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The Development of a Physics Module Based on the SETS Learning Model to Improve Students' Conceptual Understanding

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Received: December 20th, 2020. Revised: March 28th, 2021. Accepted: April 23rd, 2021

Keywords :

Module; SETS; Research and Development; 4-D Models; Concept Understanding; Validity; Practicality

ABSTRACT

This study aims to produce a learning device in the form of a physics module based on SETS that is valid and practical to improve students' conceptual understanding. The type used in this research is Research and Development (R&D). Subjects of this study were teacher and students of class XI MIA 1 with a total of 31 subjects. The research procedure is the 4-D model, namely define, design, develop, and disseminate. Due to time and cost limitations, this research is limited to the develop stage. The research instrument used was a validity questionnaire, practicality, and a description of the conceptual understanding. Furthermore, data obtained were analyzed to see the validity and practicality of the module as well as an assessment of students' conceptual understanding of dynamic fluid material. The level of understanding of students' concepts is seen from the aspects of interpretation, exemplifying, explaining, and comparing. The results showed that the physics module based on the SETS developed was categorized as very valid with an average of 82.16 and in the very practical category with a percentage of 84.29. Then for understanding the concept of students obtained a score of 94.67 in the interpretation aspect, 86.98 in the exemplary aspect, then 81.10 and 86.61 respectively for the aspects of explaining and comparing. Learning using a physics module based on SETS is very good to be applied in order to improve students' conceptual understanding of dynamic fluid material. This was proven by the increase in students' understanding of concepts in every physics learning meeting on dynamic fluid material.

INTRODUCTION

Today the role of education is very important as an effort to build the character of the nation and produce millennial generations who are innovative, creative and ready to face global challenges that are increasingly progressing every day. Currently, it is necessary to build a generation that is skilled

and adept at solving problems, wise in making decisions, innovative and creative, likes deliberation, and can communicate ideas effectively both individually and in groups [1]. Education that is held to optimize the abilities of the current millennial generation also continues to make reforms in its implementation process. Educational reforms are carried out in order to keep up with the increasingly rapid flow of globalization. One of renewal in education is the improvement of the educational curriculum, which is currently known as the 2013 Curriculum. The 2013 curriculum is a curriculum that prioritizes understanding, skills, and character education, students are required to understand the material, be active in discussions and presentations, and have high courtesy and discipline [2]. Physics is essentially the same as science or science, namely as a product, as an attitude, and as a process. Physics in the meaning of learning is a process of making students learn physics, while teacher act as motivators and facilitators, if successful this learning can cause students to actively learn and apply physics concepts inside and outside of the classroom [3].

Teaching materials are learning tools that contain learning activities designed by teacher to be used during learning activities and it also can be used as a companion learning resource. The minimal variety of teaching materials used makes students less optimal in channeling the level of critical thinking in problem solving and mastery of limited learning materials. Learning materials that do not provide an overview and linkage of material to the context of life phenomena that are around students can make students slow in understanding learning material. This is because students still depend on teacher 'explanations, so the learning process tends to be one way so that students' understanding of the concept of learning material is still low. One of the actions that can be taken to minimize the emergence of existing problems is by developing interesting and practical teaching materials for teacher and students. In this study, the teaching materials developed were modules. Module is a complete learning program, arranged systematically, referring to clear and measurable learning objectives. Modules contain learning objectives, materials and activities as well as evaluation of the achievement of learning objectives [4].

The module developed uses the Science, Environment, Technology, and Society learning model or commonly abbreviated as SETS. This SETS-based learning helps students to take advantage of the school environment to obtain information based on the material being studied [5]. Research-based learning with the SETS approach can help students solve problems and encourage students to improve higher-order thinking skills, one of which is critical thinking skills [6]. The existence of an increase in students 'critical thinking skills, can indirectly affect the level of students' conceptual understanding. This is seen based on the syntax or stages contained in the SETS learning model. Broadly speaking, the stages of the SETS learning model are (1) invitation / initiation, which aims to formulate problems and determine the relationship between the material to be studied and the previous material, (2) exploration, contains experiments or physical activity, makes observations using the five senses, social interaction to decision making, (3) introduction to concepts, containing discussions guided by educators by providing a problem topic so that students actively ask questions with the aim of straightening the knowledge obtained scientifically, (4) application, in the form of additional activities to apply knowledge concepts obtained into different contexts, and (5) evaluation, an assessment of the results that have been carried out during the learning process after the learning model is applied [7].

Conceptual understanding is the ability to understand a concept and interpret a material well [8]. Conceptual understanding is included in one of the aspects of measured learning outcomes, namely the aspect of understanding, so it can be concluded that understanding can affect student learning outcomes [9]. Students' conceptual understanding is assessed based on the aspect of assessment which consists of the ability of students to interpret, exemplify, explain, compare, and classify [10]. Interpretation is being able to translate information into another. Exemplifying is being able to find examples of general concepts. Explain, that is can create a cause and effect model in a system. Comparing is can determine the relationship between two or more objects, ideas, and events that are observed. Classifying, namely being able to group the characteristics according to examples and concepts [11]. In this study, the results of students' conceptual understanding were measured from the aspects of interpretation, exemplifying, explaining, and comparing.

Learning using SETS-based modules provides benefits to students in studying physics not only limited to scientific concepts, but also knowing the application of science in the fields of technology, environment, and society. The existence of a learning system like this is an innovation in education because it can realize education by learning that is not fixed on concepts only, but also every aspect of life. This allows students to take advantage of the knowledge gained from learning to find out the application of scientific concepts to developing technology and to know the benefits and impacts on the environment and society. In addition, students can also innovate by designing environmentally friendly technologies that benefit the wider community. Based on this statement, research using the SETS-based physics module is expected to help improve students' conceptual understanding of physics learning material.

METHOD

The type of this research is research and development / R&D. R&D is used to design products or procedures that have been systematically tested in the field, evaluated and developed in such a way as to meet the criteria for effectiveness, quality or similarity to a standard [12]. In this study, the research procedure used is the 4-D model which consists of the stages of define, design, develop, and disseminate. The research stages used a flow like the chart in Figure 1.

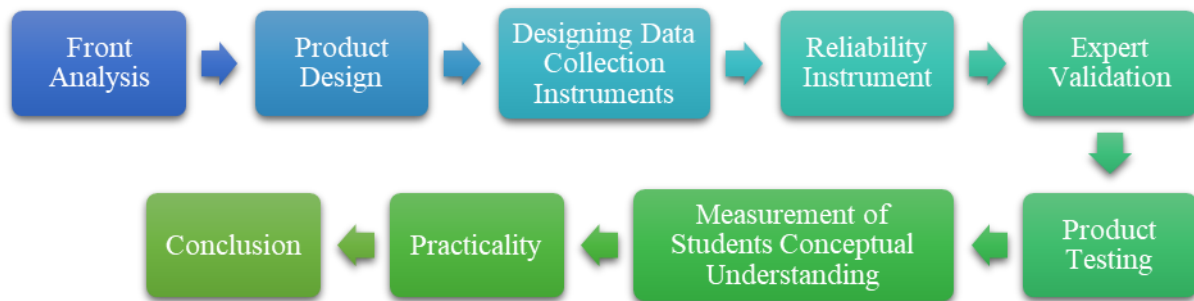


Fig1. 4-D Research Stage Chart

Subjects in this study were physics teacher and students of class XI IPA program at SMA Negeri 5 Sijunjung. The research subjects in the field trial consisted of teacher and 30 students of class XI MIA 1. The data needed in this study, namely primary data, is data obtained directly from the data source in the form of data from the validity, practicality and understanding of students' concepts. Furthermore, secondary data is data obtained from various existing sources, namely in the form of initial analysis data at the define stage [13]. The instrument in this study consisted of a validity questionnaire validated by 3 validators, a practicality questionnaire for teacher and students, and a description of the conceptual understanding for students.

Instrument Reliability

Reliability was used to test the consistency level of the questionnaire [14]. The reliability test was carried out using the modified Alpha Cronbrach formula from Fatonah [15].

$$r_{11} = \left[\frac{k}{k-1} \right] \left[1 - \frac{\sum \sigma_b^2}{\sigma_t^2} \right] \quad (1)$$

Interpretation of Data Reliability

For $n = 31$ and the real level $\alpha = 5\%$, the instrument is said to be reliable if $r_{11} > r_{table}$ [15]

Data Analysis Validity and Practicality

The data obtained from the assessment of the validity and practicalities were analyzed using the

formula by Riduwan [16] with the following steps.

- 1) Recapitulate the results of the questionnaire distribution
- 2) Calculating the value of validity and practicality

$$\text{Score} = \frac{\text{Number of scores obtained}}{\text{Maximum score}} \times 100\% \quad (2)$$

- 3) Finding the mean of all respondents

$$\bar{X}_{NA} = \frac{\sum NA_i}{n} \quad (3)$$

Interpretation of Data Validity and Practicality

The data obtained from the results of data analysis are then interpreted using the modified validity and practicality criteria by Riduwan [16] in the Table 1.

Table 1. Validity and Practicality Criteria

Interval (%)	Category
0 – 20	Very Invalid / Impractical
21 – 40	Not Valid / Practical
41 – 60	Less Valid / Practical
61 – 80	Valid / Practical
81 – 100	Very Valid / Practical

Module which have been tested and developed feasible to be used more widely if it meets the criteria of practical and very practical with the practicalities of the acquisition score is in the range of 61-100 percentage score.

Concept Understanding Analysis

The value obtained by students in dynamic fluid learning at each meeting was analyzed using a modified formula [16] in the following steps .

- 1) Assess students' answers based on assessment indicators
- 2) Recapitulate the assessment of each meeting
- 3) Finding the mean of each aspect of the assessment of conceptual understanding from each meeting using the following formula:

$$\bar{X}_{NA} = \frac{\sum NA_i}{\text{Number of students}} \quad (4)$$

Interpretation of Students' Concept Understanding

The usage criteria with the Lima scale according to Arikunto (2005) which was modified by Andriani, Samad, & Nurlina [17] which were grouped by looking at the categorization guidelines:

Table 2. Categorization of Concept Understanding Levels

Interval	Classification
80 – 100	Very High
66 – 79	High
56 – 65	Moderate
40 – 55	Low
≤ 39	Very Low

Furthermore, students' conceptual understanding is increase if there an increase in the average score of understanding the concepts of physics in dynamic fluid material from the first meeting to the next meeting.

RESULTS AND DISCUSSIONS

The research procedure on the development of a physics module based on the SETS learning model is a 4-D model which consists of 4 stages, define, design, develop, disseminate. However, in this study, this stage was carried out until the develop stage only. The following is a description of the results of the development of a valid and practical learning module referring to the 4-D model stages.

1. Define Physics Module Phase Based on the SETS Learning Model

The *define* stage is the initial stage by analyzing three components, curriculum analysis, students, and concepts. In curriculum analysis, it aims to see the suitability of the material developed with the relationship between core competencies and basic competencies and the syllabus. Curriculum analysis also aims to develop indicators and learning objectives in accordance with the established syllabus.

Then student analysis is carried out to analyze the character of students who will use the module during the learning process. Things that are considered include the individual academic abilities of students, obstacles during learning, learning motivation, and previous learning experiences. Concept analysis aims to analyze the concepts of dynamic fluid material that will be included in the module and the relationship between dynamic fluid concepts and the elements of the SETS learning model, science, environment, technology, and society.

2. The Physics Module Design Phase Based on the SETS Learning Model

At the *design* stage, a product design was carried out in the form of a physics module based on the SETS learning model. Modules are designed according to the syntax of the SETS learning model, initiation, exploration, concept introduction, application and evaluation. Each syntax presents the concept of the relationship between material and everyday life including the environment, technology, and society. Examples of the application of material of dynamic fluid which utilizes the principle of pressure in the element of technology that is like the design of a jet engine and a rocket, while in the community that daily activities like watering the plants using a hose which ends narrowed. Then in the environmental concept, design of factory chimneys in a closed space and conical upward. The module design form is presented in the Figure 2:



Fig 2. One of Learning Syntax in the Physics Module Based on the SETS Learning Model

Presentation of material linkages with the concept of life encourages students to be more active during learning activities. There are relationship between learning and life makes students more interested and creates a good impression on students and it will increasing the activeness of students [18].

3. Stage of Developing a Physics Module Based on the SETS Learning Model

The develop stage or the development stage is the stage to test the validity and practicality of the physics learning module based on the SETS being developed. Then carry out an analysis of the use of modules on the level of understanding of students' concepts of dynamic fluid material.

Instrument Reliability

Reliability is carried out to determine the extent to which the questionnaire measuring instrument that has been distributed can be trusted or relied upon [19]. The data obtained from the results of the reliability analysis using the Alpha Cronbrach formula, namely for r_{11} a score of 0.924 was obtained. The r table value for $n = 31$ and the real level $\alpha = 5\%$ is 0.355. The questionnaire is said to be reliable if $r_{11} > r$ table [15]. In addition, Kurniawan also stated that a questionnaire is said to be reliable if the Cronbrach Alpha value is more than 0.60 [14]. So from the data obtained, it can be concluded that the instrument in the form of a questionnaire is declared reliable.

Module Validity

Module validated by 3 experts. Module validation is carried out to see the feasibility of the module to be tested in the field. From the results of data analysis, it can be obtained the module validity values in general as in Table 3.

Table 3. Expert Validation Results

Assessment Aspects	Validators			Average	Validation Category
	AR	HN	RZ		
Content Feasibility Aspects	94,23	78,85	75	82,69	Very valid
Aspects of Language and Images	91,25	77,50	75	81,25	Very valid
Presentation Aspects	95,19	78,85	75	83,01	Very valid
Graphic Aspects	95	75	75	81,67	Very valid
Average				82,16	Very valid

Module is categorized as very valid with an average of 82.16. If the analysis shows valid results, then the module is suitable for use [20]. This shows that the physics module based on the SETS learning model developed is declared feasible to be tested in classroom learning activities. From the data obtained on the feasibility aspect of the content is very valid, this indicates that the indicators, learning objectives, and material descriptions in the module are in accordance with the demands of core competencies and basic competencies, then the material description is presented systematically according to the syntax of the SETS learning model. The aspects of the language and images used in the module are also categorized as very valid, which means that the language of the module presentation is communicative and easily understood by students, as well as pictures and writing of terms and symbols that are clear and have complete information. Then in the presentation aspect it is also categorized as very valid, in this aspect the module has been arranged systematically and applies pedagogical principles, a system of presenting concepts from general to specific and from easy to difficult. In the graphic aspect, the module is categorized as very valid, which shows that the design in the form of colors and images is in accordance with the learning material and the level of development of students.

Module validation aims to determine whether or not the quality of the module being developed is good. In choosing good and quality media, it must be validated media by several experts who have been tested, where the media created is able to convey the concepts taught [21]. In this study, the media was in the form of a physics learning module based on the SETS learning model. The higher the validity value of an instrument, the more accurate the data obtained from a study. If the instrument validity value is high, then the instrument can be trusted and valid [22]. This means that based on the validity score obtained, the developed physics module is valid and its validity can be trusted.

Practicality Module

Apart from validity, the feasibility of a product is also determined by the practicality of the product. Practicality testing in research aims to determine the feasibility of a product so that it can be used by students and educators through its ease of use [23]. The practical value of the module can be known based on the practicality instruments filled by teacher and students. The practical results obtained are generally presented in Table 4.

Table 4. General Practical Results

Assessment Aspects	Practitioner		Average	Validation Category
	Teacher	Students		
Ease of use	86,67%	78,96%	82,81	Very practical
Time required	93,33%	69,11%	81,22	Very practical
Easy to interpret	86,67%	78,22%	82,44	Very practical
Has the same equivalent	100%	81,33%	90,67	Very practical
Average	91,67%	76,91%	84,29	Very practical
Practicality Category	Very Practical	Practical		

The results of the practicality questionnaire generally showed that the module was categorized as very practical with a percentage of 84.29%. Based on this, the module is stated to be practical in terms of ease of use, easy to interpret or easy to understand and learn by teacher and students, the time it takes, and has the same equivalence or has equality and uniformity of material with other learning resources that discuss dynamic fluid material. The high practicality value of a product indicates that products can be developed to be used in a wider scope. The higher the practical value of a product, the more feasible the product is to be used in the learning process [24]. This means that the overall module can be said to be practical and suitable for use during the learning process.

Students' Concept Understanding

Students' conceptual understanding is seen from the aspects of interpretation, exemplifying, explaining, and comparing. From the research results, the acquisition level of students' conceptual understanding is presented in Figure 3.

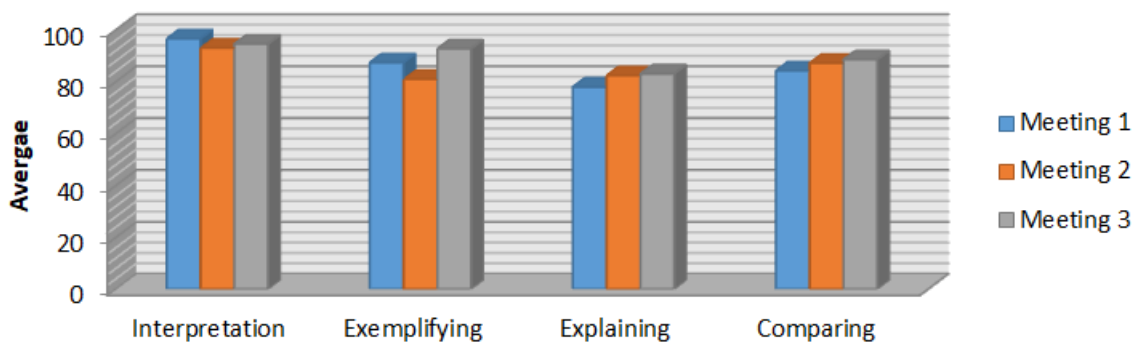


Fig 3. Level of Students' Concept Understanding of the Dynamic Fluid Material

Based on the assessment aspects used in the study, the results of students' conceptual understanding on the interpreting aspect were categorized as very high with an average assessment of each meeting that was 94.67. In the exemplary aspect, it is categorized as very high with a mean of 86.98. Then in the aspect of explaining and comparing, the students' understanding of the concept was also in a very high category with an average rating of 81.10 and 86.61. The level of understanding of the concepts of students from each meeting was categorized as very high with 87.34 when viewed from all aspects of the assessment of three learning activities.

Using modules during learning can improve students' understanding of concepts. Class that used module better with classes that do not use the module in terms of understanding the concept [25]. This opinion supports the results of the research obtained, where research conducted using a physics module based on the SETS learning model improves students' understanding of the concept of dynamic fluid material. The essence of the SETS approach is communication between students to share knowledge. Students are given the freedom to be creative in producing products, identify them together, then present them in front of the class. With the design of these learning activities, learning activities using the SETS learning model can improve students' conceptual understanding [26]. This is supported by the existence of empirical data from the research conducted. Where the field test results show that there is an increase in understanding the concept of physics material for students in each learning activity.

CONCLUSION AND SUGGESTION

Based on the results of research and discussion, it can be concluded that the development Physics Learning Module based SETS-learning model for class XI MIA students developed is categorized as very valid with a score of 82,16. The validity of the module is illustrated by the results of validation by experts on aspects of module assessment which include aspects of the feasibility of content, language and images, presentation, and module graphics. This module can be applied during the physics learning process with the subject of dynamic fluid material by teacher and students. For the instrument in the form of a questionnaire, it was declared reliable with a score of 0.924. This shows that the instrument can be used and can be trusted. The physics module based on SETS was categorized as very practical with a percentage of 84,29 %. The practicality of the module can be seen from the ease with which teacher and students use the module during learning. This is illustrated through an assessment of the four practical aspects of the module summarized in the practicality instrument, aspects of ease of use, time required, easy to interpret, and have the same equivalence. Furthermore, the level of understanding of the concept of students has increased in every aspect of the assessment. Assessment of conceptual understanding is seen from the aspects of interpretation, exemplifying, explaining, and comparing. Students' understanding of the concepts was categorized as very high with an average aspect of assessment in each learning activity with score 87.4. Based on the data obtained after using the module, it can be concluded that learning using physics module based SETS-based is very good to be applied in the learning process to improve students' conceptual understanding of dynamic fluid material. The physics module based SETS-learning model can improve students' conceptual understanding, especially in the aspects of interpreting and exemplifying because it has the highest average of other aspects in every meeting.

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