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Development of Multiple Representation Based Physics Module to Improve Students' Conceptual Understanding and Scientific Attitude

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A B S T R A C T

The module facilitates students' comprehension of physics lessons. Previous research indicates that multiple representation based physics module can improve conceptual understanding and scientific attitudes. This study aims to develop and evaluate a physics module based on multiple representation on the topic temperature and heat using the ADDIE model. The module was validated by three experts based on specific indicators and assessed for practicality by three teachers and 20 students. This study employs a quasi-experimental design with a nonequivalent control group design. Eleventh grade students were divided into an experimental class, which utilized the module, and a control class, which used conventional textbooks. Validation results indicate scores of 3.80 for content, 3.67 for pedagogy, and 3.67 for media aspects. The module's practicality was also rated highly by teachers and students, with scores of 3.76 and 3.70, respectively. The use of this module significantly improved students' conceptual understanding and scientific attitudes (Sig. < 0.05), demonstrating that the developed module is valid, practical, and effective for physics learning.

1. Introduction

Physics is a challenging subject for students due to the complexity of its concepts and the intensive use of mathematics (Dewi & Yusro, 2016). Understanding abstract concepts such as force, energy, and motion is often difficult to achieve solely through textbooks. This challenge becomes even greater when students are required to apply these concepts to real-life situations. Although physics provides extensive insights into the universe, its formal approach often makes it feel disconnected from everyday experiences. The limited instructional time in schools further also contributes to students' low comprehension of physics (Samudra et al., 2014).

The Merdeka Curriculum in Indonesia is designed to enhance the quality of education by providing schools with the autonomy to implement the curriculum according to their specific needs. (Khoirurrijal et al., 2022; Nafi'ah et al., 2023). This curriculum adopts a constructivist approach, emphasizing that students develop their understanding through interactions with their environment. One of the constructivist-based learning models is the multiple representation model, which enables students to comprehend concepts through active and experience-based learning (Dağli & Satici, 2023).

The multiple representation learning model integrates various methods of presenting information, including visual, verbal, mathematical, and graphical representations, thereby enhancing students' conceptual understanding and scientific attitudes (Sunyono, 2015). Students can examine the same concept from different perspectives by utilizing multiple representations, helping them connect theoretical knowledge with real-world applications. This model also fosters scientific attitudes such as curiosity, perseverance, and openness to diverse ways of thinking (Khairunisa & Sukardiyono, 2018).

The use of multiple representations can also reduce students' difficulties in understanding abstract concepts. By integrating various methods of information delivery, students can select the learning approach that best aligns with their individual learning styles, thereby strengthening their comprehension of physics. A strong understanding of physics concepts is essential, as it serves as the foundation for numerous natural phenomena and supports the development of students' logical, analytical, and critical thinking skills (Widyasari & Ismawati, 2020).

Scientific attitudes in physics learning are crucial for fostering the appropriate mindset in approaching scientific problems. These attitudes include curiosity, openness to evidence, precision, and perseverance in seeking solutions. Developing scientific attitudes enables students not only to memorize facts but also to understand the scientific process and how theories evolve based on empirical evidence. Unfortunately, the learning process in schools is often suboptimal, as students tend to remain passive in receiving material. Conventional teaching methods that focus solely on teacher-centered instruction without active student engagement may hinder the development of their scientific attitudes (Astika et al., 2013).

Effective physics learning not only focuses on teaching theoretical concepts but also emphasizes the development of scientific attitudes through active learning methods, such as experiments, research projects, and group discussions. One learning model that can enhance student engagement is the multiple representation model. This model enables students to gain a deeper understanding of concepts through various forms of information presentation, including visual, verbal, mathematical, and graphical representations. However, the primary challenge in its implementation is the limited availability of learning resources and laboratory facilities, particularly in pesantren environments (Hutapea et al., 2023).

Physics learning in pesantren faces significant challenges, one of which is the prohibition of mobile phone use among students. This policy is implemented to maintain discipline, reduce dependence on technology, and prevent access to inappropriate content. However, it also restricts students' access to the internet as an additional learning resource. Furthermore, pesantren located in remote areas often encounter technological infrastructure limitations, further narrowing students' opportunities to access physics materials in a more interactive manner (Suryanto, 2023).

One of the most challenging physics topics for eleventh-grade students in the Merdeka Curriculum is temperature and heat. Research indicates that students' understanding of this concept remains relatively low compared to other topics. Many students struggle to comprehend the relationship between temperature, heat, and changes in an object's length. This difficulty is also reflected in the academic performance of students at Pesantren Gunung Raya, where their daily test scores remain below the minimum competency criteria with an average ranging from 60 to 65.

An analysis of student needs in the eleventh-grade class at MAS Pesantren Gunung Raya revealed that most students are unable to learn independently without teacher guidance or adequate instructional materials. Additionally, the use of physics learning modules by teachers remains limited. Survey results further indicate that 60% of students rarely express physics concepts in their own words, 70% rarely or never ask questions when facing difficulties, and 66% lack awareness of the importance of discipline in learning. This study aims to develop a multiple representation based physics module to improve students' conceptual understanding and scientific attitudes.

2. Methodology

This study combines development research and experimental research. The development process follows the ADDIE instructional design model, which consists of five stages: Analyze, Design, Development, Implementation, and Evaluation. The experimental research employs a quasi-experimental design. The research consists of two phases. The first phase includes all stages involved in developing a multiple representation based physics module using the ADDIE instructional design model. The second phase comprises all experimental stages aimed at examining the effects on the research variables, namely students' conceptual understanding and scientific attitudes. The research procedure is illustrated in the following figure:

The first stage is the analysis phase, where researchers examine the need for developing a multiple representation based physics module and assess the feasibility of the development process. This stage consists of needs analysis and curriculum analysis.

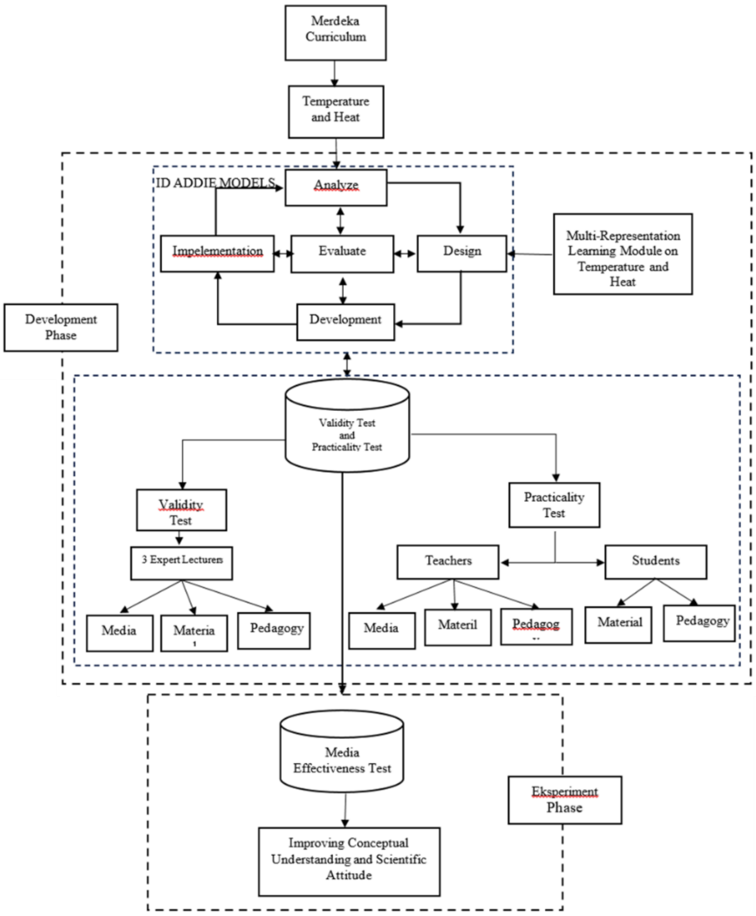


Figure 1. Research Procedure

The procedure for developing the multiple representation based physics module on the topic of temperature and heat using the ADDIE instructional design model is illustrated in the following figure:

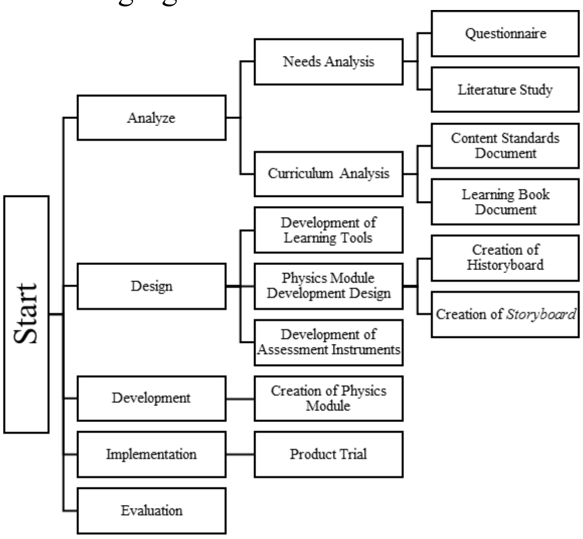


Figure 2. Physics Module Development Procedure

The needs analysis identifies the necessity of developing a contextually based learning module, aiming to identify gaps in the learning process experienced by students. The curriculum analysis examines the current curriculum used in schools to determine its characteristics. The study focuses on the Merdeka Curriculum, analyzing its learning outcomes (CP) to establish learning indicators and objectives.

The second stage is the design phase, which involves developing learning materials, designing the multiple representation based physics module, and preparing assessment instruments based on historyboards and storyboards. The third stage is the development phase, where researchers implement the plans formulated in the design phase. The fourth stage, implementation, involves product testing conducted independently by the researchers. The fifth and final stage is the evaluation phase, which involves identifying and addressing any shortcomings in the developed multiple representation based physics module to ensure it meets the intended learning objectives.

The module trial procedure consists of field testing, where the developed multiple representation based physics module on temperature and heat is implemented in classroom learning. The experiment aims to assess the module's effectiveness in enhancing students' conceptual understanding and scientific attitudes. A quasi-experimental method is employed using a posttest-only control group design, where research subjects are divided into two groups: an experimental class that uses the developed module and a control class that follows conventional instruction. The research design for this field trial is presented in the following table.

Table 1. Experimental Research Design

Class	Treatment	Post Test
Experiment	X	O_1
Control	-	O_2

Source: Sugiyono (2015a)

O_1: Post-test in the class using multiple representation based module
O_2: Post-test in the class without module
X : Learning using the multiple representation based module

The research data consists of primary and secondary data. Primary data includes needs analysis results, validity scores, practicality scores, concept comprehension test results, and scientific attitude questionnaire results. Secondary data comprises literature review findings. The research population consists of all 11th-grade students at MAS Gunung Raya, totaling three classes. The research sample includes two classes selected through random sampling. Data collection techniques include validity data, practicality data, concept comprehension test results, and scientific attitude questionnaire results, which are validated through validity and practicality tests of the module, as well as an effectiveness test.

The data analysis technique involves several stages: expert validation, practicality testing, and effectiveness testing of the learning process. Expert validation is conducted by academic experts, consisting of three pedagogical experts, three subject matter experts, and three media experts. The validation instrument framework for the module is presented in the following table:

Table 2 Module Validation Instrument Framework

Aspect	Assessment Indicators	Number of Assessment Items
Pedagogy	Language	2
	Multiple Representation Model	4
	Concept Understanding	3
Material	Content Relevance	4
	Content Accuracy	4
	Usefulness	2
Media	Format	2
	Organization	5
	Attractiveness	2
	Typography	3
	Consistency	2

Source: Adaptation from Kolin et.al, (2018), Syahroni et.al, (2020) and Hamdani et.al, (2019)

The following are the Likert scale assessment categories with scores ranging from 1 to 4, as evaluated by the validators, as shown in the table below:

Table 3. Likert Scale Assessment Categories

Score	Description
1	Strongly Disagree
2	Disagree
3	Agree
4	Strongly Agree

Source: (Sugiyono, 2010)

An assessment item is considered valid if all experts provide a minimum score of 3. Furthermore, the draft module is deemed valid as a whole if all its items are declared valid by all experts or if each item has a score of ≥3.00. The validity criteria of the draft module can be determined based on the overall average score of all items. The validity criteria for the draft module are presented in the following table:

Table 4. Module Validity Categories

Score	Criteria
≥3,00	Valid
<3,00	Invalid

Source: (Sugiyono, 2015b)

The practicality test was conducted by three physics teachers and twenty students. The students were asked to complete a questionnaire and provide feedback and suggestions regarding the tested module. The type of scale used in this questionnaire assessment is a Likert scale with a score range of 1 to 4. The instrument framework for the practicality test conducted by teachers is presented in the following table.

Table 5. Teacher Response Questionnaire Instrument

Assessment Aspects	Number of Assessment Items
Ease of Use	6
Time Efficiency	4
Benefit	5

Source: Adaptation from Friantini et al., (2020) dan Revita (2019)

The instrument framework for the practicality test conducted by students is presented in the following table.

Table 6. Students Response Questionnaire Instrument

Assessment Aspects	Number of Assessment Items
Ease of Use	5
Benefit	6
Attractiveness	4

Source: Adaptation from Revita (2019)

The percentage results of the teacher and student response questionnaire assessments are converted into quantitative values, as presented in the following table:

Table 7. Teacher and Student Response Questionnaire Criteria

Average Response Score	Criteria
$3,25 > P \leq 4$	Very Practical
$2,5 > P \leq 3,25$	Practical
$1,75 > P \leq 2,5$	Less Practical
$1 > P \leq 1,75$	Not Practical

Source: Adaptation (Dewi & Anggaryani, 2020)

The table above can be used to analyze the practicality of the product, where the developed product is considered practical for teachers if it meets at least the practical criteria. The effectiveness test of the learning process consists of two stages: descriptive analysis and inferential analysis. Descriptive analysis aims to determine the differences in conceptual understanding and scientific attitudes between the experimental class, which utilizes physics learning with a multiple representation based module, and the control class, which follows a conventional learning model. The criteria for students' conceptual understanding abilities are presented in the following table:

Table 8. Classification of Conceptual Understanding Assessment Categories

Average Score	Criteria
$81 < S \leq 100$	Very High
$61 < S \leq 80$	High
$41 < S \leq 60$	Moderate
$21 < S \leq 40$	Low
$0 < S \leq 20$	Very Low

Source: Arikunto (2013)

The test framework for conceptual understanding in this study can be seen in the table below:

Table 9. Test Blueprint for Conceptual Understanding

Indicator	Number of Questions
Translation	3
Interpretation	3
Exstrapolation	3
Total	9

Source: Adaptation from Varela et al. (2019)

Students' scientific attitudes were measured using a scientific attitude questionnaire instrument (Sunariyati et al., 2014; Wahyudi & Lestari, 2019). This scientific attitude questionnaire was given to students to assess the improvement in their scientific attitudes after using the multiple representation based physics module. The scientific attitude questionnaire instrument is presented in the following table:

Table 10. Student Scientific Attitude Questionnaire Instrument

Scientific Attitude Aspects	Number of Items
Curiosity	3
Objectivity	3
Open-mindedness	3
Critical Thinking	3
Environmental Awareness	3

Source: Anwar (2009)

The obtained assessment will be presented for each evaluation aspect and then averaged, which will subsequently be interpreted descriptively based on the following table:

Table 11. Criteria of Scientific Attitude Assessment

Percentage Obtained (%)	Interpretation
80 - 100	Very High
70 - 79	High
50 - 69	Low
25 – 49	Very Low

Source: Adaptation (Kotimah et al., 2015)

Inferential analysis is used to make various inferences from a set of data obtained from a sample. The inference actions performed include estimation, forecasting, and decision-making involving two or more variables (Rahmat et al., 2016). Inferential analysis is conducted to examine differences in conceptual understanding and scientific attitudes through the implementation of the multiple representation based physics module on the topic of temperature and heat. Before hypothesis testing, prerequisite tests are conducted, namely normality and homogeneity tests. This inferential statistical analysis involves drawing conclusions and making decisions based on the conducted analysis.

3. Result and Discussion

Results of Physics Module Development

The development of the the multiple representation based physics module on temperature and heat was carried out using the ADDIE-type instructional design model.

a. Analysis Stage

The needs analysis stage, a survey or preliminary study was conducted to determine which teaching materials were truly needed by students to overcome learning difficulties. The results of this analysis serve as one of the main references in planning the module development. Therefore, the developed module must meet the previously unmet requirements. The subjects of this study were students of Class XI Science at MAS Islamiyah Gunung Raya. The students were given a questionnaire to assess their need for a physics module as a learning medium. The questionnaire contained questions referring to the current state of physics learning activities.

b. Design Stage

Based on the analysis results, it was found that the development of the physics module serves as an alternative teaching material to enhance students' conceptual understanding and scientific attitudes. This stage consists of three steps: designing learning materials, creating the module design, and developing assessment instruments. The steps in module design can be seen in the following historyboard illustration:

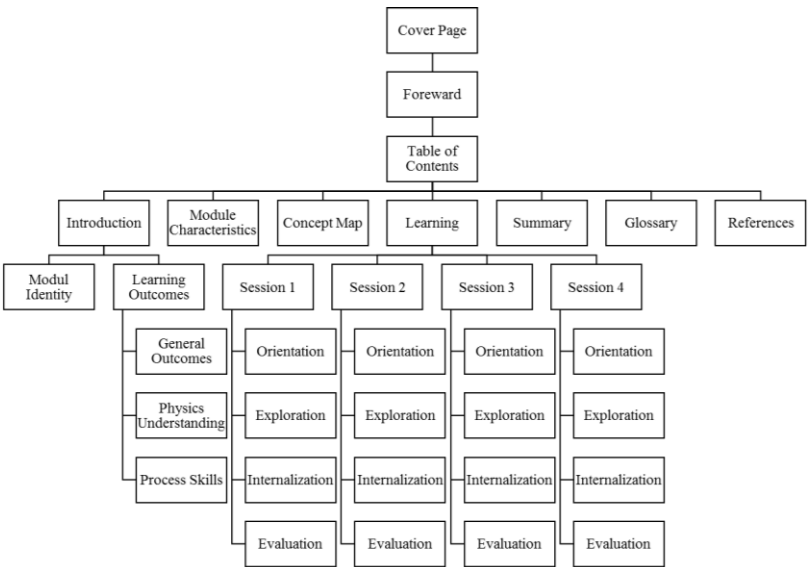
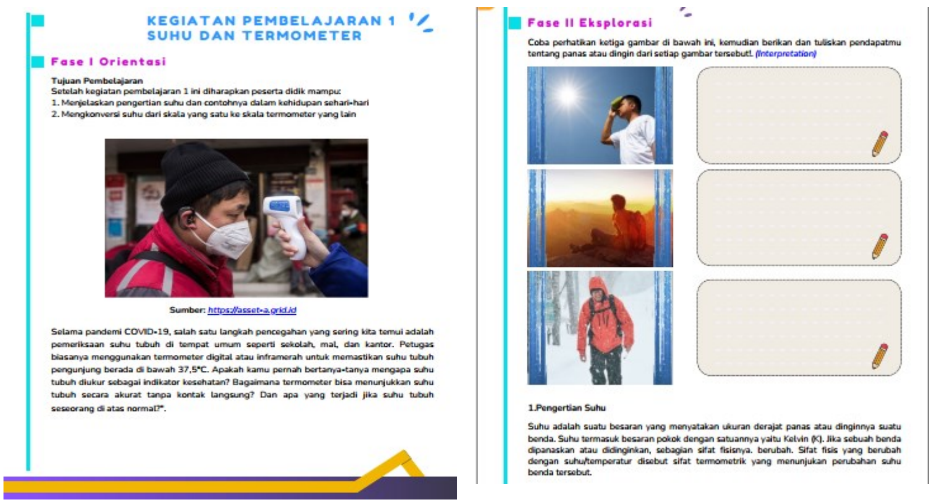


Figure 3. Historyboard of Modul

The module framework consists of a cover, preface, table of contents, module identity, learning outcomes, module characteristics, concept map, four learning sessions following the multiple representation based learning model, evaluation, summary, glossary, and bibliography. After the initial design, the theme, layout, and background of the learning module were selected accordingly. Following the module framework design, the researcher developed an assessment instrument for product evaluation by experts in several aspects. In this research and development, the researcher outlines several aspects, including material aspects, pedagogical aspects, and media aspects. These three aspects were further developed into several evaluation criteria, referring to the validity assessment of the product.

c. Development Stage

This development stage, the module was created according to the design planned in the previous stage. The result of the development is a the multiple representation based physics module on the topic of temperature and heat for Grade XI SMA/MA students, consisting of four learning activities. The module is structured following the phases of the multiple representation learning model, which include phase 1 is Orientation. Presenting learning objectives, providing motivation, and posing questions that stimulate students' curiosity about the learning material. This phase includes illustrative examples, such as in Learning Activity 1 on temperature and thermometers. Phase 2 is Exploration. The initial core phase where students explore various phenomena through images related to the studied material, accompanied by explanatory content. For example, in Learning Activity 1, three images are provided, and students are asked to express their thoughts on whether each image represents a hot or cold condition as shown in the figure below.


KEGIATAN PEMBELAJARAN 1
SUHU DAN TERMOMETER

Fase I Orientasi

Tujuan Pembelajaran
Setelah kegiatan pembelajaran 1 ini diharapkan peserta didik mampu:
1. Menjelaskan pengertian suhu dan contohnya dalam kehidupan sehari-hari
2. Mengkonversi suhu dari skala yang satu ke skala termometer yang lain

Sumber: https://asset-a.grid.id

Selama pandemi COVID-19, salah satu langkah pencegahan yang sering kita temui adalah pemeriksaan suhu tubuh di tempat umum seperti sekolah, mal, dan kantor. Petugas biasanya menggunakan termometer digital atau inframerah untuk memastikan suhu tubuh pengunjung berada di bawah 37,5°C. Apakah kamu pernah bertanya-tanya mengapa suhu tubuh diukur sebagai indikator kesehatan? Bagaimana termometer bisa menunjukkan suhu tubuh secara akurat tanpa kontak langsung? Dan apa yang terjadi jika suhu tubuh seseorang di atas normal?".

Fase II Eksplorasi

Coba perhatikan ketiga gambar di bawah ini, kemudian berikan dan tuliskan pendapatmu tentang panas atau dingin dari setiap gambar tersebut! (Interpretation)

1.Pengertian Suhu

Suhu adalah suatu besaran yang menyatakan ukuran derajat panas atau dinginnya suatu benda. Suhu termasuk besaran pokok dengan satuannya yaitu Kelvin (K). Jika sebuah benda dipanaskan atau didinginkan, sebagian sifat fisisnya. berubah. Sifat fisis yang berubah dengan suhu/temperatur disebut sifat termometrik yang menunjukan perubahan suhu benda tersebut.

Figure 4. Phase 1 (Orientation) dan Phase 2 (Exsploration)

Phase 3 is internalization, this phase students observe phenomena and record their findings in a student worksheet. The goal is to assess their understanding of concepts and their ability to apply them in obtaining results. For example, in Phase 3 of Learning Activity 1, students perform a temperature measurement activity. Phase 4 is evaluation, in this phase students present their work and deepen their understanding of the learning concept. They are given two questions related to the studied material. For example, in Learning Activity 1, students present their temperature measurement results and answer two questions related to temperature and thermometers. The structure of Learning Activities 2, 3, and 4 follows the same multiple representation model as learning activity 1, incorporating the four phases: Phase 1: Orientation, Phase 2: Exploration, Phase 3: Internalization, and Phase 4: Evaluation.

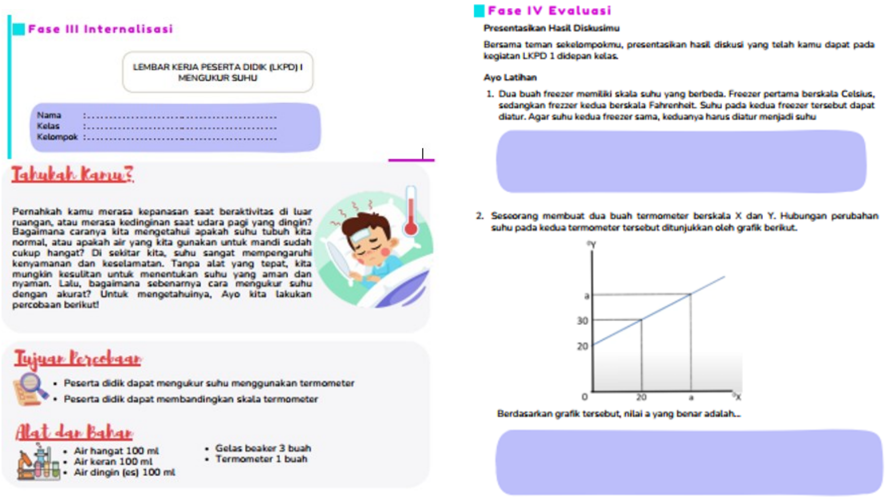


Figure 5. Phase 3 (Internalization) dan Fase 4 (Evaluaion)

d. Implementation Stage

This stage, the the multiple representation based physics module on temperature and heat was tested after undergoing a systematic development process. The trial was conducted independently by the researcher to ensure that the module met quality standards in terms of appearance, readability, and alignment with multiple representation principles. Additionally, the researcher evaluated each learning step in the module to confirm that the material presentation systematically followed the multiple representation stages, including image representation, mathematical representation, graphical representation, and experimentation. This aligns with research by Nasir & Fakhruddin (2023), which explains that during the implementation stage, product testing is conducted to ensure consistency with the initial plan.

e. Evaluation Stage

The evaluation stage was carried out to determine whether the developed learning module was successful and met expectations. In this study, evaluations were conducted at the analyze, design, development, and implementation stages. The evaluation at each of these four stages is known as formative evaluation, which aims to identify the necessary revisions for module development. This stage involves an overall assessment of the development of the physics module based on multiple representation.

Results of Validation

The physics module based on multiple representation on temperature and heat was revised and assessed by experts in content, pedagogy, and media. The validation results for the material aspect from three validators can be seen in the table below.

Table 12. Validation Results of the Material Aspect

Assessment Indicators	Average Score	Category
Material Relevance	3,93	Valid
Material Accuracy	3,75	Valid
Usefulness	3,67	Valid
Overall Average	**3,80**	**Valid**

Based on the table above, the average score for the material aspect of the module is 3.80, categorized as valid. This indicates that the the multiple representation based physics module on temperature and heat for grade XI SMA/MA students is considered valid in terms of material assessment. The content presented in a module will be easier for students to understand if it is relevant to real-life phenomena. (Sukartika et al., 2022). The second validation concerns the pedagogical aspect. The validation results for the pedagogical aspect are presented in the table below:

Table 13. Validation Results of the Pedagogical Aspect

Assessment Indicators	Average Score	Category
Language	3,67	Valid
Multiple Representation Model	3,92	Valid
Concept Understanding	3,33	Valid
Overall Average	**3,67**	**Valid**

Based on the table above, the average score for the pedagogical aspect is 3.67, categorized as valid. This indicates that the physics module is considered valid in terms of pedagogical assessment. This finding aligns with research Supeno et al. (2021) that before conducting lessons, teachers must design lesson plans, which include preparing learning media and resources, assessment tools, and lesson scenarios. One of the learning supports that teachers can design is teaching materials in the form of modules. Learning modules can be designed by integrating various learning activities and assessment tools oriented toward minimum competency assessment. The media aspect assessment results are presented in the following table:

Table 14. Validation Results of the Media Aspect

Assessment Indicators	Average Score	Category
Format	3,67	Valid
Organization	3,87	Valid
Attractiveness	3,33	Valid
Typography	3,78	Valid
Consistency	3,33	Valid
Overall Average	**3,67**	**Valid**

Based on the table above, the average score for the media aspect is 3.67, categorized as valid. This means that the the multiple representation based physics module on temperature and heat for grade XI SMA/MA students is considered valid in terms of media aspects. The advantage of teaching materials in the form of modules is that they allow students to learn independently, as teacher explanations alone may not always be sufficient for students to fully grasp the material during class. Moreover, modules can enhance students' motivation to learn because they include engaging images and animations. A varied and innovative learning resource makes learning more meaningful (Anas & Syafitri, 2019).

Practicality Results

The practicality phase was conducted after the module was validated by the experts. The practicality test was carried out by three teachers and 20 students. The results of the teacher response questionnaire are presented in the following table:

Table 15. Results of Teacher Practicality

Assessment Indicator	Average Score	Category
Ease of Use	3,78	Very Practical
Efficiency	3,83	Very Practical
Usefulness	3,67	Very Practical
Overall Average	**3,76**	**Very Practical**

Based on the table above, the practicality assessment from teachers obtained an average score of 3.76, categorized as very practical. This indicates that the the multiple representation based physics module for temperature and heat material for SMA/MA grade XI received highly satisfactory responses from practitioners. This is in line with the research conducted by Shaliha et al.(2025) that the developed physics module is considered feasible as a physics learning medium if it receives positive responses from both the validation sheet and the response questionnaire in a limited trial. The results of student practicality assessments are presented in the following table:

Table 16. Results of Student Practicality

Assessment Indicators	Average Score	Category
Ease of Use	3,75	Very Practical
Efficiency	3,66	Very Practical
Usefulness	3,70	Very Practical
Overall Average	**3,70**	**Very Practical**

Based on the table above, the practicality results for students show an average score of 3.70, categorized as very practical. A similar study conducted by Mubarok et al. (2022) during the student trial phase involved students reading, analyzing, and discussing the developed module. The results indicated a high level of student interest in the module during observations and questionnaire distribution. This is evidenced by the questionnaire responses, which also fell into the very practical category.

Results of Physics Module Experiment

The module that has been validated and deemed practical, proceeded to the experimental stage. The post-test results for conceptual understanding are presented in the table below:

Table 17. Description of Conceptual Understanding Ability Results

Class	Average Post-test Score	Interpretation
Exsperiment	71,85	High
Control	60,37	Moderate

The table above shows that the average post-test score for the experimental class is 71.85, while the control class has an average score of 60.37. These results indicate that the experimental class achieved a higher average score in conceptual understanding compared to the control class. The conceptual understanding results for each indicator can be seen in the following figure:

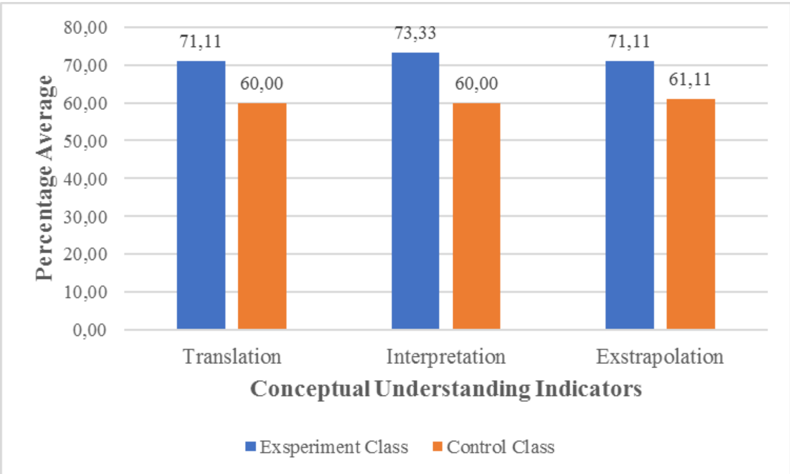


Figure 6. Average Conceptual Understanding for Each Indicator

The figure above shows that the post-test conceptual understanding of students in the experimental class has a higher average percentage for each indicator compared to the control class. Previous studies also support this finding, stating that learning using modules can enhance students' conceptual understanding (Sukartika et al., 2022) Additionally, the use of a multiple representation learning model during the learning process has been shown to improve students' conceptual understanding (Finnajah et al., 2016). The description of the student scientific attitude questionnaire results is presented in the table below:

Table 18. Description of Scientific Attitude Results

Class	Average	Interpretation
Exsperiment	78,83	High
Control	68,44	Low

The table above shows that the average score of the scientific attitude questionnaire for the experimental class is 78.83, while for the control class, it is 68.44. These results indicate that the experimental class has a higher average score in scientific attitude compared to the control class. The results of the scientific attitude questionnaire for each indicator can be seen in the following figure:

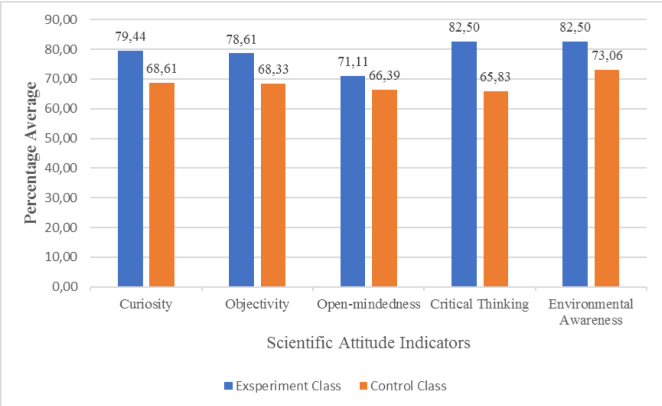


Figure 7 Average of Scientific Attitude for Each Indicator

The figure above shows that the scientific attitude of students in each indicator in the experimental class has a higher average percentage than the control class. Previous studies have also stated that the multiple representation learning model can enhance students' scientific attitudes (Rahmawati et al., 2023).

The results of the normality and homogeneity tests using the Kolmogorov-Smirnov test with SPSS show that the significance values for the concept understanding test and the scientific attitude questionnaire in both classes are ≥ 0.05. This indicates that the data are normally distributed and homogeneous, allowing the hypothesis test to proceed. The hypothesis test was conducted using an independent sample t-test with SPSS. The significance value (sig) was 0.012 < 0.05 for Concept Understanding and 0.000 < 0.05 for Scientific Attitude, meaning there is a significant difference between students' concept understanding and scientific attitude in the experimental and control classes. Thus, it can be concluded that the implementation of the multiple representation based physics module can improve students' concept understanding and scientific attitude.

4. Conclusion

This study developed a physics module based on multiple representation on the topic temperature and heat using the ADDIE development model, which includes the stages of analyze, design, development, implementation, and evaluation. The validation results indicate that the module is valid, practical, and suitable for use in physics learning. The study also found that the use of this module significantly improves students' conceptual understanding compared to traditional textbooks. Additionally, the module contributes to enhancing students' scientific attitudes in the experimental class compared to the control class. Thus, this module is effective in improving the quality of physics learning in schools.

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