze, understand, and discuss. This process engages learners in identifying solutions or answers for the given solution. This step aligns with the characteristics of critical thinking by providing opportunities for reflection, discussion, and deliberation. As Dewey (1910) noted, critical thinking is reflective and thoughtful reasoning that begins with a problematic situation and concludes with a clear and well-defined understanding. Subsequently, in Step 2: Solution Exploration, learners are encouraged to investigate solutions to key issues by retrieving information from diverse sources. They then present their synthesized findings as prospective solutions. This step allows learners to exercise critical judgment when sourcing information, formulating hypotheses, and referencing evidence. This directly aligns with Ennis's (1997) definition of critical thinking as reasonable, reflective thinking focused on deciding what to believe or do. The integration of information searching and evidence-based solution development exemplifies this reflective decision-making process.

The instructional procedures in these two steps emphasize cultivating the ability to reflect on and deliberate on complex problems and situations. This process involves utilizing credible references and evidence acquired through self-directed exploration and diverse discourses. By contributing to a reasoned understanding of the circumstances, these activities enable learners to consolidate and connect information to substantiate their conclusions. Therefore, this supports the development of logical reasoning proficiency and information synthesis, both of which are fundamental components of critical thinking skills.

2) In Step 3: Reception of Arguments, the instructional phase stimulates reflective thinking by introducing new perspectives and exploring broader or deeper paths to validate the conclusions derived from previous steps. While argumentation may superficially resemble a debate intended to persuade others through speech or writing to assert specific points, its underlying implication plays a significant role in promoting logical and reasoned thinking. It helps identify relationships between ideas and evidence, fostering the construction and critique of knowledge to validate one's synthesized understanding (Toulmin, 2003; Jeeravipoolvarn, 2020). Subsequently, in Step 4, Evidence Augmentation, learners analyze, summarize, and deliberate on the information gained from counterarguments. They actively search for supporting data and novel evidence to synthesize their conclusions or address key issues. This process forces learners to connect their thoughts with appropriate reasoning and empirical evidence to substantiate their claims (Toulmin, 2003; Jiménez-Aleixandre & Erduran, 2007).

These two steps play a pivotal role in reinforcing logical reasoning and the ability to collect and synthesize information. They require learners to use evidence-based reasoning to address counterarguments, pursue further evidence to validate or refine their ideas and systematically organize their cognitive process. Furthermore, these phases help learners approach problems methodically, exercise careful judgment, and arrive at well-considered conclusions grounded in specific contexts and multidimensional arguments. Consequently, this process is fundamental for systematic problem-solving, decision-making, and inferential reasoning ability, which are key components of critical thinking skills.

3) In Step 5: Verification Process, learners validate their synthesized conclusions through empirical testing or experimentation. This step is crucial for enabling learners to test their hypotheses, leading to fair and contextually appropriate decisions—an essential characteristic of critical thinking. Furthermore, it fosters systematic problem-solving skills by emphasizing the necessity of rigorous verification. Learners employ consistent, unbiased reasoning to evaluate their conclusions, thus affirming hypotheses and fully developing ideas that are fundamental for critical thinking. Subsequently, Step 6: Structuring and Discussion, enables learners to present and deliberate their findings, substantiated by evidence from their verification process. This step exemplifies systematic and logical thinking and encourages the exchange of ideas. It broadens learners' perspectives by inviting new viewpoints or differing opinions by receiving questions or suggestions from the audience. Such discussions deepen understanding and facilitate the refinement of conclusions, promoting self-reflection and review that are vital for developing critical thinking skills (Facione, 1990; Paul & Elder, 2014; Halpern, 2013).

5.2 Instructional Model Effectiveness

The research findings demonstrate that students' critical thinking abilities significantly increased after the experiment at the $p < .01$ level, both overall and at individual components. These results suggest that the

developed instructional model contributed to enhancing critical thinking abilities. The researchers deliberated that the supporting rationale for the model's strengths is as follows:

The developed instructional model demonstrably promoted critical thinking abilities, primarily due to the synergistic interaction between two fundamental theoretical frameworks: (1) Research-Based Learning (RBL) and (2) Argumentation. Research-based learning plays a crucial role in developing cognitive skills, promoting opportunities for questioning, information gathering, analysis, and evaluation, which tends to enhance critical thinking through logical reasoning, data credibility assessment, systematic problem-solving approach design, leading to decision-making and conclusion-drawing (Brew, 2006; Healey & Jenkins, 2009; Levy & Petrulis, 2012). The distinctive feature of this model, however, is the integration of argumentation which enables learners to practice systematic and rational thinking by requiring evidence-based reasoning to support their viewpoints while analyzing and responding to counterarguments. Although this process may necessitate perspective changes based on new evidence discovery or acceptance, it fundamentally helps learners develop diverse, broader, and deeper perspectives before summarizing and making decisions in any given situation (Kuhn, 1991; Nussbaum, 2005; Osborne, 2010). The synthesis of these two theoretical frameworks has empirically demonstrated effectiveness in promoting undergraduate students' critical thinking abilities through the six-step instructional procedures.

Beyond enhancing critical thinking abilities, the implementation of this instructional model revealed additional benefits, including improved teamwork capabilities, respect for others' opinions, and the enhancement of divergent thinking. This was evidenced by learners engaging in active listening and evaluating others' reasoning and evidence during argumentation without personal bias. Counterarguments require substantiation through credible empirical evidence. This form of argumentation fosters respect for diverse opinions, opens multiple perspectives, and mitigates fixation on personal findings. It emphasizes logical approaches over subjective judgment. This ensures that ideas are evaluated based on empirical evidence as opposed to personal subjectivity (Andriessen, 2006; Johnson & Johnson, 1989; Mercer & Howe, 2012).

During the implementation phases of Solution Exploration, Evidence Augmentation, Verification Process, and Structuring, and Discussion, there was a notable development in teamwork abilities, characterized by collaborative thinking, investigation, consideration, verification, and information exchange. This development resulted from the research-based teaching approach that emphasizes collaborative goal achievement through reasoned discourse and clear presentation of findings (Brew, 2006; Healey & Jenkins, 2009; Levy & Petrulis, 2012). Moreover, the model's foundation in research-based learning and argumentation stimulated creative and diverse thinking through argument consideration and response, practicing various problem-solving perspectives and decision-making approaches while encouraging systematic exploration of new problem-solving concepts. This learning approach cultivates divergent thinking capabilities. Specifically, the ability to find solutions to the same problem or question through flexible problem-solving abilities and creative analytical thinking, which are crucial skills in today's rapidly changing environment (Guilford, 1967; Runco, 2014; Cropley, 2006; Nussbaum, 2005; Osborne, 2010; Brew, 2006; Healey & Jenkins, 2009).

However, while the developed instructional model demonstrates clear potential for enhancing learners' critical thinking abilities, instructors must consider various dimensions in implementing the model, including information gathering and activity timing for each phase (Yaemkhayai, 2023) and sensitivity in argumentation and opinion expression. Therefore, it is essential to establish rules, criteria, and mutual agreements throughout the learning activities based on facts, academic discourse, courtesy, and mutual respect within a safe learning environment. This approach is crucial to ensure the effectiveness of the developed instructional model and to create a meaningful learning experience for all students.

6. CONCLUSION

The success of this model is attributed to its dual theoretical foundation in RBL and argumentation. RBL facilitates cognitive skill development through inquiry, data analysis, and evaluation, while argumentation fosters structured reasoning, engagement with counterarguments, and evidence-based discussions. However, to ensure effective implementation, carefully consider factors such as time management, information access, and sensitivity to argumentation. Instructors must establish clear guidelines for respectful dialogue and evidence-based discussions to maintain a constructive and inclusive learning environment.

7. RECOMMENDATIONS

7.1 Recommendations for research implementation

In implementing this developed instructional model, instructors should consider learners' capabilities when defining problems or situations that guide instructional activities throughout the process. Furthermore, they should establish a safe learning environment with clear rules and criteria for expressing opinions, discussions, evidence-based verification, academic discourse, courtesy, and mutual respect.

7.2 Recommendations for future research

Future research should focus on developing instructional models or teaching procedures that promote other thinking skills essential for modern learners' future life and career prospects, such as divergent, systematic, logical, and innovative thinking.

DECLARATION

1. Conflict of interest

The authors declare no conflict of interest.

2. Generative AI and AI-assisted technologies in the writing process

The authors used ChatGPT-4 (OpenAI) and Grammarly to refine the academic language and enhance the clarity of this manuscript. These tools were employed specifically for editing and improving the grammatical structure of the pre-written text. The authors take full responsibility for the content, interpretation, and conclusions of this work.

3. Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article.

4. Ethics statement

This study was approved by the Research Ethics Review Committee, Panyapiwat Institute of Management (Reference Number: PIM-REC 061/2024). The approval was granted on 25 November 2024. Informed consent was obtained from all participants involved in the study.

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6. Contributor Role Taxonomy (CRediT)

Chotiwan Yaemkhayai: Conceptualization, Formal analysis, Methodology, Investigation, Supervision, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing

Piyanart Piyasatit: Conceptualization, Formal analysis, Methodology, Investigation, Supervision, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing

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