Journal of Applied Science, Engineering, Technology, and Education *ISSN: 2685-0591 (online)*
Vol. 6 No. 2 (2024)
https://doi.org/10.35877/454RI.asci3766

Development and Evaluation of a Cognitive Conflict-Based Physics Learning Module in a Blended Learning Model

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Abstract

This study developed and evaluated the effectiveness of a cognitive conflict-based physics learning module within a blended learning environment. The module was designed to enhance high school students' critical thinking skills, which are essential for effective problem-solving and decision-making. The research employed the Research and Development (R&D) method with the 4-D model. The module was tested on two experimental classes, and student performance was assessed through a 5-item essay test and analysis of student worksheets. Results showed significant improvement in all aspects of critical thinking, particularly in basic clarification and inference. This improvement is attributed to the cognitive conflict approach, the blended learning model, and the engaging design of the module. The study concludes that this learning module is effective in fostering critical thinking skills, warranting further application in diverse contexts and materials, coupled with ongoing module refinement and teacher professional development.

Keywords: Cognitive conflict; Blended learning; Learning module; Work and energy concepts; Critical thinking skills

Received: 11 September 2024 Revised: 31 November 2024 Accepted: 25 December 2024

1. Introduction

Critical thinking skills (CTS) are essential cognitive abilities that empower individuals to analyze information, evaluate evidence, and make sound decisions. These skills are crucial for students to navigate the complexities of the modern world and are increasingly recognized as a critical focus in 21st-century education (Alsaleh, 2020). In physics education, CTS encompasses cognitive problem-solving abilities and the capacity to analyze physical phenomena, solve complex problems, and make informed decisions based on evidence and reasoning (Chowdhury, 2018). However, the development of CTS in physics education at the school level faces several challenges.

Traditional physics instruction often prioritizes rote memorization of formulas and concepts over fostering more profound critical thinking skills (Jailani et al., 2017). This emphasis on memorization can hinder students' ability to think independently and critically as they become accustomed to relying on established procedures rather than engaging in active inquiry and analysis (Bezanilla et al., 2019). Moreover, conventional teaching methods, such as lectures and exercises, may need to provide more opportunities for students to develop and apply their critical thinking abilities meaningfully (Mutakinati et al., 2018).

The lack of attention to CTS development in physics education can harm students' understanding and application of physics concepts in real-world scenarios. Students not yet adequately trained in critical thinking may struggle to analyze physical phenomena, solve complex problems, and make informed decisions based on evidence and reasoning. This limitation can impede their academic progress in higher education and hinder their success in the workforce, where critical thinking is highly valued.

Despite the acknowledged importance of critical thinking skills (CTS) in physics education, significant challenges remain in effectively fostering these abilities within physics courses. Traditional approaches often prioritize rote memorization of formulas and algorithmic problem-solving, neglecting the deeper conceptual understanding and

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analytical skills that underpin true critical thought (Jailani et al., 2017). Furthermore, many existing interventions focus on general CTS development, lacking the contextualization within physics that is crucial for students to apply these skills to complex physical phenomena (Bezanilla et al., 2019). This research addresses these gaps by developing and evaluating a cognitive conflict-based learning module within a blended learning environment specifically designed for the physics curriculum. By integrating cognitive conflict, a strategy proven to stimulate deeper engagement and challenge pre-existing misconceptions (Kim et al., 2006; Kwon et al., 2002), with the flexibility and accessibility of a blended learning model, this approach aims to provide a more targeted and effective method for cultivating CTS in physics students, moving beyond traditional methods and general CTS interventions.

Innovative approaches to physics instruction are needed to address these challenges to facilitate more effective CTS development in students (Redish, 2003). The cognitive conflict approach, which encourages students to question their existing understanding and seek new solutions, effectively enhances students' CTS (Kim et al., 2006; Kwon et al., 2002). Creating situations that challenge students' preconceived notions and stimulate cognitive dissonance can promote deeper engagement with physics concepts and foster critical thinking skills (Lee & Yi, 2013; Mufit et al., 2020).

In addition to the cognitive conflict approach, blended learning models that combine face-to-face and online instruction offer a promising avenue for improving CTS in physics education.

These models provide students with greater flexibility, which stimulates critical thinking (Czaplinski & Fielding, 2020; Herayanti et al., 2020; Marnita et al., 2020). Blended learning can also leverage technology to provide students access to diverse resources, simulations, and interactive activities that promote active learning and critical inquiry (Kesuma et al., 2020; Krasnova & Shurygin, 2020).

While the cognitive conflict approach within blended learning shows promise in enhancing critical thinking skills (CTS) in physics, it is crucial to compare it with other contemporary educational strategies. Problem-based learning (PBL) intrinsically promotes CTS through real-world problem-solving, boosts motivation, and enhances collaboration skills (Husein et al., 2019; Jailani et al., 2017), although it can impose a high cognitive load (Sweller et al., 1998). Guided inquiry develops scientific inquiry skills through facilitated discovery (Sari et al., 2021), but requires thorough teacher preparation. The flipped classroom, as an instructional delivery model, can support the implementation of cognitive conflict or PBL by providing class time for interactive activities (Bergmann & Sams, 2012).

By comparatively considering these strategies, this research can offer a more comprehensive understanding of how to improve CTS in physics education. The most appropriate choice of strategy depends on the specific context and learning objectives, and often the integration of blended learning can maximize effectiveness, combining the strengths of each approach to address limitations and create an optimal learning environment. In particular, studies have shown that interactive engagement methods, which often underlie PBL and inquiry approaches, are significantly more effective than traditional instruction (Hake, 1998).

This research investigates the effectiveness of a cognitive conflict-based physics learning module integrated with a blended learning model on students' critical thinking skills. By integrating the cognitive conflict approach with the flexibility and technological advantages of blended learning, this study aims to create a more interactive, challenging, and student-centered learning environment that fosters the development of critical thinking skills in physics. The findings of this research will contribute to the growing body of knowledge on effective pedagogical strategies for enhancing CTS in physics education and inform the design of future instructional interventions.

2. Methods

This study employed a Research and Development (R&D) methodology utilizing the 4-D model, which consists of defining, designing, developing, and disseminating phases (Thiagarajan et al., 1974). The developed learning module encompasses lesson plans, teaching modules, student worksheets, and assessment instruments. These components of the learning module were designed based on the cognitive conflict approach within a blended learning model.

To ensure validity and reliability, the developed learning module, student worksheets, and research instruments (critical thinking skills test and observation sheet) underwent a rigorous validation process before implementation. A panel of three expert reviewers possessing expertise in physics education and assessment conducted this validation. Their assessment encompassed a comprehensive evaluation of content validity, clarity of presentation, and appropriateness of the language used in all materials. Based on established criteria, the expert reviewers deemed all learning materials and research instruments to be in the 'very suitable' category for use in the study, confirming their quality and appropriateness for the research objectives.

This research specifically utilized the flipped classroom model of blended learning. The learning steps implemented can be seen in Table 1.

Table 1. Steps of the Cognitive Conflict Approach in a Blended Learning Model

Blended Learning Model Syntax	Cognitive Conflict Approach Phase	Teachers Activities	Students Activities
Online	Introduction: Presentation of Cognitive Conflict	Distributes learning materials and worksheets to students for study; instructs students to work on worksheets in groups.	Studies the provided learning materials and worksheets; completes the initial part of the worksheets in groups.
Offline (Classroom): Warm-up Activity		Communicates learning objectives and prepares students for the lesson.	Listens to the teacher's explanations.
Offline (Classroom): Q&A Time	Conflict: Creates conflict through demonstrations involving assimilation and accommodation.	Provides opportunities for students to ask questions.	Asks questions and discusses the material being learned.
Offline (Classroom): Guided and Independent Practice or Lab Activity		Guides and assists students in completing and presenting worksheets.	Completes and presents worksheets.
	Resolution: Discussion and conclusion of results.	Responds to students' discussion results and explain the correct concepts.	Listens to the teacher's explanation of the correct concepts.

Adapted from (Bergmann & Sams, 2012); Setyowati et al., (2011).

Researchers subsequently tested the developed learning module to measure its effectiveness in enhancing students' critical thinking skills. The trial was conducted with 10th-grade students at a high school in Mataram, West Nusa Tenggara. Two experimental classes, comprising 61 students, were involved in this trial, which consisted of three sessions, each lasting 3 x 45 minutes. Students were selected purposively based on the existing learning schedule, curriculum, and their likelihood to pursue science-related fields. Both classes received the same treatment; no control group was utilized in this study. The trial design is presented in Table 2.

Table 2. Experimental Design

Groups	Pre-test	Treatment	Post-test
Experimental Group A	O1	X	O2
Experimental Group B	O1	X	O2

Adapted from Nazir, (2011).

The instruments used to measure students' critical thinking skills consisted of a critical thinking skills test and a critical thinking skills observation sheet. The test comprised five essay questions that measured each indicator of critical thinking skills: basic clarification (CT1), basic support (CT2), inference (CT3), advanced clarification (CT4), and strategies and tactics (CT5).

Data from the trial were analyzed using normalized gain (N-gain) calculations, a method developed by Hake [20] to quantify the effectiveness of instructional interventions. The N-gain (⟨g⟩) was calculated using the following equation:

$$\langle g \rangle = \frac{\langle S_{post} \rangle - \langle S_{pre} \rangle}{\langle S_{max} \rangle - \langle S_{pre} \rangle}$$

where $\langle S_{pre} \rangle$ represents the average pre-test score and $\langle S_{post} \rangle$ represents the average post-test score. This N-gain metric provides a measure of the actual gain relative to the maximum possible gain, allowing for a comparison of the learning module's impact on student's critical thinking skills, accounting for their initial knowledge levels (Hake, 1998). All data, including pre-test, post-test, and N-gain scores, were tested for normality. Hypothesis testing was also conducted as a basis for decision-making. This analysis was performed using IBM SPSS Statistics software.

3. Results

This research will present empirical evidence regarding the effectiveness of a cognitive conflict-based physics learning module within a blended learning model in enhancing students' critical thinking skills. Overall, the research findings will be divided into several sections, namely: (1) overall results of the critical thinking skills test, (2) improvement in critical thinking skills based on their indicators, (3) results of the analysis of critical thinking skills while working on worksheets, (4) results of data normality tests, and (5) results of Wilcoxon hypothesis testing.

This study examines the effectiveness of a cognitive conflict-based physics learning module within a blended learning model on high school students' critical thinking skills on Work and Energy. The effectiveness of this learning module is analyzed through the pre-test, post-test, and N-gain scores of students' critical thinking skills in two experimental groups (A and B), as shown in Figure 1.

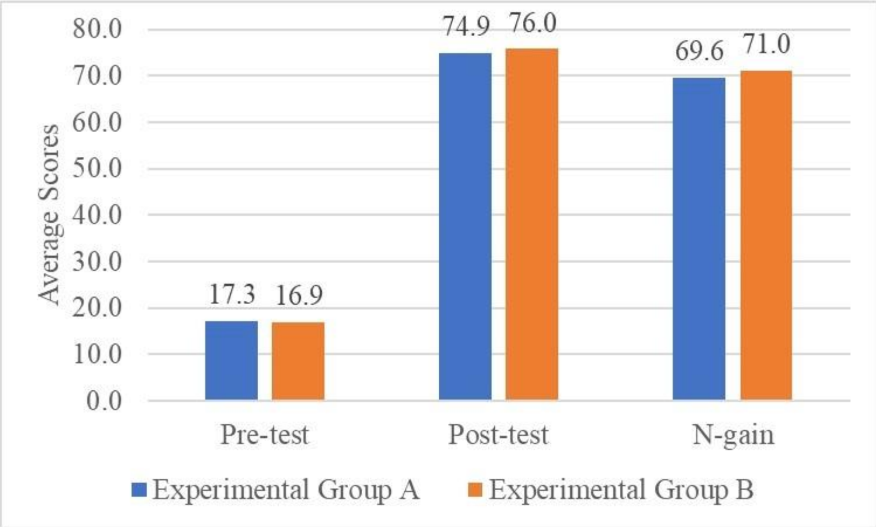

Fig. 1. Comparison of Test Results and Improvement of Critical Thinking Skills in Both Experimental Groups

Based on Figure 1, it can be observed that the average pre-test scores of both groups were relatively low, indicating that students' critical thinking skills before using the learning module still needed improvement.

However, after using the learning module, there was a significant increase in the average post-test scores of both groups from relatively low initial scores (Group A: 17.3; Group B: 16.9). The average post-test score of group A increased substantially to 74.9, while group B increased to 76.0. This marked improvement is also reflected in the high N-gain values of 69.6% for group A and 71.0% for group B, demonstrating the module's effectiveness in enhancing critical thinking skills.

In addition to the overall data, critical thinking skills were analyzed for each indicator in both experimental classes. The comparison of the improvement in critical thinking skills for each indicator in experimental groups A and B is presented in Figure 2.

Figure 2 illustrates the improvement in students' critical thinking skills across all indicators after using the cognitive conflict-based physics learning module in a blended learning model. Students achieved the most significant gains in essential clarification (CT1) and inference (CT3), indicating that students were better able to understand problems and draw logical conclusions based on the information provided. Students also showed improvements in essential support (CT2) and strategies and tactics (CT5), although less pronounced than in CT1 and CT3. This suggests that the learning module is moderately effective in helping students develop the ability to provide relevant reasoning and problem-solving strategies, though there is room for further enhancement. The lowest improvement was seen in advanced clarification (CT4), indicating that students must enhance their ability to analyze problems in depth and provide more comprehensive explanations. Therefore, further development of the learning module is necessary to optimize the improvement of students' critical thinking skills in this indicator.

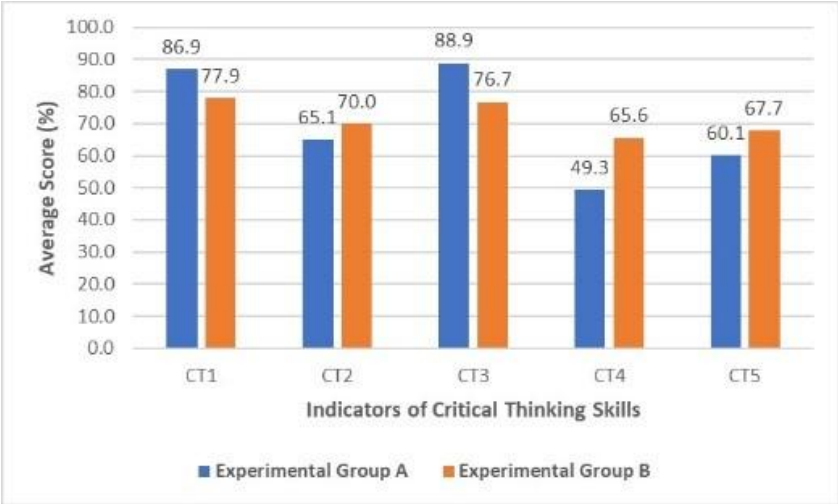

Fig. 2. Comparison of Critical Thinking Skills Improvement for Each Indicator in Both Experimental Groups

In addition to the overall and indicator-specific critical thinking skills data from both experimental classes, students' critical thinking abilities were also analyzed based on their worksheets collected from each session. The results of this analysis are shown in Figure 3.

Figure 3 illustrates students' average critical thinking (CT) scores across each indicator in every learning session. Overall, there was an increase in average scores for most indicators from the first to the third session. This indicates that the cognitive conflict-based physics learning module within a blended learning model successfully facilitated the gradual development of students' CT skills.

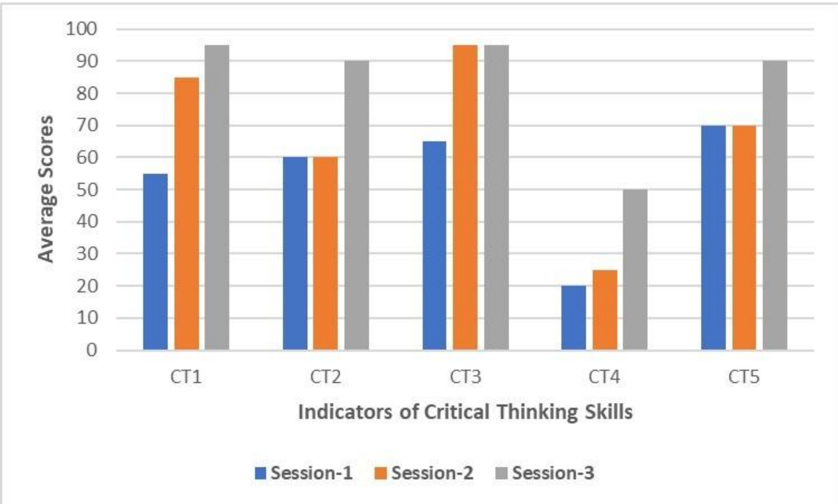

Fig. 3. Average Scores of Students' Critical Thinking Skills for Each Indicator in Each Session

Statistical tests were also conducted to validate the hypotheses and strengthen the analysis of the research findings. Initially, normality tests were performed on the pre-test, post-test, and N-gain data. The results of these normality tests are presented in Table 3.

Table 3 presents the normality test results for the two experimental groups (A and B) across three measurement stages: pre-test, post-test, and N-gain. The Kolmogorov-Smirnov and Shapiro-Wilk tests were used for normality assessment. Results indicate that both groups' pre-test, post-test, and N-gain data were not normally distributed (Sig. < 0.05). Therefore, researchers will use non-parametric statistical tests, such as the Wilcoxon test, for further analysis as they do not require the assumption of data normality.

Table 3. Normality Test Results

	Tests of Normality						
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	GROUP	Statistic	df	Sig.	Statistic	df	Sig.
PRE-TEST	Exp. Group A	.271	31	<.001	.759	31	<.001
	Exp. Group B	.280	30	<.001	864	30	.001
POST-TEST	Exp. Group A	.266	31	<.001	.805	31	<.001
	Exp. Group B	.140	30	.140	.903	30	.010
N-GAIN	Exp. Group A	.207	31	.002	.872	31	.002
	Exp. Group B	.139	30	.146	.906	30	.012

a. Lilliefors Significance Correction

Table 4 presents the results of the Wilcoxon Signed Ranks Test, which was used to compare two related scores (in this case, pre-test and post-test scores) from the same sample group. The Wilcoxon Signed Ranks Test results indicate a significant difference between pre-test and post-test students' critical thinking skills scores ($Z = -6.795$, $p < 0.001$). The negative Z value indicates that the post-test scores were significantly higher than the pre-test scores, meaning there was an improvement in students' critical thinking skills after the intervention.

Table 4. Hypothesis Test Result

Ranks

		N	Mean Rank	Sum of Ranks
Posttest-Pretest	Negative Ranks	0[a]	.00	.00
	Positive Ranks	61[b]	31.00	1891.00
	Ties	0[c]		
	Total	61		

a. Post-Test < Pre-Test
b. Post-Test > Pre-Test
c. Post-Test = Pre-Test

Test Statistics[a]

	Posttest - Pretest
Z	-6.795[b]
Asymp. Sig (2-tailed)	<.001

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

The Wilcoxon Signed Ranks Test results demonstrate a significant difference between pre-test and post-test scores within the same group. This test compares two related data sets with the null hypothesis that no difference exists between their medians. The results show a p-value of less than 0.001, far below the significance level of 0.05. This means the probability of obtaining similar or more extreme results if there were no fundamental differences is very small. Therefore, the null hypothesis is rejected, and it is concluded that there is a significant difference between the pre-test and post-test scores.

4. Discussion

This study examined the effectiveness of a cognitive conflict-based physics learning module within a blended learning model on high school students' critical thinking skills. The study involved three learning sessions on the topic of Work and Energy, with each session lasting 3 x 45 minutes. Some sessions were conducted online outside of class using the Flipped Classroom model.

The results demonstrated a significant improvement in students' critical thinking skills after using the learning module. Both experimental groups showed substantial increases in their post-test scores and N-gain values, indicating the module's overall effectiveness in enhancing critical thinking.

This improvement can be attributed to the student-centered design of the module, which promoted critical thinking, collaboration, and independent problem-solving. These findings align with previous research on the effectiveness of cognitive conflict and blended learning approaches in promoting critical thinking (Herayanti et al., 2020; Kwon et al., 2002). Furthermore, this research also strengthens the relevant theoretical foundation. Constructivism theory emphasizes the importance of students constructing their knowledge through active interaction with learning materials (Suana et al., 2017), which aligns with the learning approach used in this module. Cognitive load theory also provides insight into designing effective instruction by considering the limitations of students' information processing capacity (Sweller et al., 1998).

The significant improvement in students' critical thinking skills, particularly in basic clarification and inference, aligns with the research of (Teleková & Lukáčiková, 2023), emphasizing the importance of critical thinking in educational preparation. This study's findings echo those of Lusiana et al., (2024), highlighting the value of stimulating critical and creative thinking in students. Additionally, the enhancement of clarification and inference skills resonates with Kannadass et al., (2023), who underscore the connection between critical thinking and modeling competency. This result not only demonstrates the learning module's effectiveness in fostering a deeper understanding of physics concepts but also supports previous research suggesting that cognitive conflict-based approaches trigger conceptual change by challenging prior knowledge and encouraging the exploration of alternative explanations (Lee & Kwon, 2004; Madu & Orji, 2015). The findings also reinforce (Mufit et al., 2020) assertion of the positive impact of cognitive conflict on physics learning.

The cognitive conflict approach in this learning module is consistent with previous research indicating that cognitive conflict can improve students' conceptual understanding (Achor & Abuh, 2020; Mufit et al., 2018). The cognitive conflict that arises when students are confronted with information or situations that contradict their prior understanding can trigger cognitive disequilibrium, motivating them to seek solutions and revise their understanding (Lee & Yi, 2013). This research also shows that the cognitive conflict approach can address students' misconceptions (Akmam et al., 2018; Mufit et al., 2023). By designing learning activities that intentionally trigger cognitive conflict, teachers can help students identify and correct their misconceptions, thereby improving their conceptual understanding.

The analysis of critical thinking skills by indicator revealed varying degrees of improvement. The most significant gains were observed in basic clarification (CT1) and inference (CT3). Ennis (2011) defines basic clarification as identifying and formulating questions clearly and understanding key terms and concepts. Meanwhile, inference is the ability to draw logical conclusions from the information and identify underlying assumptions and implications. These improvements indicate an enhanced understanding of problems and the ability to draw logical conclusions, aligning with research emphasizing the importance of these foundational skills for developing higher-order critical thinking (Chowdhury, 2018).

Improvements were also noted in basic support (CT2) and strategies and tactics (CT5), suggesting that students developed better reasoning and problem-solving skills. However, the lowest improvement was seen in advanced clarification (CT4), which requires more complex critical thinking abilities, such as evaluating arguments and identifying biases. This finding is consistent with research highlighting the need for more intensive and varied instructional methods to develop higher-order critical thinking skills (Alsaleh, 2020; Bezanilla et al., 2019). Advanced clarification involves critically analyzing and evaluating arguments, including identifying biases, unstated assumptions, and weaknesses in reasoning.

The enhancement of students' critical thinking skills, particularly in basic clarification and inference, reaffirms the success of the learning module in facilitating a deeper understanding of physics concepts and the ability to draw logical conclusions. This aligns with research showing that inquiry-based learning approaches can improve students' critical thinking skills (Agustinasari et al., 2021; Sari et al., 2021). Moreover, utilizing a blended learning model, integrating both online and offline learning, can also positively contribute to the development of critical thinking skills in students (Changwong et al., 2018).

Analysis of students' worksheets further confirmed the effectiveness of the learning module. There was a gradual improvement in critical thinking skills across all indicators from the first to the third session, with the most significant gains observed in CT1 and CT3. This indicates that the module successfully developed students' critical thinking skills over time.

It is important to note that the improvement in critical thinking skills was not uniform across all indicators. Advanced clarification skills, which involve evaluating arguments and identifying biases, showed the slightest improvement. This suggests that developing higher-order critical thinking skills requires a more structured and intensive learning approach (Wechsler et al., 2018). Further research is needed to explore effective learning strategies for enhancing advanced clarification skills, such as using complex case studies, debates, or critical analysis of different information sources. This research can also be extended to examine the effectiveness of cognitive conflict-based learning modules in different contexts, such as other physics topics or educational levels (Gunawan et al., 2019; Gurcay & Ferah, 2018; Ramadhan et al., 2019; Ramdani et al., 2021).

Several factors contributed to the improvement in students' critical thinking skills. The cognitive conflict approach encouraged students to question their initial understanding and seek new solutions, stimulating their critical thinking abilities (Kim et al., 2006; Kwon et al., 2002). The blended learning model provided flexibility and collaboration opportunities, further enhancing critical thinking (Atef & Medhat, 2015; Czaplinski & Fielding, 2020; Herayanti et al., 2020; Marnita et al., 2020). Additionally, the design of the learning module, which actively engaged students in challenging tasks and problem-solving, contributed to their critical thinking development. Using technology within the blended learning environment, as Krasnova & Shurygin, (2020) highlighted, further facilitated active learning, collaboration, and effective feedback, enhancing the overall learning experience.

The findings of this research hold significant implications for physics education more broadly. Given the paramount importance of critical thinking skills in the 21st century, effective approaches, such as this cognitive conflict-based learning module within a blended learning model, warrant integration into physics curricula. This integration can begin with teacher training on how to design and implement learning activities that elicit constructive cognitive conflict and how to leverage technology within blended learning environments to support students' CTS development. Furthermore, physics curricula can be modified to place greater emphasis on real-world problem-solving, inquiry-based investigations, and critical analysis of information, rather than mere memorization of formulas and concepts (Jailani et al., 2017; Mutakinati et al., 2018). In doing so, physics education can become more relevant and engaging for students, preparing them to succeed in further studies and future careers (Alsaleh, 2020).

Moreover, an increased emphasis on critical thinking skills within the physics curriculum can have a positive ripple effect on other STEM subjects. Critical thinking skills are transferable and can be applied to solve problems and make sound decisions across various domains (Bezanilla et al., 2019; Wechsler et al., 2018). Therefore, by fostering critical thinking skills in physics, we can enhance students' abilities across the STEM spectrum, leading to a more innovative and scientifically literate workforce. However, the implementation of these approaches requires continuous evaluation and adaptation to ensure their effectiveness across diverse contexts and student populations (Gurcay & Ferah, 2018; Ramdani et al., 2021).

This research has important implications for physics education. The cognitive conflict-based physics learning module within a blended learning model can serve as an effective alternative to enhance students' critical thinking skills. Teachers can adopt or adapt this module, integrating the cognitive conflict approach and utilizing blended learning to create a more interactive, challenging, and student-centered learning environment, thereby improving the quality of instruction in their classrooms. The flexibility and accessibility of blended learning, as demonstrated by (Alsalhi et al., 2021), can be particularly beneficial in diverse educational settings. Future research could explore the effectiveness of this module in larger populations and different contexts, as suggested by Kesuma et al., (2020), and investigate further ways to enhance the development of advanced clarification skills.

This study has several limitations that need to be considered. First, the research focused solely on developing and testing the learning module on Work and Energy. Therefore, the effectiveness of this module needs to be further examined in other physics topics. Second, the study only involved students from one high school in Mataram, so generalizing the research findings should be done cautiously. Nevertheless, this research provides a significant contribution to the development of innovative and effective physics learning modules. The results indicate that the cognitive conflict-based learning module within a blended learning model has great potential to enhance students' critical thinking skills. Future research can develop similar learning modules for other physics topics and test their effectiveness in a broader population, as implemented by Bazelais & Doleck, (2018); Sivakumar & Selvakumar, (2019).

5. Conclusion

This research successfully developed and validated a cognitive conflict-based physics learning module within a blended learning model, effectively enhancing high school students' critical thinking skills. The most substantial gains were observed in essential clarification and inference, highlighting the module's effectiveness in fostering foundational critical thinking skills. This improvement was supported by high N-gain values, affirming the module's positive impact on student knowledge acquisition.

These findings suggest the potential of instructional approaches that combine elements of cognitive conflict with the flexibility and personalization of blended learning to enhance overall student learning outcomes. The module not only improved students' understanding of physics concepts, but also empowered them to analyze problems, evaluate evidence, and make reasoned decisions, which are essential skills for both academic and professional success.

While this research provides compelling evidence for the effectiveness of the cognitive conflict-based learning module within a blended learning model, it is important to acknowledge certain limitations. The study was focused on a single physics topic, Work and Energy, and involved students from one high school in Mataram. Therefore, future research should investigate the effectiveness of this module across different physics topics and within broader educational contexts to improve the generalizability of the findings. Furthermore, additional research is needed to explore ways to further enhance the development of higher-order critical thinking skills, such as advanced clarification and argument evaluation. Given the relatively lower improvement in these indicators compared to others, additional interventions or instructional approaches may be required to address these more complex aspects of critical thinking.

This research contributes significantly to the field of physics education by providing an evidence-based approach to enhance students' critical thinking skills. The cognitive conflict-based learning module within a blended learning model shows promise as an effective tool for empowering students with the critical thinking skills necessary to succeed in the 21st century. Future research should build upon these findings to further optimize and disseminate this learning module and other innovative approaches to improve student learning outcomes.

Acknowledgments

This research was funded by the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia under Grant Number 1293/UN18.L1/PP/2022 through the National Competitive Research Scheme. The authors extend their gratitude to the Ministry, the experts who validated the learning tools, and everyone involved in the preparation, implementation, and evaluation of this research, including the participating teachers and students.

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