THE EFFECTIVENESS OF THE CONTEXTUAL TEACHING AND LEARNING MODEL IN IMPROVING STUDENTS' CONCEPTUAL UNDERSTANDING

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Abstract

This study aims to analyze the effect of the application of the Contextual Teaching and Learning (CTL) learning model to enhance pre-service science teachers' conceptual understanding in physics materials. This study uses a pre-experimental method with a one group pre-test post-test design. The instrument used was a test of concept comprehension ability. The results showed a significant effect in students' conceptual understanding with a t-test result of 3.922 (< 0.05). Based on the calculation of N-Gain, there were 12 students (40%) who experienced an increase in conceptual understanding in the medium category, and 18 students (60%) in the high category. The average N-Gain value of 0.73 shows that the increase in students' understanding of concepts on temperature and heat materials is relatively high. Thus, the results report that the CTL learning model is effective in improving students' understanding of concepts and is suitable for application in the physics learning process.

Keywords: conceptual understanding; Context Teaching and Learning; physics

Abstrak

Penelitian ini bertujuan untuk menganalisis pengaruh penerapan model pembelajaran Contextual Teaching and Learning (CTL) terhadap peningkatan kemampuan pemahaman konsep mahasiswa S1 Pendidikan IPA angkatan 2024 di Universitas Hasyim Asy'ari, khususnya pada materi fisika. Penelitian ini menggunakan metode pre-eksperimental dengan desain one group pre-test post-test, yang melibatkan dua tahap pengujian, yaitu pre-test dan post-test. Instrumen yang digunakan berupa tes kemampuan pemahaman konsep. Hasil penelitian menunjukkan bahwa terdapat pengaruh yang signifikan pada pemahaman konseptual siswa dengan hasil uji t sebesar 3.922 (< 0.05). Berdasarkan perhitungan N-Gain, terdapat 12 mahasiswa (40%) yang mengalami peningkatan pemahaman konsep dalam kategori sedang, dan 18 mahasiswa (60%) yang mengalami peningkatan dalam kategori tinggi. Nilai rata-rata N-Gain sebesar 0,73 menunjukkan bahwa peningkatan pemahaman konsep mahasiswa pada materi suhu dan kalor tergolong tinggi. Dengan demikian, hasil penelitian ini membuktikan bahwa model pembelajaran CTL efektif dalam meningkatkan pemahaman konsep mahasiswa dan layak diterapkan dalam proses pembelajaran fisika.

Kata Kunci: *pemahaman konsep; Context Teaching and Learning; fisika*

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INTRODUCTION

Comprehension is defined as the ability to understand the meaning and significance of the material being studied by analyzing the main points of a text or converting data presented in a certain form into another form. A concept is defined as the fundamental unit of cognition, formed through knowledge schemas and connection patterns that are employed to group objects into categories (Hamatun & Rifai, 2022). According to Theasy *et al*. (2021), conceptual understanding is imperative in the domain of physics education, as students are expected to establish connections between theoretical concepts, mathematical equations, and their practical applications in everyday life. Furthermore, a comprehensive grasp of physics concepts is imperative for effective problem-solving in the field (Hamatun & Rifai, 2022). It is imperative to recognize that students will not adequately address the presented problems if they lack a robust comprehension of the fundamental concepts. This assertion is further substantiated by Wicaksana & Suryani (2022) This conceptual understanding is of significant importance, particularly in the context of learning. It has been demonstrated that students who demonstrate a higher level of mastery in specific science concepts tend to exhibit a stronger aptitude in other science-related skills.

One of the fundamental physics concepts that students must master is the concept of temperature and heat. This concept is an essential component of the mechanics course, which must be mastered to facilitate students's comprehension of subsequent material (Puri & Perdana, 2023). The concepts of temperature and heat are taught sequentially from elementary school through university. Therefore, it is imperative to develop a comprehensive understanding of these concepts. However, students frequently encounter difficulties in comprehending physics concepts (Hamatun & Rifai, 2022).

A study was conducted on undergraduate students majoring in Science Education at Hasyim Asy'ari University in the class of 2024 who had taken the Basic Physics course. The results of the study indicated that these students demonstrated a below-average level of conceptual understanding skills. This was evident from

their midterm examination results, with 82% of students failing to meet the passing criteria and 18% meeting them.

One method for assessing students's potential for reasoning is to implement a learning model that enables them to achieve optimal results in the learning process. This pedagogical model eschews the conventional approach of relying on factual memorization, instead emphasizing the development of students's own cognitive abilities. One learning model that can be applied to optimize students's understanding of physics concepts is Context Teaching and Learning (CTL) (Laelawati & Makiyah, 2023).

CTL is a learning concept that fully engages students in discovering material, relating it to real-world phenomena, and applying it in everyday life, thereby rendering learning more relevant and meaningful (Lestari et al., 2023). The integration of classroom material with students's lives has been demonstrated to facilitate enhanced conceptual understanding (Najib, 2023). Temperature and heat are particularly suitable topics for the implementation of the CTL model because they are closely related to phenomena that students encounter in their daily lives (Riza et al., 2024). Concepts such as changes in body temperature, weather conditions, cooking processes, heat transfer, and the use of thermal insulation can be directly observed and experienced by students. Through CTL, these everyday experiences can serve as meaningful contexts for constructing scientific understanding, enabling students to connect abstract physics concepts with real-world situations (Putri & Akhsan, 2026). As a result, students are more likely to develop deeper conceptual understanding and reduce misconceptions regarding temperature and heat phenomena.

The CTL model, which is based on the philosophical foundation of constructivism, is predicated on the notion that students should learn through "experiencing" rather than "memorising" (Kaharu et al., 2023). CTL functions as a medium for the exchange of experiences and concepts among its constituents. Students, in their capacity as learning subjects, possess a range of characteristics, learning styles and interests that, when cultivated, have the potential to foster creativity and innovation. This finding aligns with the research conducted by

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Anggraini et al. (2023), which demonstrated that the utilisation of CTL-based physics teaching materials can enhance conceptual understanding.

Research by Bahri et al. (2024) demonstrates that the implementation of the CTL model enhances students's comprehension of physics concepts, with an increase from 59.25% in Cycle I to 88.89% in Cycle II. Concurrently, research by Kahfi & Sulistiawati (2023) demonstrates that CTL-based teaching materials can enhance students's comprehension of physics concepts, with a notable 91% of students attaining mastery.

Although several previous studies have reported the effectiveness of CTL in physics instruction, detailed information regarding the specific topics investigated remains limited. In addition, most prior research has focused on elementary and secondary school students (Agusti, 2023; Bigozzi et al., 2018; Hendawati et al., 2019), while studies involving university students are still relatively scarce. In light of these, researchers have identified a compelling rationale for leveraging the CTL model to enhance students' comprehension of physics principles, particularly those related to temperature and heat and the involvement of university students. Consequently, researchers conducted a study entitled "The Effectiveness of the Context Teaching and Learning Model in Improving Students' Conceptual Understanding".

This study aimed to investigate the effect of the CTL model on university students' conceptual understanding of temperature and heat in a Basic Physics course. The CTL model was selected because it emphasizes the connection between academic concepts and real-life situations, enabling students to construct knowledge through meaningful learning experiences. This characteristic is particularly relevant to temperature and heat topics, as these concepts are closely associated with everyday phenomena that students frequently encounter, such as changes in weather, cooking processes, and thermal interactions. Through the implementation of CTL, students are expected to develop a deeper understanding of scientific concepts by relating theoretical knowledge to authentic contexts. Furthermore, this study seeks to provide empirical evidence regarding the effectiveness of the CTL model as an

alternative instructional approach for improving conceptual understanding in physics learning at the university level.

METHOD

The current study uses a type of experimental design called "pre-experimental," specifically a "one-group pre-test post-test" setup. There is no comparison group; instead, it uses a single class that takes a test before and after the intervention. The pre-test helps to measure how much the CTL learning model affects students' understanding of temperature and heat concepts.

In this study, the research subjects were administered a pre-test to ascertain their level of conceptual understanding prior to the administration of treatment. Subsequently, the students underwent a series of physics lessons focused on temperature and heat, employing the CTL model to enhance their conceptual comprehension. Subsequent to the intervention, the students were administered a post-test to ascertain their level of comprehension. This type of research can be succinctly summarized as follows (Sugiyono, 2021):

O1 ----- X ----- O2

Note:

O1 : Pre-Test

O2 : Post-Test

X : The treatment entailed the implementation of the CTL learning model, a pedagogical approach designed to enhance students's comprehension of the concepts of temperature and heat.

The people involved in this study were 30 undergraduate students studying Science Education at Hasyim Asy'ari University, who were taking the Basic Physics course. The study was carried out at Hasyim Asy'ari University on April 21 and 28, 2025. The tool used to collect data was an essay-based concept understanding test with 15 questions. The collected data were analyzed using several statistical procedures. First, a Shapiro–Wilk normality test was conducted to determine whether the pre-test and post-test scores were normally distributed. Since the data met the normality assumption, a paired-sample t-test was employed to examine the

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effect of the CTL model on students' conceptual understanding of temperature and heat. In addition, N-Gain analysis was used to measure the magnitude of students' learning improvement, which was categorized into low, moderate, and high levels according to established criteria by Hake (1999).

RESULTS AND DISCUSSION

Firstly, the normality test is used to see if the data follows a normal distribution. The primary question guiding this analysis was to determine the extent to which the calculated significance value aligned with the established significance level. The findings of the Shapiro–Wilk test for normality are presented in Table 2.

Table 2 Shapiro–Wilk Test for Data Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-Test	0.193	30	0.093	0.918	30	0.138
Post-Test	0.237	30	0.012	0.897	30	0.060

a. Lilliefors Significance Correction

The assumption of normality for the test data is predicated on the condition that the sig value exceeds the alpha value (0.05). Conversely, when the sig value is less than the specified alpha value, the data is believed to be not normally distributed. The pre-test result demonstrated a significance value of 0.138, while the post-test result exhibited a significance value of 0.06. It is noteworthy that both values exceed the 0.05 alpha value threshold, indicating a high level of statistical significance. This indicates that the data is normally distributed, as evidenced by the sig value exceeding 0.05.

Subsequently, a paired t-test is used to test the average difference of a variable against a hypothesis, especially if there was a significant improvement in students' understanding of temperature and heat after using the CTL learning model. The results of this test are shown in Table 3.

Table 3 Paired Sample T Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	PreTest - PostTest	-20.588	21.642	5.249	-31.716	-9.461	-3.922	32	0.001

Based on the hypothesis test results in Table 3, the Sig. (2-tailed) value is 0.001, which is lower than 0.05. This means the hypothesis is accepted. The result shows a big difference in how the CTL learning model is used, especially when it comes to helping students understand temperature and heat. Using the CTL learning model in the Basic Physics course at Hasyim Asy'ari University could help students better understand these concepts.

After giving the pre-test and post-test, an N-Gain analysis was conducted to check how much the students' understanding improved. The results of this analysis are shown in Table 4.

Table 4 N-Gain Scores from Pre-Test and Post-Test Results.

N-Gain	Students's Conceptual Understanding		
	Frequency	Percentage (%)	Criteria
N-gain < 0.30	0	0	Low
0.30 ≤ N-gain ≤ 0.70	12	40	Medium
N-gain > 0.70	18	60	High
Total	30	100	-
$\bar{x}$ N-gain Score	0.73		High

As shown in Table 4, the results of the N-gain scores for each of the 30 students are listed. It shows that the students' understanding of the topics improved a lot. No student had an N-gain score less than 0.30, which is considered low. Twelve students scored between 0.30 and 0.70, which is moderate, and eighteen students scored above 0.70, which is high. Overall, the test scores went up after the lesson

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compared to before. The average N-gain score was 0.73, which falls into the high category.

The students took a concept comprehension test that had two parts: a pre-test and a post-test. These tests were then grouped according to Riduwan's method (in Nisa & Nasrudin, 2022) scoring system, Students were considered to have mastered the material if they achieved a score of ⩾70. The pre-test is administered prior to the commencement of instruction, while the post-test is conducted following the conclusion of instruction to assess students's conceptual understanding of the CTL an instructional model focused on temperature and heat. The improvement of students understanding the topic before and after the intervention in Figure 1.

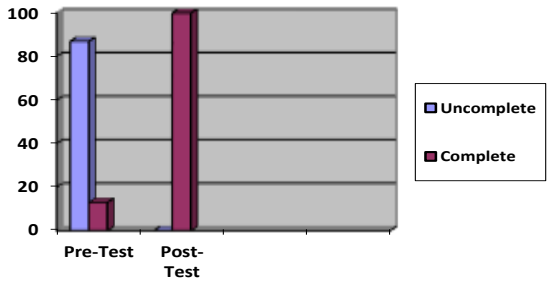

Figure 1 Comparison of Students' Conceptual Understanding Levels Before and After CTL Implementation

As shown in Figure 1, the pre-test results showed that 87% of the students did not fully understand the ideas of temperature and heat, while 13% had a full understanding. However, in the post-test, none of the answers were incomplete, and all of them were considered fully understood. The pre-test results demonstrated the students's initial abilities prior to undergoing treatment through the implementation of the CTL model. It is imperative for educators to be cognizant of the students's initial abilities, as this knowledge is instrumental in effective management of the learning process. At this stage, the role of the lecturer is of paramount importance in providing meaningful information and helping students to build their knowledge independently. Furthermore, the pre-test results can be utilized to monitor student progress in the learning process (Siregar *et al*., 2023).

The teaching and learning process is a fundamental aspect of education that involves interaction between instructors and students (Tang, 2023). These activities are meticulously designed to achieve specific educational objectives, including the impartation of knowledge, the cultivation of skills, and the promotion of critical thinking (Sodirjonov, 2020). In this case, the role of the lecturer is of paramount importance, as they are responsible for facilitating the learning experience and guiding students towards achieving these goals.

A critical responsibility of an instructor is to select a pedagogical approach that aligns with the established learning objectives. Learning models provide a structured framework for delivering material and organizing learning activities in a way that actively engages students (Octavia, 2020). The selection of an appropriate model enables educators to cultivate an instructional environment that fosters optimal student engagement, promotes active participation, and facilitates a more profound comprehension of the subject matter. The implementation of an appropriate learning model has been demonstrated to result in substantial enhancements in conceptual understanding. This is due to the ability of such models to enable educators to customize their pedagogical approach to align with the distinct requirements of their students, thereby rendering the learning experience more pertinent and efficacious. So, choosing the right learning models carefully is very important to help students reach the educational goals they want.

The CTL model helps students understand concepts better by linking what they learn in class to real-life situations and their own personal experiences (Ilyas et al., 2022). Furthermore, the CTL model functions as a pedagogical approach that underscores the significance of comprehensive student engagement, thereby facilitating students's comprehension of the subject matter and its subsequent application in their daily lives (Syaifuddin et al., 2021). The utilization of the CTL model to enhance conceptual understanding is consistent with the findings of Hani et al. (2024) who observed that learning facilitated by a model that connects learning to daily life can influence students's enthusiasm, leading them to actively participate in learning and thereby enhance their conceptual understanding.

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In accordance with the principles of contextual learning theory, it is imperative that students engage in learning that is more productive and that can facilitate the application of course material to their daily lives (Nababan et al., 2023). In accordance with the CTL model, which adheres to the constructivist approach, it is anticipated that students will acquire knowledge through the process of "experiencing" rather than "memorizing" (Ulya, 2024). This assertion is corroborated by the findings of Salelenggu & Santoso (2021) which demonstrate that in the context of contextual learning, the process of learning does not entail mere memorization. Rather, it is characterized by the reconstruction of knowledge derived from one's personal experiences. Consequently, the accumulation of experiences directly correlates with the accrual of knowledge. Learning is not merely about accumulating facts; it is about organizing all experiences so that the knowledge acquired influences human behavior patterns, such as thinking patterns, action patterns, problem-solving abilities, and conceptual understanding (Nababan et al., 2023).

The capacity to comprehend the concepts under scrutiny in this study was found to be at the 100% level. According to Riduwan (in Nisa & Nasrudin, 2022), this percentage is classified as very high. This finding indicates that the implementation of the CTL model has yielded positive outcomes in facilitating student comprehension of concepts. By fostering an environment that is more engaging and student-centered, instructors can ensure that students not only absorb the material but also apply it in practical and meaningful ways, thereby enhancing their conceptual understanding.

CONCLUSION

The implementation of the CTL model has a significant effect on improving pre-service science teachers' conceptual understanding, particularly in temperature and heat topics at Universitas Hasyim Asyari. The results indicate that students experienced a substantial improvement after the application of the CTL model, demonstrating that this approach is effective in facilitating meaningful learning and helping students connect concepts with real-life situations. These findings imply that

the CTL model can be used as an appropriate instructional strategy in physics learning to enhance pre-service science teachers' conceptual understanding. Therefore, lecturers are encouraged to apply the CTL model to create a more engaging and student-centered learning environment that supports deeper comprehension of scientific concepts.

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