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Development of Case-Based Learning Device with Cognitive Conflict Strategies to Improve the Critical Thinking Ability of Prospective Teacher Students

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Abstract

This study aimed to develop and evaluate a Case-Based Learning (CBL) device incorporating cognitive conflict strategies to enhance the critical thinking abilities of prospective teacher students, a response to the global competitiveness challenge faced by Indonesian education. Through a methodological lens of research and development, the study meticulously validated a suite of educational devices, including lesson plans, student worksheets, teaching materials, and instruments designed to test critical thinking abilities. Additionally, the research scrutinized the practicality of these devices in actual classroom settings, ensuring their applicability in real-world educational environments. The findings from this comprehensive analysis revealed that the CBL device not only met the criteria for validity and reliability but also demonstrated significant practicality, as evidenced by its seamless integration and consistent application in classroom scenarios. A pivotal aspect of the study was the quantifiable enhancement in the critical thinking capabilities of the students involved, which was rigorously assessed through pretest and posttest measures. These assessments, underpinned by substantial effect sizes obtained via paired t-test analyses, highlighted a marked improvement in the critical thinking skills of the prospective teachers. The empirical evidence garnered through this research underscores the transformative potential of the CBL device, advocating for its widespread adoption in teacher education programs. The study posits that such an innovative educational device is quintessential for equipping future educators with the necessary skills to navigate and contribute effectively to the 21st-century educational landscape, thereby responding adeptly to the evolving demands of global educational competitiveness.

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INTRODUCTION

The quality of education serves as a benchmark for a nation's progress, with a key aspect being the ability of students to compete globally and to solve everyday life problems. In terms of global competitiveness, Indonesian education appears to be relatively low, as evidenced by the 2015 results from the Programme for International Student Assessment (PISA) conducted by the Organization for Economic Cooperation and Development (OECD), where Indonesia ranked 62nd out of 70 countries (OECD, 2016). PISA assessment indicators include students'

problem-solving abilities and higher-order thinking skills (De Vries et al., 2022), among which critical thinking is a vital component.

Critical thinking is one of the skills encompassed within 21st-century competencies (Almazroa & Alotaibi, 2023). This skill transcends mere conceptual knowledge, involving the application of knowledge referred to as a 21st-century competency. The enhancement of educational quality is observed through curriculum reform changes. For example, Finland, a leading nation in education, has long integrated critical thinking as a learning objective within its curriculum (Horn & Veermans, 2019). Ennis (2018) describes the concept of critical thinking as reflective and logical thinking focused on deciding what to believe or do.

Teaching critical thinking to prospective teachers has been a cornerstone in the realm of education, reflecting a deep-seated recognition of its pivotal role in shaping educators capable of navigating the complexities of modern classrooms. The imperative for teacher educators to impart and nurture cognitive skills in prospective teachers before they transition into their professional roles is underscored by the understanding that these foundational skills are critical for the holistic development of students. According to Prayogi and Verawati (2020), when prospective teachers are adept in critical thinking, they possess the ability to significantly enhance their students' analytical capabilities. This is not merely about the transfer of knowledge but about fostering a learning environment where students are encouraged to question, analyze, and synthesize information, thereby achieving learning objectives more effectively (van Peppen et al., 2021). Critical thinking empowers prospective teachers with the discernment needed to sift through the vast amounts of information available, applying it judiciously to enrich the learning experience. This approach not only elevates the quality of education but also prepares students to tackle real-world challenges with a well-developed capacity for critical analysis, making the teaching of critical thinking to prospective teachers a crucial investment in the future of education.

One of the learning objectives, critical thinking, is included in Indonesia's Curriculum. However, the reality is that many educational approaches still primarily focus on developing and testing memory, thus reducing thinking skills to merely the ability to remember (Herpiana & Rosidin, 2018), rather than orienting towards achieving problem-solving and thinking skills as demanded by the curriculum. This necessitates the use of appropriate learning models, such as Case-based Learning (CBL). CBL is a learning model where students are motivated through self-directed learning to develop analytical and problem-solving skills (Dewi & Rahayu, 2023). These skills are part of critical thinking, suggesting that CBL is a method that can enhance critical thinking abilities. CBL allows for the analysis of content by first introducing core knowledge domains and encouraging students to explore other potentially relevant knowledge domains for the given problem case. A case defines a realistic and relevant problem scenario related to the studied material (Carder et al., 2001). Researchers also view prior knowledge of concepts, cases, or problems as triggers for maximal learning. Learners' prior knowledge is a primary factor in the learning process, supporting the construction of future knowledge (Waxer & Morton, 2012), aligning with constructivist learning views on the importance of connecting new knowledge with existing learner knowledge to promote meaningful learning (Aarto-Pesonen & Piirainen, 2020). Thus, educational activities must be improved to enhance critical thinking skills. One problem-solving alternative is the use of cognitive conflict approaches (Verawati et al., 2019).

The importance of cognitive conflict includes conceptual change (Anggoro et al., 2019; Lee et al., 2003), though it does not always result in consistent conceptual change (Vosniadou & Ioannides, 1998), meaning that even when students are presented with new, potentially contradictory information in learning, they often fail to recognize the conflict. Therefore,

several strategies can facilitate learners in recognizing conflict and engaging in learning, including presenting contradictory information or anomalous data (Limón, 2001). Effective case-based learning processes require that learners have prior knowledge of the material to be studied, thereby eliciting cognitive conflict. Such conflict within the cognitive structure is a primary asset of case-based learning (CBL). The learning process also requires instructional tools with an approach capable of developing students' thinking skills in understanding concepts correctly (Fitriani et al., 2022).

Literature studies indicate that employing cognitive conflict strategies in learning can bridge prior knowledge with actual concepts. In cognitive conflict learning strategies, counterexamples, analogies, and demonstrations can be presented (Dreyfus et al., 1990). The use of cognitive conflict strategies in Case-based Learning represents a collaborative learning endeavor that can theoretically enhance thinking abilities, particularly critical thinking skills. This is because learning through a cognitive conflict approach allows students to present their concepts and critique teachings that differ from their conceptions. This approach actively involves students in learning, expectedly enabling them to master concepts well and improve their thinking abilities, especially critical thinking skills. Therefore, it is necessary to innovate in learning, in this case, the development of Case-based learning devices with cognitive conflict strategies. The development of learning devices is critical for the success of educational activities (Yustina et al., 2020). This statement aligns with Ubaidah and Aminudin (2019), who argued that learning devices need to be developed for planned and measurable learning activities.

Specifically, the aim of this research is to develop a CBL apparatus with cognitive conflict strategies to enhance the critical thinking abilities of prospective teacher students. The learning devices developed include lesson plan and scenarios, student worksheets, teaching materials, and evaluation instruments. The devices developed must be valid, practical, and effective. The feasibility of all components of the learning device includes the practicality of the device's use by educators (lecturers) and the effectiveness of the learning device in enhancing students' critical thinking abilities. The research questions are formulated as follows.

1. How is the validity of CBL device with cognitive conflict strategies developed in enhancing the critical thinking abilities of prospective teacher students?
2. How practical is the developed CBL device with cognitive conflict strategies in enhancing the critical thinking abilities of prospective teacher students?
3. How effective is the CBL device with cognitive conflict strategies in enhancing the critical thinking abilities of prospective teacher students?

Novelty and Significance of the Current Research

The novelty of the current research lies in its targeted development of a Case-Based Learning (CBL) device, incorporating cognitive conflict strategies specifically designed to bolster the critical thinking abilities of prospective teacher students. This innovation addresses a crucial gap in educational practices, where traditional methodologies often fall short in nurturing essential higher-order thinking skills. By integrating cognitive conflict strategies, the research introduces a novel approach that not only challenges students to confront and reconcile conflicting information but also stimulates deeper analytical and problem-solving capabilities. The application of such strategies within a CBL framework is particularly significant, as it leverages the strengths of case-based learning—connecting theoretical knowledge with practical, real-world scenarios—while enhancing the engagement and

cognitive development of learners. This dual focus on case-based learning and cognitive conflict represents a sophisticated pedagogical strategy aimed at preparing prospective teachers to cultivate a similar depth of critical thinking and problem-solving skills in their future students.

The significance of this research extends beyond its novel methodology, promising substantial impacts on the quality of education for prospective teachers. By equipping teacher students with the tools to critically engage with content, question assumptions, and explore multiple perspectives, the study contributes to the development of educators who are better prepared to foster a learning environment that emphasizes critical thinking and problem-solving among their students. This is particularly relevant in the context of global educational competitiveness, where the ability to think critically is paramount for addressing complex, real-world problems. Moreover, the research's emphasis on practicality and effectiveness, through the development of lesson plans, scenarios, student worksheets, teaching materials, and evaluation instruments, underscores its commitment to creating tangible, usable educational resources. As such, the study not only contributes to the theoretical understanding of how cognitive conflict strategies can enhance critical thinking in a case-based learning context but also offers a concrete, tested toolset for immediate implementation in educational settings, marking a significant advancement in the field of teacher education.

METHODS

Study Design

This research is a development study (Research and Development) aimed at producing an educational device product utilizing a case-based learning (CBL) model with cognitive conflict strategies. The goal of the developed educational device in this study is to enhance students' critical thinking abilities. The development research was adapted and modified from the Gall et al. (2007) theory, incorporating three stages of research: pre-development of the device, development and validation of the device, and implementation and testing of the device, with criteria set in this study to produce a learning device that is valid, practical, and effective.

The pre-development phase involves preliminary studies and information gathering, as well as planning for device development. The preliminary research and information collection include literature reviews, initial observations, and determination of the main issues, conducted to understand the learning needs related to the development plan of the CBL device with cognitive conflict strategies. Based on the preliminary study, researchers then design and draft a CBL device with cognitive conflict strategies aimed at enhancing students' critical thinking abilities. The devised device is subsequently validated by three validators. Device validation assesses the validity of the lesson plan and scenarios, student worksheets, teaching materials, and the test instrument for critical thinking abilities. Suggestions and inputs from validators are followed up to refine the CBL device with cognitive conflict strategies. The device, having met the criteria for validity, is then implemented in the classroom to assess its practicality and effectiveness in enhancing students' critical thinking abilities.

Research Subjects and Ethical Consideration

The subjects of the trial in this development research are 20 students at Universitas Pendidikan Mandalika - Indonesia. Purposive sampling technique is applied to determine the research trial subjects, where the sample exclusively consists of students undertaking basic physics courses, and they are prospective physics teachers. Demographically, the research

sample ranges from 19 to 20 years of age, with a relatively balanced gender distribution between male and female.

In selecting the research subjects for this development study, ethical considerations were paramount to ensure the protection and respect of the participants' rights and well-being. Their participation was voluntary, with assurances that all data would be treated with confidentiality and used solely for research purposes. Before the commencement of the study, informed consent was obtained from all participants, emphasizing their right to withdraw from the study at any point without any penalty. The ethical approach to subject selection and treatment aimed to foster a trustworthy and safe research environment, adhering to ethical standards in educational research.

Instruments

The validity of the CBL device with cognitive conflict strategies is measured using validation sheets, each designed to assess the validity of the lesson plan and scenarios, student worksheets, teaching materials, and the test instrument for critical thinking abilities. Three expert validators provide their assessments of the developed learning device on the prepared validation sheets, marking their evaluations by checking (√) the available value columns. The practicality of the CBL device with cognitive conflict strategies is based on the parameters of learning implementation in the classroom.

The practicality of the device is measured using an observation sheet instrument for learning implementation. Observations are conducted by two observers who assess the quality of learning implementation based on the CBL device with cognitive conflict strategies. Lastly, the effectiveness of the CBL device with cognitive conflict strategies in enhancing students' critical thinking abilities is measured using a critical thinking test instrument (essay test). This test comprises 8 items referring to predefined critical thinking indicators. The test is administered to students twice to measure critical thinking abilities, first before the learning activities (pretest) and then after the learning intervention is completed (posttest). Students are given the opportunity to provide their answers within a set time frame.

Data Analysis

Data from the validation of the CBL device with cognitive conflict strategies are analyzed using quantitative descriptive analysis, averaging the scores obtained from the validators' evaluations. Validity scoring uses a 5-point scale (highest score 5, lowest score 1). The scores obtained from validators are then converted and categorized into criteria ranging from very valid to not valid (Prayogi et al., 2018). The validity criteria for the CBL device with cognitive conflict strategies are a minimum of valid, allowing for classroom implementation. The reliability of each validator's assessment is calculated using the percentage of agreement equation by Emmer and Millett (in Borich, 2016). An instrument is considered reliable if it has a percentage agreement of ≥ 75%.

The practicality of the CBL device with cognitive conflict strategies, based on the observation of learning implementation in the classroom, uses observation sheets, and the results are analyzed using quantitative descriptive analysis. The cumulative learning implementation scores from two observers are converted and categorized into criteria ranging from excellent to poor (Evendi et al., 2022). The CBL device with cognitive conflict strategies is deemed practical if it meets the learning implementation criteria in the good category. Furthermore, the effectiveness of the CBL device with cognitive conflict strategies is measured using a critical thinking test instrument. Data on students' critical thinking abilities are descriptively analyzed with parameters of average critical thinking scores and the increase in critical thinking scores (n-gain). Critical thinking scores are analyzed and categorized into

criteria ranging from very critical to not critical (Prayogi et al., 2018), and the increase in critical thinking scores (n-gain) is calculated according to Hake's equation (Hake, 1999). Data on critical thinking abilities (pretest-posttest) are also statistically analyzed (using a paired t-test) to test the difference in average scores between pretest and posttest. Statistical analysis is performed using JASP-8.13 software. The CBL device with cognitive conflict strategies is considered effective in enhancing critical thinking abilities if the students' critical thinking abilities meet the "critical" criteria, the score increase is categorized as "moderate," and there is a statistically significant difference in thinking skills scores from pretest to posttest.

RESULTS AND DISCUSSION

Research has been conducted to develop a Case-Based Learning (CBL) device incorporating cognitive conflict strategies aimed at enhancing students' critical thinking capabilities. The developed educational device was evaluated based on criteria of validity, practicality, and effectiveness in fostering critical thinking skills among students. The outcomes of the descriptive analysis concerning the validity aspect of the learning device are presented in Table 1, while the reliability of evaluations from each validator is detailed in Table 2. The examination of these elements is crucial for comprehending the efficacy and applicability of the developed CBL device in an educational context. This systematic approach ensures a comprehensive evaluation, highlighting the device's potential in contributing to the enhancement of critical thinking skills, which is of paramount importance in the current educational paradigm.

Table 1. Validation results of CBL devices with cognitive conflict strategies

Learning device	Validator			Average	Criteria
	V_1	V_2	V_3		
Lesson plan and scenarios	3.56	4.50	4.43	4.17	Valid
Student worksheets	3.68	4.32	4.80	4.27	Very valid
Teaching materials	3.81	4.56	4.56	4.31	Very valid
Test instrument	3,77	4,55	4,33	4,22	Very valid

The analysis of Table 1 reveals the validation outcomes for the Case-Based Learning (CBL) devices utilizing cognitive conflict strategies, showing various validity levels for the components. The lesson plans and scenarios are considered valid with an average score of 4.17, indicating they meet the criteria for effective implementation. The student worksheets and teaching materials received "very valid" ratings, with average scores of 4.27 and 4.31, respectively, signifying their high suitability for educational use. Additionally, the test instrument was rated as very valid with an average score of 4.22, affirming its adequacy in evaluating critical thinking skills. These results highlight the thorough validation process the CBL device underwent, ensuring its capability to enhance critical thinking skills among prospective teacher students.

Table 2. Reliability results of CBL devices from each validator

Learning tools	Percentage of agreement			Average	Criteria
	PA_{12}	PA_{13}	PA_{23}		
Lesson plan and scenarios	89	90	99	92.66	Reliable
Student worksheets	93	87	95	91.66	Reliable
Teaching materials	92	92	100	94.66	Reliable
Test instrument	91	94	98	94.33	Reliable

Table 2 presents the reliability assessment of the CBL devices by each validator, with percentage agreement scores showcasing a high reliability level across all components. The lesson plan and scenarios achieved a reliability average of 92.66%, student worksheets 91.66%, teaching materials 94.66%, and the test instrument 94.33%. These scores underscore the consistency and reliability of the CBL devices.

The data on the practicality of the Case-Based Learning (CBL) device employing cognitive conflict strategies were obtained from observations of the learning implementation in the classroom. Over four classroom sessions, two observers assessed the execution of learning, particularly the implementation of the phases of the CBL model with cognitive conflict strategies as outlined in the learning scenarios. The results are presented in Table 3. The observers' evaluations provide critical insights into how well the designed learning scenarios facilitate the application of cognitive conflict strategies in enhancing critical thinking skills among students.

Table 3. Results of learning implementation

Fase	P_1		P_2		P_3		P_4	
	O_1	O_2	O_1	O_2	O_1	O_2	O_1	O_2
Orientation	4	4	4	4	5	5	5	5
Presentation of the problem	5	4	5	4	5	5	4	5
Hypothesis formulation	5	4	5	5	5	3	5	5
Hypothesis test	5	5	5	4	5	4	5	5
Formulation of explanation	5	4	5	4	4	4	4	5
Reflection	5	4	5	5	5	4	5	4
Average	4.50		4.58		4.50		4.75	
	Very good		Very good		Very good		Very good	

The practicality data from Table 3, derived from classroom learning implementation observations, indicated that the CBL device utilizing cognitive conflict strategies performed excellently across all assessed phases, with average scores of 4.50 and 4.58 in different sessions. These findings illustrate the device's effectiveness in engaging students and facilitating the application of cognitive conflict strategies, thereby enhancing critical thinking skills through a well-structured learning process.

The effectiveness of the Case-Based Learning (CBL) device with cognitive conflict strategies was measured to evaluate the enhancement of students' critical thinking abilities. This assessment was based on the parameters of the average scores from the pretest and posttest, and the increase in critical thinking scores (n-gain). The results are presented in Table 4.

Table 4. Results of students' critical thinking abilities

Variable	Pretest	Posttest	N-gain
N	20	20	20
Mean	3.030 (Less critical)	12.650 (Critical)	0.447 (Moderate)
Std. Error of Mean	0.255	0.748	0.037
Std. Deviation	1.142	3.345	0.166
Coefficient of variation	0.317	0.264	0.364

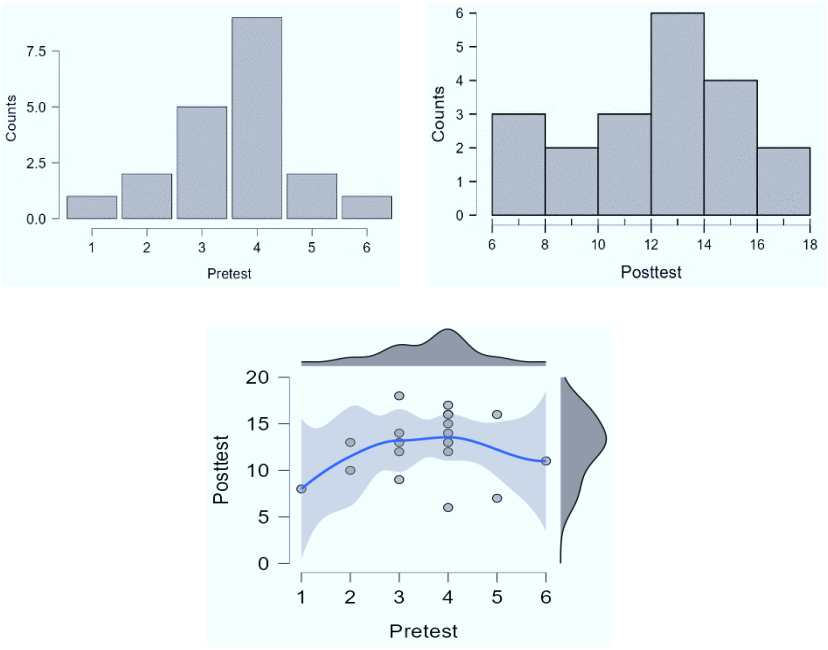

Figure 1. Descriptive plots of students' critical thinking ability scores on the pretest-posttest

Table 4 examines the effectiveness of the CBL device in improving students' critical thinking abilities, as evidenced by the pretest and posttest scores and the moderate n-gain of 0.447. The results indicate a significant improvement from "less critical" to "critical" levels of thinking ability among the students, showcasing the device's effectiveness in fostering critical thinking skills through its application. Figure 1, which seem to be histograms and a scatter plot with a density overlay, represent the distribution of scores from pretests and posttests. The first histogram depicts the distribution of pretest scores. The scores are concentrated at the lower end of the scale, with the highest frequency around the score of 3, indicating that initially, most students had lower critical thinking abilities as measured by the pretest. The second histogram shows the posttest score distribution. This histogram indicates a shift towards higher scores, with the peak frequency around scores of 10 to 12. This distribution suggests a significant improvement in critical thinking abilities after the implementation of the CBL device. The scatter plot with a density overlay, which presents the individual pretest scores against the posttest scores. There is a noticeable upward trend, illustrating that students generally scored higher on the posttest. The density plot on the side reflects the distribution of posttest scores, emphasizing the increase in critical thinking abilities. The combined view of the scatter and density plots indicates that for nearly all ranges of pretest scores, there is an improvement in the posttest scores.

Statistical analysis of the difference in students' critical thinking ability scores between the pretest and posttest was conducted using the paired t-test, with the results presented in Table 5. The findings are based on the assumption of data normality for the tested pretest and posttest scores, indicating a normal distribution ($p>0.05$).

Table 5. Results of statistical analysis of differences in critical thinking scores

Variable	N	Mean	t	df	p	Cohen's d	SE Cohen's d
Pretest	20	3.030	-11.977	19	< .001	-2.678	0.628
Posttest	20	12.650	-	-	-	-	-

Finally, Table 5's statistical analysis, using a paired t-test, confirms a significant increase in critical thinking scores from pretest to posttest, with a very high Cohen's d value of -2.678, indicating a substantial effect size. This statistically significant improvement (< .001) in critical thinking abilities underscores the CBL device's efficacy with cognitive conflict strategies in enhancing critical thinking skills among prospective teacher students, thereby supporting the device's intended educational objectives.

The study's successful demonstration of the Case-Based Learning (CBL) device, incorporating cognitive conflict strategies to enhance the critical thinking abilities of prospective teacher students, marks a significant stride in educational methodologies. The notable improvement in critical thinking skills, as evidenced by the pretest and posttest results, attests to the efficacy of the CBL device. This improvement is not merely incremental but represents a substantive leap from 'less critical' to 'critical' levels of thinking. Such a finding is crucial, given the context of Indonesian education's pursuit of global competitiveness, particularly in areas highlighted by the Programme for International Student Assessment (PISA) such as problem-solving and higher-order thinking skills (De Vries et al., 2022). The robust increase in critical thinking abilities aligns with the skills demanded by the 21st-century competencies framework and underscores the need for educational approaches that extend beyond rote memory and recall. This research, therefore, provides empirical support for the integration of CBL in curricula.

The CBL device's design, validated and deemed reliable through rigorous assessment by expert validators, reflects a high level of pedagogical soundness and applicability. The validation process, grounded in educational theory and praxis, underscores the meticulous approach adopted in this study, echoing the constructs of educational validity discussed by (Semmelroth & Johnson, 2014). The findings also resonate with previous studies that emphasize the importance of validation in developing educational tools (Farrés-Tarafa et al., 2020). The reliability of the CBL device, as evidenced by the high percentage agreement among validators, suggests that the device is consistent and stable across various evaluative perspectives. Such reliability is crucial for the broader application of the device beyond the context of this study and suggests that the results are not anomalies but indicative of the CBL device's inherent strengths.

Furthermore, the practicality of the CBL device, as observed during classroom implementations, points to its feasibility and effectiveness in actual educational settings. The positive reception and successful application of the device in the classroom, where the theoretical constructs were translated into tangible learning experiences, are pivotal. These findings are in line with the assertions by Evendi et al. (2022) regarding the importance of the practicality of educational devices. The practical application in classroom settings signifies that the device is not merely a theoretical model but a functional tool that educators can seamlessly integrate into their teaching repertoire. This reinforces the narrative that for educational interventions to be genuinely transformative, they must be accessible and executable within the constraints of everyday teaching environments.

The study's statistical analysis provides a compelling narrative on the impact of the CBL device. The significant increase in students' critical thinking ability scores, as measured by the paired t-test, offers robust evidence of the device's effectiveness. The considerable effect size, indicated by the high Cohen's d value, is particularly telling of the substantial influence the CBL device has on students' cognitive development. These statistical findings corroborate the visual data presented in histograms and scatter plots, which illustrate the shift in students' performance from the pretest to the posttest. Such a marked improvement is a testament to the CBL device's capacity to engage students in higher-order thinking and mirrors the

substantial effects observed in other studies where cognitive conflict strategies were employed. CBL based on exploration activities prioritizes the learning process through scientific experiences in searching for information, asking questions, and investigating environmental phenomena to discover a concept or principle, and ultimately can effectively improve students' critical thinking abilities. These results are supported by previous research which shows the advantages of the CBL model based on inquiry and exploration activities in developing science literation (Faiza & Wulandari, 2023), motivation and attitudes towards science (Çam & Geban, 2017), student understanding and achievement (Magwilang, 2022; Nair, 2013), and provide space for students to learn according to their respective learning styles -respectively (Zumbach et al., 2020)

However, it is critical to consider these results in light of previous research that has presented cognitive conflict as a sometimes ineffective strategy for conceptual change, as discussed by Vosniadou and Ioannides (1998). The current study challenges this position by providing evidence that when cognitive conflict is effectively embedded within CBL, it can lead to significant improvements in critical thinking. This suggests that the success of cognitive conflict in educational settings may be highly dependent on the context and manner in which it is presented to learners. By engaging students with realistic problem scenarios and prompting them to re-evaluate their preconceived notions, the CBL device has proven to be a powerful catalyst for fostering critical reflection and analytical thinking.

Lastly, the broader implications of these findings cannot be overstated, particularly in the context of preparing future educators. The ability of prospective teachers to think critically is paramount, not just for their success but for the educational outcomes of the students they will eventually teach. The cultivation of cognitive skills in teacher candidates is crucial for the advancement of students' analytical abilities. This study contributes a validated, practical, and effective tool that teacher educators can utilize to enhance the critical thinking skills of their students. By doing so, it lays the groundwork for future research and development in this vital area, promising a ripple effect that could reach far beyond individual classrooms to the educational system as a whole. In conclusion, the development and successful implementation of the CBL device represent a meaningful advancement in educational strategies designed to elevate critical thinking, an essential skill in the 21st century's complex and rapidly evolving landscape.

CONCLUSION

The study conclusively demonstrates that the Case-Based Learning (CBL) device, enriched with cognitive conflict strategies, has been validated, deemed practical, and proven effective in enhancing the critical thinking abilities of prospective teacher students. Through a meticulous validation process, the device was affirmed to meet high standards of educational quality, ensuring its relevance and applicability in fostering critical thinking. Its practical implementation in classroom settings further validated its feasibility, showcasing a seamless integration into existing teaching practices. Most importantly, the effectiveness of the CBL device was evidenced by significant improvements in students' critical thinking abilities, marking a substantial advancement towards addressing the educational challenge of nurturing critical thinkers equipped to navigate the complexities of the 21st-century landscape. This study underscores the potential of integrating innovative pedagogical tools, such as the CBL device with cognitive conflict strategies, in teacher education programs to elevate the critical thinking skills essential for global competitiveness and problem-solving in everyday life.

LIMITATION

One limitation of this study is its focus on a specific context and sample size, which may affect the generalizability of the findings to other educational settings or disciplines. While the results are promising within the scope of prospective teacher students in Indonesia, further research is needed to explore the applicability and effectiveness of the CBL device with cognitive conflict strategies across different cultural contexts, subject areas, and larger student populations. Additionally, the study's reliance on quantitative measures of critical thinking enhancement could be complemented by qualitative insights to provide a deeper understanding of students' cognitive processes and experiences during the learning intervention.

RECOMMENDATION

Future research should aim to extend the application of the CBL device with cognitive conflict strategies to a broader range of educational contexts and disciplines to validate its effectiveness across diverse learning environments. Investigating the long-term impact of the CBL device on students' critical thinking skills and their application in real-world problem-solving scenarios would provide valuable insights into the sustainability of learning gains. Furthermore, incorporating qualitative research methods, such as student interviews or reflective journals, could enrich our understanding of the cognitive and emotional dimensions of learning through cognitive conflict. This holistic approach would not only validate the quantitative findings but also offer a comprehensive view of the educational impact, facilitating the development of more nuanced and effective teaching strategies

Author Contributions

The authors have sufficiently contributed to the study, and have read and agreed to the published version of the manuscript.

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Declaration of Interest

The authors declare no conflict of interest.

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