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The Influence of *the Contextual Teaching and Learning* (CTL) Model Based on Local Wisdom on Students' Physics Learning Outcomes at SMAN 8 Banda Aceh

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ABSTRACT

Low physics learning outcomes in high school are often caused by teacher-centered learning that does not relate the material to real life or local culture. This study aims to determine the effect of the contextual teaching and learning (CTL) model based on local wisdom on the physics learning outcomes of students at SMAN 8 Banda Aceh. The population of this study was all 10th grade IPAS students, using random sampling. Grade X IPAS 2 became the research sample. Data were collected through learning outcome tests and observations. Data analysis used normality tests (Shapiro Wilk), N-Gain tests, and t-tests (paired sample tests). The average pretest score was 23.1, while the average posttest score was 83.83. Furthermore, the results of the hypothesis test using the t-test showed that tcount ≥ ttable (5.45 ≥ 1.699) ($\alpha = 0.05$), so it was concluded that the contextual teaching and learning (CTL) model based on local wisdom had a significant effect on improving students' physics learning outcomes. Observations of the implementation of the first meeting reached 88.812 and the second meeting reached 88.49, indicating that students were more motivated and understood the concepts better. Thus, contextual teaching and learning (CTL) based on local wisdom effectively improves students' physics learning outcomes.

1. INTRODUCTION

Physics is one of the natural sciences that plays a crucial role in understanding natural phenomena, matter, energy, and the interactions between them in the context of everyday life. Physics education does not only aim to build conceptual understanding, but also to foster critical thinking skills, problem-solving skills, and scientific attitudes in students through observation of phenomena occurring in the surrounding environment (Nurmasyitah et al., 2022; Erlangga et al., 2022). Therefore, the physics learning process is not merely about memorizing formulas, but rather training students to think scientifically and apply physics concepts in real-life contexts.

However, in practice, the physics learning process in schools is still dominated by a theoretical and abstract approach. Educators tend to emphasize the delivery of formulas and the memorization of concepts, without connecting them to the reality of students' lives. This condition causes students to have difficulty understanding the essence of the physics concepts being studied, so they feel that physics is difficult and irrelevant to their daily lives (Ady, 2022; Nawahdani et al., 2022). This situation has an impact on students' low motivation, interest, and learning achievement in physics.

Based on the results of observations and initial interviews with physics teachers at SMAN 8 Banda Aceh, it was found that the learning achievement of grade X IPAS students was still relatively low. Students have difficulty understanding basic physics concepts, such as quantities and units, because the learning process does not relate the material to everyday life or local culture. This condition indicates the need for more contextual learning innovations so that students can understand physics concepts meaningfully and apply them in real life.

One relevant model is Contextual Teaching and Learning (CTL). According to Alman (2020), CTL provides opportunities for students to build understanding through direct experiences related to everyday life. Chofifah & Setiawan (2024) emphasize that CTL can increase student participation, encourage them to think critically, and connect learning concepts to real-life situations. In addition, Nababan (2023) states that in the CTL approach, teachers act as facilitators who help students connect learning materials with their surroundings, making the learning process more meaningful and applicable (Johnson, 2002; Karim & Zoker, 2023; Dewi & Dwikoranto, 2021).

However, the effectiveness of the Contextual Teaching and Learning (CTL) model will be maximized if the context applied in the learning process is adapted to the cultural background and environment of the students. If the context presented comes from an unfamiliar external culture, students will find it difficult to understand its essence. Therefore, the integration of local wisdom in the CTL approach is crucial so that students not only understand scientific concepts but also develop awareness and pride in their culture. In the context of Aceh, the integration of local values can be realized through the introduction of traditional measurement systems such as gantang, nale, and depa, which have long been used in the lives of the people of Aceh (Saminan et al., 2017). These traditional measurement systems reflect the basic principles of physics and can be used as a concrete and meaningful learning context.

Unfortunately, the potential of local culture, such as traditional Acehnese measuring tools, has not been widely utilized in the physics learning process in schools. In fact, the use of local cultural contexts can help students understand measurement concepts in a more tangible and contextual way. Similarly, Masfufah & Ellianawati (2020) stated that CTL based on local wisdom is able to connect science with cultural practices that are alive in society.

Previous studies have also shown that the CTL model and local wisdom-based learning are effective in improving student learning achievement and thinking skills. Siagian (2024) and Fitriani (2023) found that contextual teaching and learning can improve physics learning achievement and student activity. Uran et al. (2024) and Fahrudin & Maryam (2022) also reported that learning that integrates local cultural values can improve learning achievement and students' positive responses to the material. Pomalato et al. (2018) even stated that a scientific approach based on local wisdom can improve understanding of physics concepts, while Rima et al. (2019) showed that teaching materials developed with local cultural content are effective in improving student activity and learning achievement.

Although various studies have demonstrated the effectiveness of the Contextual Teaching and Learning (CTL) model and the integration of local wisdom in physics education, most previous research has focused on general cultural contexts or different physics topics. Very limited studies have specifically examined the application of a CTL model integrated with Acehnese local wisdom in physics learning, particularly in the topic of quantities, units, and measurement errors, which are closely related to traditional Acehnese measurement systems.

This study offers novelty by explicitly integrating Acehnese traditional measurement concepts such as gantang, nale, and depa into the CTL learning framework and empirically examining their impact on students' physics learning outcomes. Therefore, this research not only evaluates the effectiveness of CTL but also strengthens the contextualization of physics learning through culturally relevant local wisdom. Based on these considerations, this study aims to examine the effect of applying a local wisdom-based CTL model on students' physics learning outcomes at SMAN 8 Banda Aceh.

2. METHODS

2.1 Research Design

This study employed a quantitative approach using a pre experimental research design, specifically the one-group pretest–posttest design. This design was selected to examine the effect of implementing the Contextual Teaching and Learning (CTL) model based on local wisdom on students' physics learning outcomes.

In this design, a single group of students was given a pretest to measure initial learning outcomes, followed by instructional treatment using the CTL model integrated with Acehnese local wisdom, and finally a posttest to measure learning outcomes after the intervention. The research design is presented in Table 1.

Tabel 1. *One group pretest* dan *postest design*

Pretest subject	Prtest	Treatment	Posttest
X IPAS 2	O1	X	O2

Source: Sugiyono, 2022

Information:
O_1 : *Pre-test* value (before treatment)
O_2 : *Post-test* score (after treatment)
X : Learning treatment using the CTL model based on local wisdom

It should be noted that this study did not employ a control group. Therefore, the findings are limited to measuring changes in learning outcomes before and after the intervention within the same group. This limitation should be considered when interpreting the causal effects of the treatment.

2.2 Population and Sample

The population of this study consisted of all Grade X IPAS students at SMAN 8 Banda Aceh. The sampling technique used was random sampling, and Class X IPAS 2, consisting of 30 students, was selected as the research sample.

2.3 Research Instruments

The instruments used in this study consisted of:

1. Physics Learning Outcomes Test
   The learning outcomes test was administered in the form of a pretest and posttest, consisting of multiple-choice questions related to the topics of quantities, units, and measurement errors. The test was designed to measure students' cognitive learning outcomes before and after the implementation of the CTL model based on local wisdom.
   Content validity of the test items was established through expert judgment by physics education lecturers and senior physics teachers to ensure alignment with learning objectives and curriculum standards.

Reliability of the test instrument was examined using internal consistency analysis, and the results indicated that the test items were reliable and suitable for measuring students' learning outcomes.

2. Learning Implementation Observation Sheet
   The observation sheet was used to assess the implementation of the CTL learning model based on local wisdom during the learning process. The observation instrument was developed according to the core components of CTL, including constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment.
   Observations were conducted by two independent observers during each learning session. The observation scores were then converted into percentages using Equation (1).

$$\text{Percentage value} = \frac{acquisition\ score}{maximum\ score}\ x\ 100\ \% \qquad (1)$$

Table 2. Criteria for Learning Implementation Score

Score Interval	Description
Score ≤ 20	Very poor
21 ≤ Score ≤ 40	insufficient
41≤ Score ≤ 60	Adequate
61 ≤ Score ≤ 80	Good
Score ≥ 81	Very good

Source: Kartini & Putra, 2020

The percentage scores were interpreted using the criteria presented in Table 2.

2.4 Data Analysis Techniques

Data analysis was conducted using descriptive and inferential statistical techniques. The analysis procedures included:

1. Normality Test, using the Shapiro–Wilk test at a significance level of 0.05 to determine whether the data were normally distributed.
2. N-Gain Analysis, to determine the magnitude of improvement in students' learning outcomes after the treatment.
3. Paired Sample t-Test, to examine the significance of differences between pretest and posttest scores at a significance level of 0.05.

3. RESULT AND DISCUSSION

3.1 Learning Outcome Test Results

The pretest and posttest results were used to determine the extent to which student learning outcomes had improved after the application of different learning models in each class X IPAS 2. The pretest scores showed the students' initial abilities before the treatment, while the posttest was used to measure the students' understanding after the learning process and treatment. The calculation of the average learning outcomes of students in class X IPAS 2 is presented in Table 3 below.

Tabel 3. Average learning outcomes of students in class X IPAS 2

Statistical data	Pretest	Posttest
The highest score	40	100
Lowest value	10	70
Average	23,16	83,83

Table 3 shows that there was an increase in the average score in class X IPAS 2 after learning. This indicates that the contextual teaching and learning model based on local wisdom in learning contributes more to students' physics learning outcomes.

Before testing the hypothesis, prerequisite tests were conducted in the form of normality and N-Gain tests. The normality test aimed to determine whether the student learning outcome data was normally distributed, while the N-Gain test aimed to determine the increase in student learning outcomes from the pretest to the posttest. The normality test was conducted using the Shapiro Wilk test at a significance level of 0.05. The calculation results are presented in Table 4.

Table 4. Shapiro Wilk Normality Test Results

α	Frequency	Pretest		Posttest		Conclusion
0,05	30	Wcount	Wtable	Wcount	Wtable	Data is normality distribution
		0,937	0,927	0,946	0,927	

Based on Table 4 above, Wcalculated > Wtable in both the pretest and posttest, so it can be concluded that the data is normally distributed.

After the data was declared normally distributed, an N-Gain test was conducted to determine the increase in learning outcomes. An N-Gain value of 0.79 was obtained. After observing that the data was normally distributed and there was an increase, a hypothesis test was then conducted to determina the difference in learning outcomes. The test used was a paired sample t-test at a significance level of 0.05. The results of the statistical analysis using the t-test showed that the t-count value of 5.45 was ≥ t-table 1.699 at a significance level of 0.05. This, there was a significant difference between the learning outcomes of students before and after being given treatment with the contextual teaching and learning model based on local wisdom.

Overall, these results provide empirical evidence that integrating local wisdom into the contextual teaching and learning model improves students' physics learning outcomes.

3.2 Results of Observations on Learning Implementation

Observations of learning implementation were conducted by two observers tasked with observing the implementation of the contextual teaching and learning model in physics learning in class X IPAS 2, SMA Negeri 8 Banda Aceh. The observations were conducted during two meetings. The purpose of these observations was to assess the extent to which the implementation of the learning model syntax was in accordance with the design specified by. The results of the analysis of the implementation of the Contextual Teaching and Learning model based on local wisdom are presented in Table 5.

Tabel 5. Results of the analysis of the implementation of the Contextual Teaching and Learning model based on local wisdom

CTL Activities and Components	Session 1		Average (%)	Note	Session 2		Average (%)	Note
	P1 (%)	P2 (%)			P1 (%)	P2 (%)		
Kegiatan Pendahuluan	93,75	87,5	90,62	Very good	93,75	87,5	90,62	Very good
Core Activities								
Constructivism	75	87,5	81,25	Very good	87,5	87,5	87,5	Very good
Questioning	75	75	75	Good	75	87,5	81,25	Very good
Learning community	75	87,5	81,25	Very good	87,5	87,5	87,5	Very good
Inquiry	87,5	75	81,25	Very good	87,5	87,5	87,5	Very good
Modelling	87,5	87,5	87,5	Very good	87,5	87,5	87,5	Very good
Reflection	75	75	75	Good	75	100	87,5	Very good
Authentic assessment	75	75	75	Good	75	100	87,5	Very good
Closing Activities	87,5	75	81,25	Very good	87,5	87,5	87,5	Very good
Class Atmosphere	80	80	80	Good	95	100	97,5	Very good
Total			**88,812**	**Very good**			**88,187**	**Very good**

The observation results show that all syntaxes of the contextual teaching and learning model based on local wisdom were implemented with a "very good" rating in both meetings. The average implementation of learning in the first meeting reached 88.812% and in the second meeting reached 88.187%, reflecting that the implementation of the model went according to the designed scenario. All stages of learning, from introductory to closing activities, were carried out consistently and effectively. These activities supported students' active involvement in the learning process and reflected that the model successfully created a participatory and meaningful learning atmosphere.

4. CONCLUSION

This study shows that the contextual teaching and learning model based on local wisdom has a significant effect on students' physics learning outcomes in the subject of quantities and units. Students who participated in learning using this model demonstrated a better understanding of the concepts compared to students who learned without the contextual teaching and learning model. Observations of the implementation showed that the learning process was highly optimal. Therefore, this model is considered not only to improve learning outcomes but also to create an interactive, efficient, and inclusive learning environment, making it suitable for application in physics education and other conceptual and experimental subjects.

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