Development of Contextual Teaching and Learning (CTL) Worksheet based on Blended Learning to Enhance Students' Critical Thinking

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Abstract. This study aims to develop a Contextual Teaching and Learning (CTL) worksheet based on blended learning, which is appropriate for enhancing students' critical thinking skills. The study follows the Research and Development (R&D) approach, utilizing the ADDIE phases: Analysis, Design, Development, Implementation, and Evaluation. The participants in this study are educators and students of class ten at Senior high school in Banda Aceh, Indonesia. Data collection involves expert validation surveys, practitioner validation, teacher feedback, and student responses. The data is quantitatively described using percentage analysis, and the progress in students' critical thinking is measured using the N-gain test. The findings of the study reveal that expert validation scored an average percentage of 96.97%, indicating high suitability. Similarly, practitioner validation achieved a percentage of 90.48%, falling within the highly suitable range. The results from both the teacher and student questionnaires positive scores, confirming the suitability of the CTL worksheet designed for blended learning. After the implementation of the CTL worksheet based on blended learning, students demonstrated an enhancement in their critical thinking abilities, as evidenced by an N-gain score of 0.7714, signifying a high level of progress. Thus, it can be inferred that the CTL worksheet based on blended learning effectively contributes to the improvement of students' critical thinking skills in the physics learning, especially on the topic of Work and Energy.

Keywords: Critical thinking, CTL, Blended Learning, Worksheet..

1 Introduction

In the current school learning process, many conventional teaching methods are still prevalent, with a teacher-centered approach. Additionally, there are students who do not actively participate in the learning process, such as not paying attention when the teacher or their peers explain in front of the class, hesitating to express their opinions, being afraid to ask questions when they don't understand, and a lack of classroom hours is still a common issue [1]. This indicates that the classroom learning process is not running smoothly, resulting in a deficiency in students' critical thinking abilities. Indonesia's critical thinking skills are ranked 71st in the Programme for

International Student Assessment (PISA) with an average score of 396 points in science performance, which is considered low [2]. This aligns with the critical thinking abilities of students in Aceh Province, where the average percentages for explaining simple concepts are 42.25%, problem-solving is 36.00%, and drawing conclusions is 46%. Consequently, the average percentage of students' critical thinking test results is 45%, which is considered low [3].

The low level of critical thinking skills in students can be attributed to several factors, including the use of teaching materials and the shortage of classroom hours. One of the factors influencing the low critical thinking skills of students is that teachers may not be proficient in methods, strategies, and teaching approaches that can create an optimal learning environment, causing students to struggle with problem-solving tasks [4]. Critical thinking is a set of skills in solving problems logically and reflectively, and both are interrelated in metacognitive problem-solving processes [5]. Effective teaching involves teachers choosing suitable models and teaching tools to address students' low critical thinking skills, such as the contextual teaching and learning (CTL) model. The CTL model enables students to connect their knowledge to real-life situations, promoting meaningful learning experiences [6]. The CTL model consists of steps, including building new skills, conducting inquiry activities, nurturing curiosity, creating a learning community, presenting models through teaching examples, encouraging student reflection, and conducting objective assessments [7], which are highly suitable for improving critical thinking skills in students [8].

However, implementing the CTL model may be limited by time constraints in school, preventing the complete achievement of learning objectives [9]. Therefore, a blended learning approach that combines direct and indirect learning is needed [10]. This combination has proven effective in addressing existing issues and is suitable for all genders [11]. However, indirect learning really needs guidelines to ensure that learning is more structured in achieving learning goals and can be in line with direct learning in the classroom. Therefore, it is necessary to develop CTL worksheets that can be used to support the learning process both direct leraning and indirect learning, without space and time limitations using a Blended Learning approach (CTL worksheet based on Blended Learning) as an effort to improve students' critical thinking skills on the subject of work and energy.

2   Method

This type of research is categorized as Research and Development (R&D) research, employing the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) stages. This research represents an effort to develop a specific product and test the effectiveness of the product on students' critical thinking [12]. The research was conducted at one of senior high school in Banda Aceh, specifically in class ten, with a sample size of 17 students.

The data collection process began with interviews with several teachers at senior high school in Banda Aceh. The collected data were analyzed and used as the basis for developing CTL worksheet based on blended learning. The initial design of the CTL worksheet based on blended learning was validated by experts and practitioners, and subsequently refined based on their suggestions and input. The improved CTL worksheet based on Blended Learning was then pilot-tested with 17 students from class ten and 2 physics teachers to assess its usability in the learning process. In

addition to that, students were given a critical thinking test to measure the improvement in their critical thinking skills before and after using the CTL worksheet based on Blended Learning. Data collection in this research was conducted using a questionnaire instrument. The research data were then processed using percentages with the following equation (1)

$$percentage\ of\ feasibility\ score = \frac{the\ total\ score\ obtainde}{the\ total\ score} x100\%$$

(1)

After obtaining the research data, the data is then transformed into categorical data with levels. The data resulting from expert and practitioner validation is interpreted according to Table 1

Table 1. Criteria for the Feasibility Level of Worksheet

Feasibility Percentage	Criteria
$00,00\% < < P \leq \leq 50,00\%$	Not Feasible
$50,00\% < < P \leq \leq 70,00\%$	Quite Feasible
$70,00\% < < P \leq \leq 85,00\%$	Feasible
$85,00\% < < P \leq \leq 100,00\%$	Highly Feasible

Meanwhile, data from teacher and student responses are interpreted according to Table 2:

Table 2. Criteria for Assessing Questionnaire Scores of Teachers and Students' Responses

Score Percentage (%)	Criteria
0-21	Very Low
21-40	Low
41-60	Moderate
61-80	Good
81-100	Very Good

The improvement in students' critical thinking is analyzed using the N-gain test with the equation:

$$N = g\ \frac{Spost - Spre}{Smaks - Spre}$$

(2)

In the context of the experiment, "Spost" represents the posttest score, while "Spre" stands for the pretest score. These variables are crucial for evaluating the effectiveness of the treatment. Researchers can assess the impact of the treatment by comparing the posttest scores (Spost) with the initial pretest scores (Spre). This comparative analysis helps determine the extent of improvement or change resulting from the administered treatment.

3   **Results and Discussion**

In the analysis phase, the design of the previous worksheet was very basic, with a plain white cover design, making it less visually appealing. Furthermore, aspects such as the cover, design color, indicators, concept maps, and the steps of the CTL model used were not clearly visible in the previous worksheet, making it difficult for students to understand the learning material. The previous worksheet appearance can be seen in Fig. 1
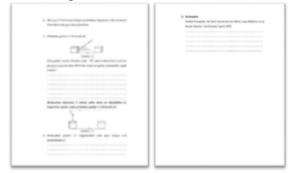

Fig. 1.   The appearance of the LKS before develop

The design of the CTL worksheet based on blended learning follows a systematic process that begins with learning objectives, designing learning activities, developing learning materials, and designing evaluation methods to enhance learning. The developed worksheet follows the syntax of the CTL based on, serving as the model and approach used within the worksheet. The choice of colors should align with the objectives to capture students' attention when working on tasks within the worksheet. Each color used has its own meaning and purpose. Therefore, the developed worksheet uses white, green, and blue as the colors for the worksheet.

The student worksheets developed here incorporate complete CTL steps and are organized within the worksheet to facilitate teachers in implementing this teaching tool and to facilitate student learning both inside and outside the classroom. The systematically arranged worksheet stages can enhance students' critical thinking [8]. Therefore, with this CTL worksheet based on blended learning, students can continue the learning process outside the classroom using the same teaching model as inside the classroom, addressing the issue of limited school hours and promoting student self-directed learning [13]. Outside the classroom, students can access and complete tasks within the worksheet through images, instructional videos, and other learning links embedded in the CTL worksheet based on blended learning, which can be accessed anytime and anywhere. This well-structured worksheet can also enhance students' critical thinking [14]. Please refer to Fig. 2 for the design of the CTL worksheet based on blended learning.

Fig. 2. The appearance of the worksheet before being validated by experts and practitioners

The feasibility of the CTL worksheet based on blended learning design was assessed by validators, namely experts, through three types of assessments: Lesson Plans, worksheet, and the correlation between lesson plans and worksheet. The feasibility test resulted in an average percentage score of 96.97%, with the criteria being highly feasible, as shown in Table 3

Table 3. Feasibility Test Results by Experts

No	Assessment aspect	Percentage	Criteria
1.	The Aspect of Lesson Implementation Plan	96,75%	Highly Feasible
2.	The Aspect of Student Worksheets	98,33%	Highly Feasible
3.	The Aspect of the Relationship between Lesson Plans and Student Worksheets	95,83%	Highly Feasible
	Persentase rata-rata	96,97%	Highly Feasible

The results above indicate that the aspect of the relationship between Lesson Plans and Student Worksheets received the lowest score due to the presence of discrepancies between the learning objectives outlined in the lesson plan and the instructional activities designed in the worksheet. However, the learning method represents the operational steps of the selected teaching strategy to achieve the learning objectives [15], so it is crucial to improve this aspect to ensure that students can follow the learning process according to the activity steps and complete tasks effectively in line with the learning objectives. Additionally, criticisms and suggestions were also obtained from the feasibility test results by practitioners, as indicated in Table 4

Table 4. The feasibility test results by practitioners

No	Assesment Aspect	Percentage score
1.	Feasibility of Content	91,6%
2.	Language Proficiency	87,5%
3.	Presentation	95,8%
4.	Visual Design	87,5%
5.	Critical Thinking Abilities	90%
	Average percentage score	90,48%
	Criteria	Highly Feasible

The results above indicate the lack of visuals in the CTL worksheet based on blended learning design, making it appear text-heavy and less engaging for use. The inclusion of images or symbols can clarify material descriptions and enhance visual appeal, reducing student boredom with the worksheets [16]. The language used in this CTL worksheet based on blended learning design is already good, with a percentage score of 93.75%. However, there are still suggestions for improvement because the use of correct and proper language in accordance with the rules of the Indonesian language is crucial in the development of learning materials [17]. This ensures that teachers do not misinterpret the learning process scenario when using the CTL worksheet based on blended learning, and students can easily understand the learning material using these worksheets. The improvements made to the CTL worksheet based on blended learning the feasibility test results by experts and practitioners can be seen in Fig. 3

Fig. 3.   The appearance of the worksheets after being tested for feasibility by experts and practitioners

Next, a limited test was conducted with 2 teachers and 17 students from class ten at senior high school in Banda Aceh. The limited test used a questionnaire instrument to

collect feedback from teachers and students regarding the CTL worksheet based on blended learning, as well as a critical thinking test for students. The results of the limited test showed that the teachers' response to the CTL worksheet based on blended learning was very positive, with an average percentage score of 95.83%, as indicated in Table 5

Table 5. The Results of Teacher's Response to CTL worksheet based on blended learning.

No	Assesment Aspect	Percentage score
1.	Presentation of the material	97,5%
2.	Presentation of material in the worksheets	95%
3.	Critical thinking abilities	95%
	Average percentage score	95,83%
	Criteria	Very Good

The results of student responses to CTL worksheet based on blended learning obtained an average percentage score of 89.51%, as shown in Table 6

Table 6. The Results of Student Response to CTL worksheet based on blended learning

No	Assesment Aspect	Percentage score
1.	Ease of using worksheets	89,21%
2.	Ease of following the learning	90,56%
3.	Student's assistance in understanding the material using worksheets	89,47%
4.	Student's assistance in the learning process	88,82%
	Average percentage score	89,51 %
	Criteria	Very Good

The results of the students' critical thinking test show an improvement after they learned using CTL Worksheet based on Blended Learning, which was analyzed using the N-gain test, as indicated in Table 7

Table 7. The results of the students' critical thinking test using N-gain.

	N	Min	Max	Mean	Std. Dev
Ngain_Score	17	.56	.94	.7714	.112
Ngain_Persen	17	56.25	94.4	77.13	11.2

The results above indicate an N-gain score of 0.7714, which falls into the high category, and an N-gain percentage of 77.14, which is categorized as effective. This shows that the developed CTL worksheet based on blended learning have been proven to be effective in enhancing students' critical thinking abilities.

When examined per indicator, the results of the students' critical thinking test can be seen in Table 8

Table 8. The Results of Students' Critical Thinking Test by Indicator.

No	Critical Thinking Indicator	Average Score Percentage	
		Pre-test	Post-test
1	Elementary Clarification	88,23%	94,11%
2	Basic Support	64,70%	85,29%
3	Inference	47,05%	82,35%
4	Advance Clarification	38,23%	68,42%
5	Strategy And Tactics	52%	70,58%

The percentage scores for the lowest pretest and posttest results are found in the indicator of providing further explanations, while the highest percentage scores for both pretest and posttest are in the indicator of Elementary Clarification. The indicator of Elementary Clarification is highly trained with the activities present in the CTL worksheet based on blended learning because with the modeling stages, students directly engage in activities to discover the concepts they are learning. The learning activities are oriented towards active student engagement, which stimulates critical thinking as students actively ask questions, discuss, and express their opinions [18]. As a result, concepts can be explained in a simple manner based on their own learning experiences.

However, the indicator of Advanced Clarification has not yielded optimal results because in the Authentic Assessment stage of the CTL worksheet based on blended learning, students have not been thoroughly trained to assess the overall learning activities they have undertaken. These worksheets only calculate scores, whereas in this stage, students can be trained to advanced clarification or evaluate the assumptions they have encountered related to the material they have learned or the tasks they have completed [19].

4   Conclusion

The CTL worksheet based on blended learning, which have been created, fall into the highly feasible category according to the validation tests conducted by experts, practitioners, and the feedback from both teachers and students. Moreover, this worksheet has demonstrated its capability to enhance students' critical thinking skills, with an N-gain score percentage of 77.14%, categorizing it as an effective tool for enhancing students' critical thinking abilities. This highlights the appropriateness of CTL worksheet based on Blended Learning for enhancing students' critical thinking. Nonetheless, there is still a necessity for continued development concerning other physical materials.

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