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Character-based physics learning module through generative learning model: Student conceptual understanding

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Abstract: One of the causes of students' low conceptual understanding is the lack of instructional materials with a composition that aids students in understanding concepts independently or during classroom learning. The aim of this research is to produce a character-based learning module, particularly emphasizing the virtues of honesty, valuing others' opinions, and caring, through a valid, practical, and effective generative learning model to enhance students' conceptual understanding. This study follows a research and development approach. The development design employs the ADDIE model, tested with 29 eleventh-grade science students at SMAN 6 Banjarmasin. Data collection involved validation sheets for the learning module, observations of lesson plan implementation, student response questionnaires, and learning outcome tests. The data were then analyzed qualitatively and quantitatively. The results show: (1) the developed character-based learning module with an average score of 2.9 is declared valid, (2) the module, assessed through lesson plan implementation and student response questionnaires, is considered practical, and (3) the developed character-based learning module is effective in improving students' conceptual understanding, yielding an N-gain of 0.65 categorized as moderate, with a noticeable difference in students' character achievement before and after the learning process. In conclusion, this study affirms that the character-based learning module with a generative learning model is deemed suitable for enhancing students' conceptual understanding.

Keywords: character; generative model; learning module; conceptual understanding

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Introduction

Conceptual understanding in physics learning is crucial because physics education has the primary goal of applying physics principles to solve various everyday life problems (Simanjuntak, 2012). According to Kulsum & Nugroho (2014), teachers play a pivotal role as facilitators in improving students' conceptual understanding, avoiding misconceptions, using innovative teaching tools, and implementing appropriate teaching models. Improved conceptual understanding influences students' critical thinking and creativity.

In reality, up until now, there are still teaching and learning processes that require improvement. One of them, according to Trihono (2015), is the use of conventional learning models that lack variety. This results in students having a limited understanding of the concepts being taught because the learning process is solely centered on the teacher, and students are not actively engaged in the learning process. Learning references or instructional materials used are often limited to designated books,

without creating more innovative and interesting teaching materials. This has an impact on the students' enthusiasm for understanding Physics concepts.

Another reality is that the instructional materials currently used in schools, especially at SMAN 6 Banjarmasin, rely on books or Student Worksheets (Lembar Kerja Siswa) from specific publishers, which are also used in other subjects. According to a physics teacher at SMAN 6 Banjarmasin, during an interview, the teaching has been relying solely on instructional materials, namely LKS and package books. This approach influences students to face difficulties in grasping concepts. LKS only provides a broad overview of the material, and package books lack detailed learning steps that students can study independently, both in the learning process and when studying at home. The teaching model used is a direct learning model with lecture and discussion methods.

As for the understanding of concepts by eleventh-grade students at SMAN 6 Banjarmasin, it is still low. This can be seen from the daily test scores where 100% of the 29 students in class XI MIPA 2 did not pass. The students' low ability to understand concepts is one of the reasons for their lack of success in the Physics subject. Based on interviews with the Physics teacher, the lacking characteristics of students include honesty. Furthermore, direct observations at the school during teaching practices reveal additional character deficiencies in students, specifically a lack of appreciation for others' opinions and a lack of empathy.

Considering the understanding of concepts is crucial in physics learning so that students can apply these concepts to solve physics problems for success in their studies. In addition, to train students' understanding of concepts, it should be accompanied by teaching materials that are easily understood by students and by linking learning to everyday life. This way, participants can not only understand the concepts but also comprehend the relevance of the material to daily life, making learning more meaningful, in line with the main principles of the 2013 curriculum. This emphasizes the teacher's ability to implement meaningful learning processes so that the potential of students can develop as expected by the national education goals (Kurniaman & Noviana, 2017).

Efforts to address the issues in physics learning require the development of teaching materials, in this research, in the form of character-based learning modules using the generative learning model. The product of this development can be used to enhance students' conceptual understanding. Several studies show that the development of learning modules can improve students' conceptual understanding to a moderate extent, consistent with research conducted by (Brigenta, Handhika, & Sasono, 2017). Additionally, research by Setiyadi, Ismail, & Gani (2017) indicates that learning modules can also improve students' learning outcomes.

Developing character-based learning modules with the generative learning model to train students' conceptual understanding in the temperature and heat topic is one way to address these problems. Learning modules are systematically organized and attractively packaged teaching materials that facilitate independent use by students (Sirate & Ramadhana, 2017). Consistent with the research findings, the use of learning modules can enhance students' test results (Bangun, Wati, & Miriam, 2019). Character education is important as a foundation for realizing the national development vision, aiming to create a society with noble morals, culture, civilization, and ethics (Anggela, Masril, & Darvina, 2013). Character education is not about memorizing material but developing habits that cannot be formed instantly; they must be trained. Character can be defined as the way of thinking and behaving that is distinctive to each individual (Subekti, Alawiyah, & Sumarlam, 2016). Based on the above understanding, it can be concluded that character-based learning modules are systematically organized and engaging teaching materials with character content to train the expected character. From interviews and direct observations of students, the characters included in this learning module are honesty, respect for others' opinions, and care. This is consistent with research by (Hasani, Hartini, & Annur, 2019), which found that physics learning modules can improve students' science process skills and character.

One learning model that can be used to improve students' conceptual understanding and instill the characters of honesty, respect for others' opinions, and care is the generative learning model. This aligns with research by (Hendriansyah, Zainuddin, & Mastuang, 2018), where the generative learning model can improve students' learning outcomes.

The general objective of this research is to "produce a character-based learning module with the generative learning model that are suitable for improving students' conceptual understanding." Furthermore, the specific objectives of this research are as follows: (1) to describe the validity of a character-based learning module with the generative learning model based on the validity of the learning modules, (2) to describe the practicality of a character-based learning module with the generative learning model developed based on the implementation of lesson plans and student response questionnaires, and (3) to describe the effectiveness of a character-based learning module with the generative learning model developed based on students' conceptual understanding through learning outcome tests and students' character achievements.

Method

The type of research to be conducted is development research aimed at training students' conceptual understanding with a character-based approach. The developed product is a learning module designed for both students and teachers. This research focuses on developing a character-based learning module on the topic of Temperature and Heat for 11th-grade high school physics education, aiming to enhance students' conceptual understanding using the generative learning model. The ADDIE research design is employed for this development research, outlined in Table 1.

Table 1. ADDIE Research Design

Research Design Phase	Activities
Analyze	Analyzing teaching materials and student characteristics through direct teaching in schools, identifying learning objectives for the research.
Design	Designing a character-based learning module through a generative model to improve students' conceptual understanding.
Develop	Developing the character-based learning module through the generative model, making improvements to align with module characteristics, and conducting module validation.
Implement	Implementing the developed learning module in real classroom.
Evaluate	Collecting and analyzing data from the implementation stage to measure the module's effectiveness in improving conceptual understanding and character achievement. This involves self-evaluation sheets completed by students.

The subjects in this research were students of class XI MIPA 2 at SMAN 6 Banjarmasin, totaling 29 students, with 7 male students and 22 female students. After the development phase, the researchers proceeded to the validation stage of the learning module by the validators. Subsequently, the try out was conducted from November 11 to November 27, 2019, at SMA Negeri 6 Banjarmasin, located at Jalan Belitung Darat No. 130 RT. 19 RW. 02, Banjarmasin Barat Subdistrict, Banjarmasin, South Kalimantan Province.

Data collection was carried out using instruments such as the validity assessment sheet for the learning module. This sheet was used to measure the module's suitability developed in terms of format, language, content, presentation, and the module's benefits, evaluated by three validators consisting of one practitioner and two experts. After obtaining validation results with average scores for each aspect, they were adjusted according to the assessment criteria (Widoyoko, 2016). Subsequently, the reliability of the learning module was calculated, and the reliability coefficient results were adjusted to the assessment criteria (Arikunto, 2015).

Observation instruments for the practicality of the learning module were used to measure the practicality of the learning module based on observation sheets filled out by two observers regarding various aspects of the module during the teaching process. These observations were conducted by the teacher in the classroom. The scores were then calculated using the average score, and the results were interpreted within score intervals adapted from criteria adapted from (Widoyoko, 2016). Additionally, to assess the practicality of the module, student response questionnaires were used, with responses

from students providing feedback on the use of the learning module. Respondent questionnaire results were calculated using a percentage formula (Lestari, 2017).

Conceptual understanding test instruments were employed to measure the effectiveness of the learning module in improving conceptual understanding through two stages: pre-test and post-test. The results were calculated using the Normalized Gain (N-gain) to determine the effectiveness of the product according to Hake (1999) as cited in Simbolon and Tapilouw (2015). The normalized gain index was then adjusted based on the effectiveness category of the module. Furthermore, to measure the effectiveness of the learning module, self-evaluation instruments were used by students to assess their character achievements before and after the learning process. These scores were then calculated using the average score with categories in accordance with Permendikbud No. 81A of 2013, and the results were subjected to paired t-test analysis using SPSS.

Results and Discussion

The learning module was developed to fulfill the characteristics of a module, namely being self-contained, containing all necessary material, standing alone, and user-friendly. In addition to the observed characteristics of the module, the developed learning module also meets the components within the module and incorporates the characters that are intended to be trained for students during the learning process. The characters included in the learning module are honesty, respect for others' opinions, and care. The components found in the module include concept maps, table of contents, learning instructions, basic competencies, learning indicators, learning objectives, teaching materials, character corners, sample questions, learning worksheets, summaries, and exercises with answer keys and assessment criteria for each worksheet and exercise. This allows students to independently assess their understanding of the concepts based on the learning outcomes achieved. The content of the character-based learning module on temperature and heat consists of four sub-topics, namely the first sub-topic on temperature and heat, the second sub-topic on changes in the state of matter, the third sub-topic on the principles of Black, and the fourth sub-topic on heat transfer. The appearance of the module can be seen in Figure 1 and Figure 2.

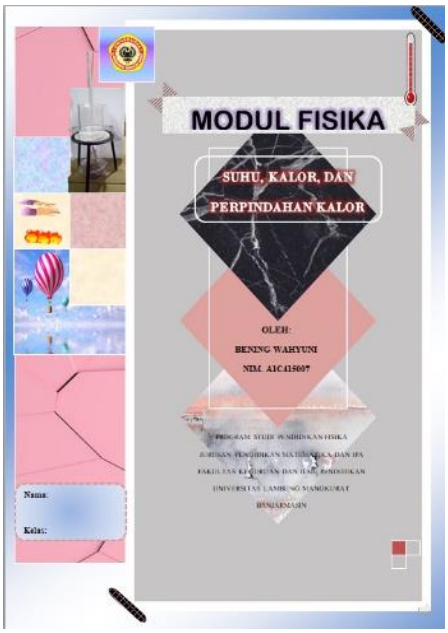

Figure 1. Cover of the character-based learning module

Figure 2. Character corner in the character-based learning module

The validity of the learning module was assessed to determine its suitability. The character-based learning module is considered suitable if it meets various aspects outlined in the validation instrument as standards for module suitability. The validation results for the character-based learning module are presented in Table 2.

Table 2. Results of validation for the character-based learning module

Aspect	Validity	
	Average Score	Information
Format of the Module	3,0	Valid
Language	3,0	Valid
Content of the Module	3,0	Valid
Presentation	2,8	Valid
Usefulness the Modul	2,5	Fairly valid
Overall Average	2,9	Valid
Reliability	0,95	Very Valid

Based on these five aspects, the average results for all aspects fall into the valid category, and the degree of reliability is categorized as very high. These results indicate that the character-based learning module developed can be considered appropriate because it has fulfilled the components of the module presented by the Ministry of National Education (Depdiknas) in 2008, as cited in (Syauqi, 2012). These components consist of three parts: the opening section, the core section, and the closing section. Additionally, the developed learning module is considered appropriate because it meets the characteristics of a module, such as being self-instructional, self-contained, standalone, and user-friendly. Therefore, the learning module can be tested to improve students' conceptual understanding. The results of the validity of this character-based learning module indicate a very high degree of reliability, making the module reliable. Based on the validation results, the character-based learning module is deemed suitable. Subsequently, to enhance students' conceptual understanding in the temperature and heat topic, the module will be pilot tested in class XI MIPA 2 at SMAN 6 Banjarmasin.

The practicality of the character-based learning module, using the generative learning model to improve students' conceptual understanding in the temperature and heat topic, can be assessed based on the implementation of lesson plans (RPP) and student response questionnaires. Throughout the

four meetings of the learning activities, two observers, fellow physics education program students, were present to evaluate the implementation of the lesson plans. Observation of the RPP implementation was conducted to measure the practicality of using the character-based learning module. The observation results regarding the implementation of RPP in each meeting can be seen in Table 3.

Table 3. Results of Lesson Plan Implementation

Learning Phase	Average Score (Category)			
	P.1	P. 2	P.3	P.4
Reviewing	3,50 (VP)	3,75 (VP)	3,42 (VP)	3,91 (VP)
Challenges and Confrontation	4,00 (VP)	3,22 (P)	3,67 (VP)	3,50 (VP)
Reorganization of Conceptual Framework	3,50 (VP)	3,50 (VP)	3,58 (VP)	3,75 (VP)
Application and Conceptual Reinforcement	3,00 (P)	3,33 (P)	3,67 (VP)	3,83 (VP)
Reflection	3,25 (P)	3,25 (P)	3,50 (VP)	3,75 (VP)
Average	3,45 (P)	3,41 (P)	3,57 (VP)	3,75 (VP)
Reliability	0,97 (VH)	0,96 (VH)	1,01 (VH)	1,00 (VH)

Information: VP = Very Practical;
P =Practical; VH = Very High

Based on the observations conducted by the two observers during the four meetings, the results indicate practicality and very high reliability. This indicates that the development of the character-based learning module using the generative learning model can be considered practical, and teachers can implement the learning process effectively and in accordance with the stages of the learning model. The practicality of the learning module is also influenced by the module itself, as it is self-instructional and can be learned independently. It has fulfilled complete components, learning objectives, and competencies, making it easier for the learning process as students have studied the module at home and review it during the school learning process. Additionally, the practicality of the learning module, as assessed from the implementation of lesson plans (RPP), is influenced by a conducive learning environment, including tools, teaching materials (module), and the learning environment (generative learning) that supports the achievement of RPP (Sapari, Jatmiko, & Hidayat, 2015). In this case, students have teaching materials in the form of a module that meets the characteristics and components of the developed module.

The practicality of the character-based learning module using the generative learning model can also be assessed based on the questionnaire responses regarding the developed learning module, with students as the respondents. The results of the student response questionnaire regarding the temperature and heat learning module can be seen in Table 4.

Table 4. Student Response Questionnaire Results

Aspect	Average of Percentage (%) (Category)
Appearance/Attractiveness of the module	71 (M)
Ease/Practicality	63 (M)
Usefulness and Uses	65 (M)
Average Percentage of All Aspects	66 (M)
Reliability	0,91 (VH)

Information: H = High; M = Medium; L = Low

Based on the results obtained for the practicality of the developed character-based learning module and the average percentage scores for all aspects falling into the agreement category, the agreement category can be interpreted as practical. Therefore, the character-based learning module on the topic of temperature and heat can be declared as a practical learning module. The factor influencing the questionnaire responses from students is the character-based learning module itself, which was developed to meet the characteristics of a learning module. It can be used independently as it has clear learning objectives and learning stages to achieve those objectives and competencies

(self-instruction). Additionally, the module possesses complete module components (self-contained), along with a character corner to instill or habituate certain characters in students. With these complete and self-learnable module components, the character-based learning module can be used without relying on other media (standalone). Furthermore, the module is designed in a practical and user-friendly manner, using easily understandable language. Student responses obtained after receiving treatment, where treatment according to Hobri (2010) used during the learning process, including instructional materials.

The effectiveness of the character-based learning module in improving conceptual understanding in the topic of temperature and heat, as developed, is assessed based on the results of the pre-test and post-test. This is in line with the notion that the effectiveness of a module is obtained from student achievement data, such as test results, according to Misbah et al. in Oktaviana, Hartini, & Misbah (2017). The results of the pre-test and post-test for students' conceptual understanding can be seen in Table 5.

Table 5. Results of Students' Conceptual Understanding

Average of *Pre-test*	Average of *Post-test*	*N-gain*	Information
13,60	70,01	0,65	Medium

Based on the N-gain results obtained, it can be stated that the character-based learning module using the generative learning model in the topic of temperature and heat is effective in improving students' conceptual understanding. The increased conceptual understanding of the students is attributed to the presence of the character-based learning module, which can be learned both during classroom learning and independently. Subsequently, a paired t-test was conducted to determine the difference in students' characters before and after Physics learning. This module has advantages, including clear learning stages and exercises that help students evaluate their conceptual understanding. It also incorporates characters trained for students, contributing to the enhancement of their conceptual understanding. Furthermore, the developed character-based learning module meets the components and characteristics of modules outlined by Syauqi (2012). These include: (1) Self-instructional: The module is designed to be used independently by students. (2) Self-contained: The module contains learning objectives, basic competencies, detailed content, clear learning instructions or stages, a character corner containing trained characters, physics information providing additional material related to the topic, example problems for student evaluation, and self-assessment tools. (3) Standalone: The module does not depend on other teaching materials or media as it fulfills complete module components. (4) User-friendly: The module is created with easily understandable material presentation, packaged practically, and with an attractive design.

The effectiveness of the character-based learning module is also assessed based on students' character achievements. The results of students' character achievements related to the characters included in the developed module and the learning process, such as honesty, respecting others' opinions, and care, can be seen in Table 6.

Table 6. Results of Students' Self-Evaluation

Character	Average Score - Before Learning (Category)	Average Score - After Learning (Category)
Honesty	2,88 (G)	3,15 (G)
Respecting others' opinions	3,81 (VG)	4,10 (VG)
Care	3,87 (VG)	4,12 (VG)
Reliability	0,67 (H)	0,75 (H)

Information: VG = Very Good; G = Good; P =Poor

The results of student character achievements were then subjected to a normality test, and the p-value for character achievement before and after learning was > 0.05. Therefore, the data on student character achievements before and after learning can be considered normally distributed. Subsequently, a paired t-test for student character achievements was conducted to determine

differences before and after the teaching and learning process. The t-test results for student character achievements can be seen in Table 7.

Table 7. Paired t-Test Results for Student Character Achievements

	t	df	Sig. (2-tailed)
Pair 1 Self-Evaluation of Students Before and After Learning	-3.109	11	.010

Based on the results outlined above, the achievement of students' characters obtained shows a difference that is not too significant before and after the learning process. However, the results after the learning process for each character have average scores that are better compared to the results before the learning process. Thus, the learning module used is capable of fostering students' characters to become even better. This aligns with the research conducted by Puspitasari (2019), where physics modules can help instill character values in students for independent learning, both inside and outside the classroom, with or without guidance. Therefore, it can be said that the character-based learning module using the generative learning model enhances students' conceptual understanding in the topic of temperature and heat and trains their characters.

The development of the character-based learning module on the topic of temperature and heat using the generative learning model aims to improve students' conceptual understanding. The advantage of the developed product, a learning module, is that it serves not only as teaching material but also as a tool to measure students' learning outcomes and conceptual understanding. This module is not limited to classroom use; it can also be used independently or outside the classroom learning process. With clear learning instructions and learning objectives in each subtopic, students can study and understand the concepts of temperature and heat independently. They can evaluate their ability to understand concepts by answering exercises and learning worksheets available in the module. Furthermore, students can assess their own understanding of the concepts or mastery of the material with answer sheets and assessment methods provided. Another advantage of the developed learning module is that it contains characters trained and habituated to students, presented in the character corner. These characters include honesty, respecting others' opinions, and caring. These characters are not only found in the learning module but are also trained during the generative learning process. The developed character-based learning module meets the characteristics of a good learning module, as per the rules of the Ministry of National Education in 2003. Therefore, this character-based learning module can enhance its effectiveness in improving students' conceptual understanding.

Conclusion

Based on the discussion, it can be concluded that the character-based learning module using the generative learning model is deemed suitable for enhancing students' conceptual understanding. The developed character-based learning module with the generative learning model is considered appropriate based on assessments by academics and practitioners, falling into the valid category. Additionally, it is deemed practical based on observations of the implementation of lesson plans and student response questionnaires, with agreement from students interpreted as practical.

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