KUANTUM
Jurnal Pembelajaran & Sains Fisika
e-ISSN: 2774-1966
Volume. 6. Number 2. Desember 2025
Pages: 249 -256
DOI: https://doi.org/10.63976/kuantum.v6i2.1058

Interactive Contextual-Based Physics E-Module on Temperature and Heat Material to Enhance Middle School Students' Understanding

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ABSTRACT

This research aims to develop contextual-based interactive physics e-modules on temperature and heat materials for junior high school students. Learning media that is still dominated by conventional teaching materials makes it difficult for students to understand concepts concretely and less motivated to learn independently as a solution to increase student learning motivation. Therefore, the development of digital-based learning media is expected to be an effective solution to improve student motivation and quality of understanding. The research uses the Research and Development (R&D) method with a 4D (Define, Design, Develop, Disseminate) model. The subjects of the study were 39 grade VIII students of SMP Negeri 44 Tanjung Jabung Barat. Data collection techniques are carried out through student needs questionnaires and interviews with science teachers, as well as instrument validation by material experts and media experts. Data analysis used quantitative descriptive techniques.
The results of the study show that the majority of students use interactive digital learning media to improve their understanding. The development of e-modules is equipped with texts, images, learning videos, practice questions. This study recommends the use of contextual-based interactive e-modules as an innovative learning media solution to support the understanding and learning motivation of physics students in junior high school. This study recommends the use of contextual-based interactive physics e-modules as innovative learning media that can support the teaching and learning process and empower students to learn independently and meaningfully.

Keywords: *Interactive E-Module, Physics Learning, Temperature and heat*

INTRODUCTION

Physics science learning at the first school level (SMP), especially temperature and heat materials, often experiences obstacles in understanding concepts by students. This is due to the abstract nature of the concept and is difficult to observe directly (Muliyani et al., 2023). Therefore, a learning approach that connects physics concepts with real-world contexts is needed so that students can build meaningful understanding (Fitriani et al., 2023). This contextual-based learning is also encouraged by various curriculum reforms Modern science education as an effective strategy in increasing student engagement and motivation (Arifin et al., 2024).

One of the learning innovations that supports the inu approach is the interactive physics e-module and the use of smart classrooms as a learning technology that improves the learning experience of students and teachers (Twahirwa & Ntivuguruzwa, 2024). This digital learning medium not only provides materials in a structured manner, but also engages students in

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interactive activities that reinforce the understanding of concepts through hands-on experience (Barrun et al., 2025). Studies show that interactive e-modules designed with students' learning context and learning styles in mind are able to improve learning outcomes as well as critical thinking skills (Lafifa et al., 2023). This module, which integrates content such as videos, simulations make abstract concepts of temperature and heat more concrete and easy to understand independently by students (Richter & Kickmeier-Rust, 2025).

The contextual learning approach encourages teachers to relate learning materials to relevant situations and phenomena in students' daily lives, so that the learning process becomes more meaningful and can improve students' ability to apply scientific concepts (Muliyani et al., 2023). The ability of teachers to integrate context with scientific content supports the creation of an effective learning process. Quantitative research shows that contextual implementation has a significant influence on the formation of students' physics behaviors, which has an impact on increased motivation and active involvement in physics learning (Ilyas et al., 2023). Therefore, the ability of teachers to integrate context with scientific content greatly determines the creation of an effective and student-cantric learning process (Agyei & Agyei, 2021).

Initial observations at one of the junior high schools show that the physics learning process is still facing various obstacles. Based on the results of the questionnaire, around 76.92% of students stated that they had difficulty understanding physics lessons. As many as 69.23% felt that the delivery of material was too fast, making it difficult to understand. In addition, as many as 79.49% of students stated that the material presented was less associated with daily life, while 76.92% said that the learning media used was still limited to printed books and whiteboards. In the temperature and heat material, 76.92% of students stated that they were still confused about distinguishing the two. Most tend to just memorize formulas without understanding their meaning and application. More than 79.49% of students also want digital learning media that can be learned independently through gadgets and laptops, such as interactive e-modules.

Interviews with science teachers support the findings of the initial observations. The teacher said that learning in the classroom is still dominant with the lecture method with teaching materials in the form of text materials, so that students are less active, easily bored, and learning motivation decreases. The teacher also added that students have difficulty reinterpreting the concepts of temperature and heat in their own language and are often confused in understanding them (Ab Patar et al., 2024). It is also related to students' low self-confidence in their ability to manage the physics learning process and a lack of intrinsic motivation that encourages active engagement and collaboration in learning (van Blankenstein et al., 2019). Improvement through interactive digital learning media that supports and increases students' learning motivation.

To address these challenges, contextual learning and teaching have been widely recommended and adopted as an effective approach to connecting scientific concepts with real-life contexts. Contextual is not only supported by modern science education reforms, but it is also empirically proven to improve student engagement, process skills, and critical thinking (Millah & Wildani, 2023). Meta-analysis shows that contextual models have a major positive impact on process skills, as well as significantly improving creative and critical thinking skills.

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One of the important innovations that is in line with this approach is the use of interactive e-modules. This digital learning resource not only presents learning content, but also integrates visualization, simulation, practice problems and gamification elements to encourage active learning and self-regulation (Supartin et al., 2023) When contextually-based digital modules are combined with inquiry-based, community-centric, and reflective components, learning environments become more meaningful and relevant, paving the way for 21st century skills developers(Atchley et al., 2024).

Against this background, this article examines the development and effectiveness of contextual-based interactive physics e-modules on temperature and heat materials for junior high school students (Ramadan et al., 2020). The main goal of this research is to improve students' conceptual understanding while strengthening critical thinking skills through innovative learning media that are integrated with technology and relevant to current educational needs.

RESEARCH METHODS

The research uses a quantitative descriptive method with the aim of describing the need for an effective contextual-based interactive physics e-module learning media on temperature and heat materials at the junior high school level. The subject of the study was 39 students in grade VIII of SMPN 44 Tanjung Jabung Barat. Data collection from respondents was carried out on August 29, 2025. The selection of research subjects is based on the fact that at this level students have studied temperature and heat material, so it is considered relevant for needs analysis.

Instruments

The main instrument is in the form of a questionnaire analyzing the needs of students and teachers which is compiled on a Likert scale with five answer choices, namely strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). The questionnaire consists of 20 questions grouped into several indicators as on a table. The preparation of indicators refers to research (Rahmawati et al., 2021) (Sihombing & Yohandri, 2025) which emphasizes the importance of analyzing student needs as the basis for developing learning media. The analysis indicators of the need questionnaire are shown in Table 1.

Table 1. Questionnaire Analysis Indicators

Needs Analysis Indicators	Question Item No.	Statement
Needs in physics learning	1- 5	I find it difficult to understand science learning, especially in Physics material
Material requirements for temperature and heat	6- 10	I have a hard time distinguishing between the concepts of temperature and heat
Understanding the Concept of Temperature and Heat	11- 15	I can re-explain the meaning of temperature and heat in my own language

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The need for contextual E-Module media	16- 20	I am interested in using electronics-based modules

The data collection procedure includes validation assessments by material and media experts, which are carried out by Physics Education lecturers. This validity assessment includes the suitability of the indicator with the purpose of the research, the clarity of the language used, the completeness of the content, and the readability of each question item. The average validation score is calculated using the following equation.

$$V_{ah} = \frac{T_{se}}{T_{sh}} \times 100\% \quad (1)$$

Where expert validity is obtained from the total score given by the validators divided by the total maximum score that can be obtained.

Data Collection

Data collection was carried out by distributing questionnaires to students. This questionnaire was distributed through Google Form and distributed through the WhatsApp application. In addition, a short interview was also conducted with science teachers to strengthen the results of the questionnaire. In this interview, the focus of the conversation was on the learning strategies used, the teaching materials used, and the obstacles experienced by students when studying temperature and heat materials (Rudnova et al., 2023).

Data Analysis

The data obtained from the needs questionnaire was analyzed using quantitative descriptive analysis. The respondents' results are calculated with the following percentage formula:

$$P = \frac{f}{N} \times 100\% \quad (2)$$

Where P is the percentage, f is the sum of the scores obtained and N is the maximum score. The categories of student needs analysis results are displayed in a table that allows researchers to understand the trends of student needs in each aspect more easily (Sullivan & Artino, 2013).

Table 2. Student Needs Outcome Categories

Interval (%)	Information
81-100	Very High
61-80	Tall
41-60	Enough
21-40	Low

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0-20	Very Low

In the context of education research, descriptive analysis with percentage calculations like this is commonly used to provide a comprehensive picture of students' needs and preferences(Dani, 2023). This method allows researchers to interpret data in a practical and cumicative way, supporting data-driven decision-making (Nusrotus Sa'idah et al., 2024).

RESULTS AND DISCUSSION

Research Results

The results of the analysis of student needs showed that most students had difficulty in understanding physics material, especially in the concept of temperature and heat based on a questionnaire distributed to 39 grade VIII students of SMP Negeri 44 Tanjung Jabung Barat, as many as 73.33% of students expressed difficulty understanding physics material in general. In addition, 71.49% of students felt that the method of delivering material was too fast, making it difficult for them to understand. As many as 71.49% of students also stated that the material presented was less associated with daily life, while 79.59% of students said that the learning media used was still limited to printed books and whiteboards.

More specifically, in the material of temperature and heat, 71.49% of students stated that they were confused about distinguishing between the two concepts. Many students simply memorize formulas without really understanding their meaning and application in real-life situations. Therefore, as many as 79.59% of students want interactive digital learning media, such as e-modules that can be accessed independently through electronic devices such as gadgets and laptops.

Interviews with science teachers revealed that classroom learning is still dominant using lecture methods and teaching materials in the form of printed texts, causing students to be less active, bored easily, and students' motivation to learn decreases. The teacher also added that students often have difficulty explaining the concept of temperature and heat in their own language and are often confused in understanding the concept (Setyabudi, 2024).

Based on this need, the development of contextual-based interactive physics e-modules is expected to be an effective solution to help students understand temperature and heat materials in a more interesting and meaningful way (Graham, 2024). The e-module products developed have gone through a validation process by material experts and media experts. The following are the results of the analysis of students' needs for teaching materials

Table 3. Analysis of Student Needs for Teaching Materials

Needs Analysis Indicators	Score obtained	Maximum Score	Percentage (%)	Category
Needs in Physics Learning	715	975	73,33	Tall
Material Requirements for Temperature and Heat	743	975	76,21	Tall
Understanding the Concept of Temperature and Heat	687	975	71,49	Tall

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The Need for Contextual-Based E-Module Media	776	975	79,59	Tall

Discussion

The results of this study confirm that the majority of students still have difficulty in understanding the concepts of temperature and heat. The main obstacles found came from the lecture method and the lack of use of interactive digital media. These findings are in line with research (Cynthia et al., 2023) which concludes that the integrity of digital media with visual vitur and simulation can significantly improve the understanding of physics concepts.

The design of the interactive E-module developed in this study has been designed based on the results of the analysis of the needs of students and teachers. The e-module contains a variety of temperature, heat, expansion materials. There are pictures, learning videos, practice questions, etc. This design answers the main needs of students to acquire learning that is not only theoretical but also applicable and contextual. Emphasis on interactive e-modules proved relevant to the study (Yersi et al., 2025).

In addition to being based on empirical findings, the development of this e-module refers to the principles of instructional design and instrument validation by material and language experts (Ab Patar et al., 2024). This validation ensures that every design element, both material and visual presentation, is in accordance with the learning objectives and is easy for students to understand in accordance with the learning objectives and easy to understand by students according to the junior high school level category. Thus, this discussion emphasizes that the development of contextual-based interactive e-modules is able to answer the main problems in temperature and heat learning. E-modules not only improve the conceptual quality of students, but also increase motivation and independence to learn in the digital age.

CONCLUSION

The contextual-based interactive physics e-module on temperature and heat materials developed has been proven to be feasible and effective in increasing the understanding and learning motivation of junior high school students. This learning media meets students' needs for teaching materials that are interesting, interactive, and relevant to daily life. Thus, e-modules are recommended as an innovative and effective alternative learning media to support the temperature and heat learning of junior high school students, while enriching digital learning practices that are adaptive to student needs.

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e-ISSN: 2774-1966
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