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Development of Interactive Media-Based Wave Teaching Materials to Improve Students' Problem and Performance Capability

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Abstract

This study aims to produce teaching materials to improve problem-solving skills that are feasible to use as a class XII physics learning media on sound wave material. In addition, it is also to find out the response of students to teaching materials developed in terms of meeting the standards of usability and quality. This research is R & D research with design according to Borg including: needs analysis, product planning and development, product development, product evaluation, and final products. The instructional materials developed have been implemented in 63 students of class XII SMAN 5 Semarang. Data collection is done by giving a validation sheet to the senior teacher. Data on students 'problem solving abilities were obtained from the results of the pretest and posttest while the students' performance was seen from the observation of practical activities in the laboratory. Students are also given a questionnaire to provide input on the teaching materials that have been developed. The results of the study indicate that the product of development is declared feasible based on expert judgment. Implementation of teaching materials in physics learning in sound wave material is able to improve problem solving skills and student performance.

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INTRODUCTION

Physics at the high school level is one branch of science which is taught as a separate subject. One of the core competencies of senior high school is to understand, apply and explain factual, conceptual, procedural and metacognitive knowledge in technology, art, culture and humanities with humanity, nationality, state and civilization insights related to the causes of phenomena and events, and apply procedural knowledge to fields specific studies according to their talents and interests to solve problems. This competency is stated in Permendikbud No. 69 of 2013.

Students are expected to have the ability to understand the concept of Physics. The ability to understand the concept of physics is very helpful for students in solving problems. The purpose of learning physics is that students are expected to be able to apply their knowledge to solve problems in the real world (Hedge and Meera, 2012). Students who can understand the concept well are more able to transfer and generalize their knowledge when compared to students who only memorize. Kohl and Noah (2005) concluded that students' success in solving physics problems was influenced by the format of representation of those problems. Representation can be done through various methods including verbal, image, graph and mathematical (Fatmaryanti, 2015). In expressing the concept of physics that is understood by students, it can be done with a question of understanding the concepts that show its representation For students who understand a concept will not have difficulty expressing their understanding in various forms of representation. Solving problems needs to have adequate understanding and knowledge, and has a variety of strategies that can be chosen when facing different problems (Zevenbergen et al., 2004).

A concept can be explained verbally that is by text or sentence that can explain the concept so that a concept can be understood and mastered by students. In addition to images and mathematical equations, the relationship between physical variables can also be explained by a graph (Murtono et al., 2014). Ghufron & Risnawita (2014) suggest that individuals are a unit that each has its own characteristics, there are no two individuals who are the same. Differences also occur in individual learning styles. There are individuals who are more suited to certain learning styles and there are individuals who are not in accordance with certain learning styles. Each student also has different learning characteristics, in order to facilitate all of the student's learning characteristics needed teaching materials that can teach students independently (Suparman, 2014).

Preparation of teaching materials that are in accordance with student learning styles, of course to improve learning outcomes. Learning styles have a relationship with student learning outcomes. This statement was obtained and reinforced by the results of Reyza's research (2015) investigating the relationship between VAK learning styles (Visual, Auditory and Kinesthetic) with student learning outcomes in material dynamics of rotation and equilibrium of rigid objects in class XI IPA of senior high school throughout Jambi city. The results of the study state that there is a relationship between visual, audio, and kinesthetic learning styles with student learning achievement.

Teaching materials that are appropriate to the learning style will increase student interest so that learning outcomes will increase. Teaching materials that fit learning styles are still not enough because students' interest in reading in Indonesia is still relatively low. It is known from students who have never visited the school library or regional library. There are various factors that cause the low interest in reading Indonesian children as stated by Hentasmaka (2011), one of which is the lack of availability of quality books at affordable prices and less even distribution in each region. In addition, the rapid development of technology also worsens the situation, because students prefer gadgets rather than books. Though books are very important in supporting learning activities, because books are one of the main learning resources of students that exist today.

Along with the progress of the times, began to be developed using the results of technological developments in the world of education. One of the uses of technological development is the use of virtual laboratories in physics learning, which is proven to make students have thinking skills in solving problems, the process of learning physics becomes more effective, makes students active and arouses student motivation to learn (Sari, 2016).

In this study selected sound wave material on the basis of the results of observations made to a number of students to fill out questionnaires about difficult physical material according to them. The results of the difficult physics questionnaire are presented in Table 1

Table 1. Physical material most difficult according to students

No	Physics Material	The number of students who choose
1	Wave	17
2	Fluida	14
3	Electricity	7
4	Optics	6
5	Kinematic	4
6	Thermodynamic	3
7	Kinetic theory of Gas	2
8	Work, Energy, and Force	1

From the results of Table 1.1 it can be seen that the wave material is most often chosen by students as the most difficult material, for various reasons one of which is wave material having many branches of matter and too many similarities, and wave graphs. Therefore, the researcher intends to conduct research on "Development of Wave Learning Materials Assisted by Interactive Media to Enhance Problem Solving Capabilities and Student Performance".

METHOD

The procedure or steps of research and development do not have to use standard steps that must be followed, but each development can choose and determine the most appropriate steps for its research based on the conditions and constraints it faces. The development procedure for research on the development of wave teaching materials assisted by interactive media to improve problem solving skills and student performance is carried out in various stages. The workflow chart for developing teaching materials to improve problem solving skills and student performance on physics subjects in high school that has been modified by the developer, can be explained as follows:

Needs Analysis

At this stage, the developer carries out: (1) Analysis of teaching materials that have been used in various high school schools in the city of Semarang; (2) Analysis of material data contained in the 2013 curriculum revision of class XII in semester 1 with very important material to be developed; (3) A survey of physics learning by giving a number of questions relating to wave material learning and student interest in the existence of a teaching material in which there are simulations that facilitate physics learning, especially wave material; (4) Assessment of problems faced by students.

Product Development Planning

At this stage, the developer determines the purpose and character of the product, looks for the sources of content from the product design to be made, arranges the stages of making the product / product concept and develops the initial product teaching material.

Product Development

The development of the initial product of this teaching material, the researchers consulted directly and collaborated with experts namely material experts and media experts.

Product Evaluation

With the validation carried out by experts, it will produce a representative measuring instrument in obtaining data. Small-scale field trials of the initial products of teaching materials were conducted to obtain product responses and revisions by experts and students.

Final Products

The final product is produced by the developer based on the input and revision of the initial product. After going through expert review and trial, the product is refined based on expert input and students, so as to produce teaching material products to improve the ability to solve problems and performance of students who are feasible and effective. Products are also implemented in class XII MIPA to get responses from students.

RESULT AND DISCUSSION

This research produces a product in the form of sound wave teaching materials to improve problem solving skills and student performance. Teaching materials consist of electronic books in the form of PDFs that can be opened directly through a smartphone or PC or can be printed into a book. The initial stage begins with a literature study on the development of electronic book-making software and its use. The next stage is the initial product design. The initial product design begins with making and choosing a design. The electronic book produced has three parts, namely the beginning of the cover, preface, usage instructions and table of contents. The second part is the content in the form of sound wave material equipped with examples in everyday life, questions at the end of each material, as well as illustrations in the form of images, videos, and simulations. At the end there is a reading and reference list.

Figure 1. Cover of sound wave teaching material

The advantages of using this wave teaching material compared to conventional teaching materials include video and simulation features. Examples of adding videos in Figure 1. The addition of supporting videos is intended to improve the convenience of students in understanding the concept well. The audio visual content that is displayed is considered appropriate to explain the material, thus helping students to understand the material. This is supported by the Quarcoo-Nelson et al. (2012) who concluded that the use of audio-visual in science learning increases student understanding so that it has an impact on improving student learning outcomes. Furthermore, Owusu et al. (2010) stated that audio-assisted learning can explain abstract material.

Media experts and material experts who assess teaching material products in this study provide the ratings presented in Table 2 and Table 3.

Table 2. Results of Testing Analysis by Media Expert

Category	Percentage (%)	Criteria
Modul Size	87,50	Very good
Modul Design	88,19	Very good
Modul Content	90,10	Very good
Average	88,59	Very good

Table 3. Results of Testing Analysis by Material Expert

Category	Percentage (%)	Criteria
Feasibility of Content	84,38	Very good
Feasibility of Presentation	78,13	Good
Language Assesment	79,81	Good
Average	80,77	Good

Based on Table 3 the results of the analysis of research data from testing by material experts obtained overall good results. The aspect of content eligibility gets 84.38% with very good criteria. Conformity of book material with SK (competency standard) and KD (basic competency) get good results, which means that it is in accordance with the established BSNP criteria. Books must present minimal material contained in Competency Standards (SK) and Basic Competencies (KD) (BSNP, 2006: 127). The accuracy of the material gets very good results, meaning the material in the book is in accordance with the subject matter. The link to a web containing supporting simulations of the learning material contained in the book is good at providing examples. This is in accordance with the description of the instrument from the BSNP, namely presenting examples from the local environment (2006: 130).

Material updates get very good results, meaning the examples in the book are the latest examples that are in line with the times. The feasibility of presenting gets the results of 78.13%, thus the presentation technique is presented in accordance with the systematic pre-presentation, content and closing. Presentations like this are in accordance with BSNP regarding the systematic presentation of principles that comprise the introduction, contents, and conclusions (BSNP, 2006: 132). Supporting presentation in the form of practice questions, introduction and bibliography get good results. Completeness of presentation in accordance with BSNP standards consisting of introductory parts (preface, usage instructions and table of contents), contents and closing sections. The value of problem solving abilities and student performance is presented in Figure 2.

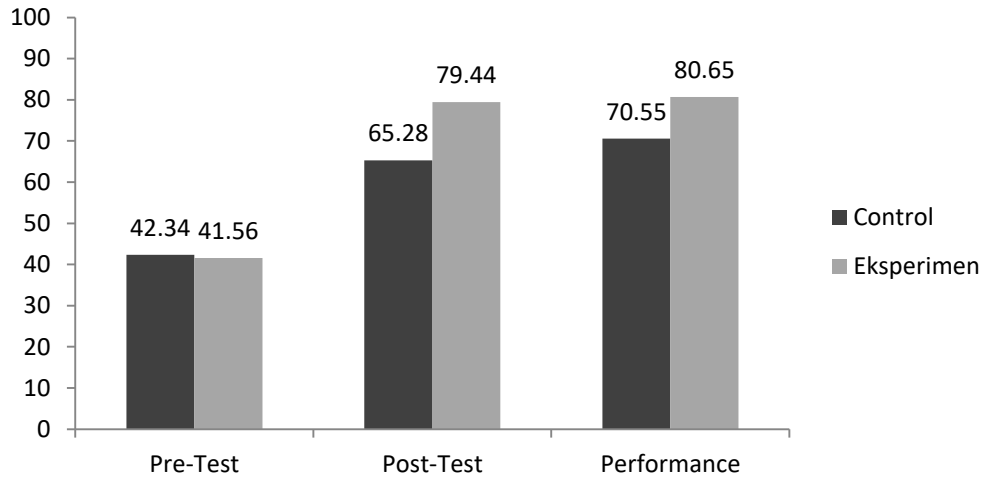

Figure 2. The average value of problem solving abilities and student performance

The results and analysis of the application of teaching materials to students in the experimental class proved to improve problem solving skills than in the control class. Performance of students who use interactive teaching materials in the experimental class is higher than learning in the control class. This happens because the wave teaching materials that have been developed contain interactive media that help students improve learning performance. This is consistent with the research (Huang et al., 2010; Hwang & Chang, 2011) which shows that the use of interactive media improves learning performance rather than learning in the traditional way. The results of the study by Ahmed and Parsons (2013) show that student performance is better in their learning activities, when learning uses interactive media.

CONCLUSION

Teaching materials that have been developed to improve problem solving skills and the performance of high school class XII students have met the assessment standards of material experts and media experts and are suitable for use in learning. The form of teaching materials in the form of PDFs that can be opened through gadgets or printed into modules make it easier for students who have different learning styles to learn more independently. Learning using interactive media-assisted wave teaching materials is proven to be able to improve problem solving skills and improve student performance in laboratory activities.

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