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Analysis of Completeness and Accuracy of PBL-Based Physics Module Materials in Simple Harmonic Motion

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ABSTRACT

The development of a teaching module is carried out as a learning support medium, but in developing a teaching module it is necessary to analyze its completeness and accuracy. This study aimed to determine the validity of the PBL-based physics module on simple harmonic motion material that has been prepared. This type of research in this research was qualitative research. The data analysis method used in this research was descriptive analysis method. The data that had been obtained from the validation test in the form of a completeness and accuracy test of the material will be analyzed and described. In the PBL-based Physics module on simple harmonic motion material, a test was carried out with the validation of material experts obtained from the percentage value of the completeness aspect of the material by 87.5% and the accuracy of the material by 87.5%. These results were obtained using qualitative research methods that tend to use descriptive analysis. So that this module can be declared valid or can be used without revision.

INTRODUCTION

The Independent Curriculum is an educational approach that aims to give more freedom to students in choosing and managing their own learning. This approach aims to develop students' independence, creativity, initiative, and critical thinking skills. The Merdeka curriculum emphasizes giving autonomy to students to manage their own learning process. Students are given the freedom to choose topics of interest, determine the most effective learning methods for them, and plan and evaluate their own progress. This allowed students to take responsibility for their learning and provides space for creativity and self-exploration. In the Merdeka Curriculum, learning is not only limited to the classroom environment, but also involves interactions with society and the real world. Students are invited to be involved in projects that are relevant to everyday life and have a real impact in their communities. It helps students develop social, leadership and teamwork skills that are essential for success in the real world (Suryaman, 2020).

The Independent Curriculum Approach also recognizes individual diversity and takes into account different learning styles. Students have the opportunity to explore their own interests and talents, so they can develop their potential to the fullest. This curriculum encourages the development of

students' critical, analytical, and creative abilities , while reinforcing the understanding of core concepts in a variety of subjects. The success of the Independent Curriculum is highly dependent on the teacher's role as a facilitator and guide. Teachers have an important role in helping students plan their learning, provide resources and guidance, and provide constructive feedback. Teachers also help students develop critical thinking skills, evaluate information, and make informed decisions. With the Independent Curriculum, it is hoped that students will be more motivated and actively involved in their learning process. They can develop the confidence, risk-taking and independence necessary to succeed in a changing and complex world. This curriculum can also help students develop their own interests and prepare them to better face future challenges. However, it is important to remember that the Independent Curriculum does not mean a loss of structure or a lack of discipline. Guidance and supervision is still needed to ensure that effective learning and educational goals are achieved. The Merdeka Curriculum is all about giving students freedom in learning (Vhalery *et al.*, 2022).

Teaching materials refer to any material or resources used in the learning process to help students understand and master certain concepts, skills and knowledge. Teaching materials cover various types, such as textbooks, modules, presentations, multimedia, educational software, audio or video recordings, and online materials. The main purpose of teaching materials is to facilitate the transfer of knowledge from educators or sources of information to students in an effective and efficient manner. Good teaching materials must be relevant to learning objectives, according to the level of development and needs of students, and present information in a way that is clear, interesting and easy to understand (Cahyadi, 2019)

Teaching modules are important components in education designed to help students or participants learn in a structured and systematic way. The teaching module consists of a series of materials, activities, and assessments aimed at achieving the learning objectives that have been set. In the teaching module, there is an explanation of the concept or topic to be studied, the learning objectives to be achieved, and the steps or activities that must be carried out by students or participants to achieve these goals. With teaching modules, the learning process becomes more directed and organized, making it easier for students or participants to understand the material and achieve optimal learning outcomes (Maulida, 2022).

Learning innovation includes new ideas that are applied in the learning process to achieve learning goals effectively. This innovation can be carried out by educators, government, and other educational institutions. Educators have a role as facilitators, mentors, consultants, and study partners who aim to make students feel happy and comfortable during learning. To implement learning innovations, the government and educational institutions need to improve the quality of educators so that they become professionals. One effort that can be done is to organize a seminar program (Rosyiddin *et al.*, 2022).

Simple harmonic motion is the phenomenon of regular and repeated oscillatory motion with a consistent pattern. This motion can be observed in a variety of physical systems, from simple swings to sound waves. The basic principle of simple harmonic motion is a restorative force which is proportional to the displacement of the mass from the equilibrium position. That is, the farther the mass is pulled or pressed from the equilibrium position, the greater the restoration force exerted by the rope or rod. This restoration force aims to return the mass to an equilibrium position. In addition to restorative forces, inertia also plays an important role in simple harmonic motion. Inertia is the property of a mass to remain in a state of motion or rest. When a mass is shifted from its equilibrium position, inertia causes the mass to have momentum pushing it back to its equilibrium position. Simple harmonic motion is characterized by several properties. First, there is a period, which is the time it takes for one movement cycle, from the lowest point back to the lowest point. The period of simple harmonic motion depends on factors such as the suspended mass, the elastic constant of the string or rod, and the acceleration due to gravity. In addition, simple harmonic motion also has an amplitude, which is the maximum distance of mass transfer from the equilibrium position. The amplitude determines how far the mass moves when swinging (Yaz, 2007)

Simple swing is a form of oscillation besides a mathematical pendulum. The swing consists of a rope that is assumed to have no mass and a weight tied to the bottom end of the rope. the upper end of the rope is tied in a fixed position (like a nail), the weight will hang freely and move back and forth due to the influence of the earth's gravitational force. The main concept in the simple swing is that the suspended mass will move back and forth in a regular oscillatory motion. This movement is caused by

the gravitational force acting on the mass. The basic principles governing the motion of a simple swing are Hooke's Law and Newton's Laws of Motion. Whereas the spring force in a simple swing refers to the restorative force produced by the rope or rod supporting the suspended mass. This force is similar to the restorative force in a typical spring and is described by Hooke's Law. Hooke's law states that the restorative force acting on a spring (or in this case, a swinging rope or rod) is proportional to the displacement or deformation of the spring. In the context of a simple swing, the rope or rod acts as a spring that provides a restorative force, then the gravitational force acting on the mass causes acceleration towards the center. When a mass is displaced from its equilibrium position, the restorative force produced by the rope or swing bar opposes the displacement and returns it to the equilibrium position. This is what causes the simple oscillatory motion of a swing. This restorative force returns the mass to its equilibrium position when the suspended mass is moved. When the mass is moved to one side, the rope or rod will stretch and provide a force that pulls the mass back to the center. Conversely, if a hanging mass is pulled in the opposite direction, the rope or rod will be compressed and provide a force that pushes the mass back to the center. This spring force allows a simple swing to perform a regular oscillatory motion. When a suspended mass is pulled to one side and then released, the restorative force from the rope or rod will cause the mass to move back and forth about the equilibrium position. This movement will continue until friction and other forces stop the swing motion (Abdullah, 2016)

The PBL learning model is one model that makes the learning atmosphere fun so that both students and educators enjoy the learning process. Problem-based learning (PBL) is a learning model that involves students learning knowledge related to the problem solving students through the stages of the scientific model so that they have a skill in solving a problem. Students' learning conditions only receive material from the teacher, take notes, and memorize it must be changed to sharing knowledge, finding knowledge actively so that there is an increase in understanding. To achieve these goals, teachers can use innovative learning approaches, strategies, models or methods. One of them is problem-based learning (problem based learning). Problem Based Learning (PBL) is also a learning model that is oriented to real life contexts which is solved by critical thinking, and by mastering multiple practical "how to learn" using intelligence. PBL is a learning strategy that utilizes human intelligence such as IQ, EQ, and SQ to utilize life that is directly related to scientific fields and develops students' critical and creative thinking (Kertati *et al.*, 2023).

According to Shofan, et al. (2013) which stated that the abilities and characters of students in learning were different, so that all students were not able to serve their individual needs. The module is a strategy that can be applied to meet the learning needs of individual students. In addition, the module is also able to help students to get important information about learning material. A good and quality module is a module that has the following characteristics: (1) self instruction; (2) self contained; (3) stand alone; (4) adaptive; (5) friendly; (6) consistency in the use of fonts, spacing, layout; (7) having a clear writing organization (Suastika & Rahmawati, 2019).

Problem solving is a learning that involves students actively in solving a problem. Problem solving learning focuses more on giving problems to analyze and discuss solutions to these problems (Hadi & Junaidi 2018). There are several characteristics of the problems that can be used in problem solving learning, namely, the problems are real and can train students' mentality and ways of thinking, the problems that are solved have meaning so that students can solve them seriously, and the last characteristic is that the problems must be in accordance with students' abilities so that students have no difficulty in solving these problems. Problem solving is a part of PBL learning that can train students' critical thinking. PBL learning has a very important role in being able to train students to be able to analyze and understand phenomena, events, and problems that exist in society and train students to be able to solve problems (Argusni & Sylvia, 2019).

PBL-based physics teaching module on simple harmonic motion material is structured as a physics learning innovation to make it easier for students to solve problems on simple harmonic motion

material. The selection of this model is based on the advantages of the problem base learning model, namely the use of learning phases that stimulate students to be able to solve a problem. The goal is to be able to foster motivation to learn, improve critical thinking skills, and develop skills to work together in groups. Thus, this study aims to determine the validity of the PBL-based physics module on simple harmonic motion material that has been compiled. The validation test in this study consisted of a material completeness test and a material accuracy test. The completeness of the material includes all the material contained in KD and learning objectives, as well as the depth of the material, namely the material presented contains concepts, definitions, principles and procedures on the topic of simple harmonic motion. The accuracy of the material, namely the material presented accurately in accordance with KD and learning objectives, as well as the accuracy of the literature, namely the literature presented must be accurate. In the validity test there are module criteria that can be said to be valid or not. The criteria for completeness of the material and accuracy of the material are if the percentage is 75% -100% then the module is declared very valid and can be used without revision, the percentage is 50% -75% then the module is declared valid and can be used with slight revisions, the percentage is 25% -50% then the module declared invalid and can be stated with major revisions, and a percentage of 0% -25% then the module is declared invalid and cannot be used.

LITERATURE REVIEW

Teaching Materials and Teaching Modules

According to Harahap *et al.* (2022), one of the components of teaching materials is in the form of modules. Modules are teaching materials that are arranged systematically with language that is easily understood by students according to their level of knowledge and age so that they can learn on their own (independently) with minimal assistance or guidance from educators. Students learn independently can allow them to learn actively and creatively, and modules are also contextual in nature so that students more easily link the material learned with their daily lives, both in the family environment, school environment, community environment and even the country with the aim of finding the meaning of learning in material for their lives (Arainru, 2022; Iskamto et al., 2019, 2022).

Module Development and Expert Validation

Module development procedures can be carried out in several stages, namely: (1) preliminary research/study and data collection, (2) planning, (3) product draft development, (4) initial field trial or, in this study, a validation test by experts, (5) revising the results of the initial field trial, (6) main field trial or in this study is a small-scale trial, (7) revising the main field test results product, (8) field implementation test or in this study is a field/class trial, (9) final product revision. In particular, the research in the article written by Chrisyarani and Yasa (2018) stopped at stage 4; namely the initial field trial or in this study, it was an expert validation test. Describe the results of expert validation and the results of the test of attractiveness and practicality. Quality teaching materials, if they meet the aspects of validity, practicality, and effectiveness. In the research and development of the module, researchers added aspects of attractiveness to find out the response of students about the module used.

Problem Base Learning

The use of activity-based teaching materials and connecting classroom learning with everyday life that students face directly can overcome students' skill gaps, one of which is by using problem-based teaching modules (Nastiti et al., 2018). problem-based learning is open-ended learning in which students are given problems and asked to solve them by collecting, discussing and analyzing the information needed to solve the problem. Through problem-based learning, students are trained to develop various skills creatively, think critically and work together in teams (Tanti, 2020).

METHOD

This type of research in this research was qualitative research. Qualitative research is research that is descriptive in nature and tends to use analysis. In qualitative research what is often emphasized is the process and meaning with a theoretical basis that is used as a guide, so that the research focus is in accordance with the facts on the ground (Ramdhan, 2021: 6-7).

The data analysis method used in this research was descriptive analysis method. The data that had been obtained from the validation test in the form of a completeness and accuracy test of the material will be analyzed and described. The validation test was carried out using a questionnaire filled in by the validator. The validator in this study was one of the Professors in the Physics Education Study Program at the University of Jember. The validation questionnaire contained validation regarding the material aspects of the physics module. There were two components that were analyzed, namely regarding the completeness of the material and the accuracy of the material. In the material completeness component, there were two validation points, namely the completeness of the material in the physics module and the depth of the material in the physics module. Then in the material accuracy component there were two points, namely the accuracy of concepts and definitions and the accuracy of references to the literature.

The validity value can be obtained from the questionnaire scores that have been filled in by the validator. To calculate the value of validity can be done in the following way:

$$Nilai\ Validasi = \frac{(Skor\ Validasi)}{(Skor\ Maksimal)} \times 100\%$$

From the percentage data, it will then be analyzed using the criteria for completeness of the material.

RESULT AND DISCUSSION

The module developed is a PBL Physics Teaching Module on Simple Harmonic Motion Material. The components in the preparation of the PBL Physics Teaching Module Simple Harmonic Motion Material are covers, prefaces, table of contents, glossary, concept maps, introduction (module identity, brief description of the material and instructions for using the module), learning activities (material description, sample questions, evaluation, answer key) and bibliography. This module also had problems that were easy to understand because they were commonly encountered in everyday life. Then, after this module was designed, it was continued with printing it. After that, the PBL Physics Teaching module on Simple Harmonic Motion Material was validated by the material expert.

Material expert validation was carried out by an expert in the field of education who is a Professor of the Physics Education Study Program at the University of Jember. The assessment includes evaluating the completeness of the material in the module, the depth of the material in the module, the accuracy of concepts and definitions, and the accuracy of references in the literature. Table 1 states the material expert validation score.

Table 1. Material Expert Validation Score

Validators	Component	grain	Percentage	Average Percentage
Material Expert	Material equipment	Material equipment	100%	87.5%
		Material Depth	75%	
	Material Accuracy	Accuracy of concepts and definitions	75%	87.5%
		Reference accuracy	100%	

The material completeness test in the PBL-based physics module on simple harmonic motion material that had been developed was carried out by a material expert validator. The results of the validation test by material experts on the completeness aspect of the module material included, the material presented covering all material contained in KD and learning objectives of 100%, with the criteria for the material presented being very complete so that users really understand the material. Then, the results of the validation test on the depth aspect of the module material included the material presented containing explanations of concepts, definitions, principles and procedures on the

topic of simple harmonic motion by 75% with the criteria that the material presented is in depth so that users can understand the material. The results of validation on the material completeness component obtained an average percentage of 87.5% which indicates that the material in the module meets very valid standards so there is no need to revise the simple harmonic motion material that has been developed in the module.

The component validation test for the accuracy of the material in the PBL-based physics module on simple harmonic motion material that has been developed was carried out by a material expert validator. The validation results on aspects of the accuracy of concepts and definitions include that the material must be presented accurately in accordance with KD and learning objectives by material experts at 75%, with the criteria that the material presented is accurate and in accordance with KD and learning objectives. Furthermore, the test results on aspects of the accuracy of references to the literature are 100%, with the criteria presented in the literature being very accurate. Therefore, the validation results on the material accuracy component obtained an average percentage of 87.5% which indicated that the material in the module met very valid standards so there was no need to revise the accuracy of the simple harmonic motion material that had been developed in the module.

Based on the validation results that had been carried out by material experts, the PBL-based physics module on simple harmonic motion material that had been developed met the completeness and accuracy requirements of the material with a final validity value of 87.5%. Therefore, the validity results obtained, this module can be used as a learning tool in facilitating student learning. Therefore, the use of this module was expected to foster students' learning motivation, improve critical thinking skills, and helped to develop skills in working together in groups.

CONCLUSION

Based on the results of the research that had been done, it can be concluded that the PBL-Based Physics Module in Simple Harmonic Motion Material was declared valid based on the validation component of the completeness of the material and the accuracy of the material. Data validation results showed the percentage of the material completeness component with an average percentage of 87.5% and the accuracy of the material component with an average percentage of 87.5%. So, it can be concluded that this module was declared valid or can be used without revision.

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