



Development of Wave Material Worksheets Based on Science Process Skills

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Abstract

The aim of this research is to develop a worksheet based on science process skills on wave material and determine student perceptions of the worksheet developed. This type of research is development research with a 4D development model including define, design, develop and disseminate stages. The test subjects for this research were physics education students who took basic physics II courses. The instruments used were expert validation questionnaires and student perception questionnaires. Data analysis techniques in the form of validation questionnaire scores and student perception questionnaires were carried out using descriptive statistics. Meanwhile, data analysis resulting from document review during initial observations and validator suggestions was carried out in a qualitative descriptive manner. The result of this research is a worksheet based on science process skills on wave material. The specifications contained in this worksheet are that the worksheet is designed with an attractive cover appearance and is equipped with appropriate images. The reliability of the student perception questionnaire is in the good category. Results of analysis of student perceptions on aspects of worksheet cover design, worksheet content design, presentation components, Science Process Skills aspects and linguistic components. From these four aspects, it was found that the results of students' perceptions of the Worksheet Based on Science Process Skills in Wave Material were very good.

Keywords: Worksheet; Science Process Skills; Waves; Basic Physics II

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INTRODUCTION

The Basic Physics II course requires students to master work skills and managerial skills and knowledge. A combination of work skills, managerial skills and knowledge is science process skills. Dimiyati & Moedjiono (2002) stated that there are various process skills, these skills consist of basic science process skills. "Science process skills are skills to process information obtained in teaching and learning activities which provide the widest possible opportunity for students to observe, classify, interpret, predict, apply, plan research, communicate the results of the experiment" (Hariyadin & Rusmini, 2013). Meanwhile, according to Conny (1992), "Science process skills are skills that are capable of being the driving wheel of discovery and development of facts and concepts as well as attitudes and values". Furthermore, according to Bundu (2006) in another book, it also states that "Science process skills or abbreviated to science processes are a number of skills for studying natural

phenomena in certain ways to obtain knowledge and further develop that knowledge." As stated by Rezba (1995), science process skills consist of two parts, namely basic science process skills and integrated science process skills.

Science poses skills involve cognitive, manual and social skills. Rahayu (2011), said that the process skills approach can improve student learning outcomes. Students with high science process skills are able to carry out experiments well. Students with high science process skills will have better cognitive achievements than students with low science process skills (Deta et al, 2013). While manual skills are very dominant in process skills, because these skills involve the use of tools and materials, measuring, preparing or assembling tools. This includes being able to ask questions and create networks or communicate in scientific skills (Septiani, 2016). Science Process Skills is very important for every student as a provision to use scientific methods in developing science and is expected to gain new knowledge or develop the knowledge they have.

Science Process Skills have a very important role in the learning process to gain knowledge, but the reality in the field is that science process skills have not been optimally developed. Learning is still emphasized on aspects knowledge. The low level of Science Process Skills is influenced by many factors including learning models, learning methods and learning resources consisting of books and worksheets. One solution that can be done to overcome this problem is to develop a worksheet based on science process skills in the wave material for basic physics II courses. Worksheets based on science process skills are worksheets that develop process skills so that students are able to discover and develop the required facts, concepts, attitudes and values. Supiati (2013) states that "A worksheet is a piece of paper for drawing up problem-solving schemes or making designs, recording data from observations and discussion sheets". The guide to developing teaching materials (Diknas, 2008) states that student activity sheets are sheets containing assignments that must be carried out by students. Worksheets usually consist of instructions or steps to complete a task. According to Poppy in Fauzi (2015) states that "The text or worksheets for learning science must be based on subject matter, strategies, and must develop the student process skills as well as critical thinking". Have an understanding that worksheets for science learning must be based on subject matter, strategies and must also develop science process skills and critical thinking about science learning.

This research aims to develop a worksheet based on science process skills in wave material for basic physics II courses and to determine students' perceptions of worksheets based on science process skills in wave material for basic physics course II.

RESEARCH METHODS

This type of research is development research (Research and Development). According to Sukmadinata (2010), research and development research and development (R&D) is a process or steps to develop a new product or improve an existing product, which can be accounted for. According to Ridho, Indrawati, & Gani (2016), the 4D model consists of four stages of development, the first stage is definition, planning, development, and dissemination.

The development procedure used in the research consists of 4 stages, namely define, design, develop and disseminate. The data collection instrument in this development research is a questionnaire, Maksum (2012) said "A questionnaire is a series of questions used to reveal information, whether regarding facts or opinions." Validation questionnaire for material and design. In this research, reliability is measured using SPSS and then the reliability coefficient is looked at. The reliability test decision making method uses a limit of 0.6. According to Tripratiwi, Minarsih & Hasiolan (2016) A variable is said to be reliable if $r_{\alpha} > 0.6$

The data analysis techniques used in this research are qualitative and quantitative. Miles and Huberman revealed that activities in qualitative data analysis were carried out interactively and took place continuously at each stage of the research until completion (Sugiyono, 2012). Qualitative data is obtained from input or responses from validators and documentation. These data were analyzed descriptively qualitatively. Meanwhile, quantitative analysis aims to obtain a percentage of the questionnaire results

which are analyzed descriptively (Krisnayani, Arthana, & Darmawiguna, 2016). In testing the suitability of the worksheet, to see how the development results are obtained, student perceptions are also seen. This quantitative data is then analyzed and processed descriptively into interval data using a Likert scale.

The steps for analyzing material expert validation data, media expert validation and student perception questionnaires are as follows: (1) Quantitate the checking results by giving scores according to previously determined weights. (2) Determine the average score of the indicators given based on assessments from media expert validation, material expert validation and student perceptions. (3) To identify the tendency for change in each sub-variable, the ideal average (X_i) and ideal standard deviation (S_{di}) are used. (4) Then each sub-variable is categorized into four categories. And (5) the final step in the data analysis technique in this research is draw conclusions from research results and discussions. Data from questionnaires and documentation are concluded descriptively.

RESULTS AND DISCUSSION

The results of this development research are in the form of worksheet teaching materials based on science process skills in wave material for basic physics II courses. Worksheets based on science process skills developed using the 4D development model. The 4D model consists of 4 main stages, namely defining, designing, developing and disseminating. However, in this research, the final stage, namely dissemination, was not carried out. This is because the research objectives have been achieved at the development stage. The validation results by the expert team are as follows:

a. Material Expert Validation

Table 1. Results validation expert material *worksheets* based Skills

No.	Assessment Indicators	Statement	Stage I	Stage II	Stage III
1.	Material suitability with the intention of learning	Material arranged completely and according to purpose learning.	Clarify material and concept maps	Clarify material and maps draft	Can be used
2.	Accuracy material and content	Fact, draft, principles, laws, and theory which explained appropriate and accurate. Completeness information according to the material which studied The practice questions prepared are able to measure indicator achievements learning. Picture which used according to the material. Suitability investigative activities with the problems presented in <i>worksheets</i> .	Clarify material every activity Add application in life daily Customize problem with material	Can be used Can be used Can be used	Can be used Can be used Can be used
3.	Linguistic component	Language And spelling used in accordance with language rules	Use language in accordance Improved spelling	Can be used	Can be used

Indonesia which
 Correct.
 Use term and Consistent Can be used Can be
 symbols/symbol towards used
 consistent. symbols/symbols

In table 1, it is known that material expert validation from the first stage to the last stage shows that after the third stage was carried out the product was declared suitable for use.

b. Validation Media Expert

Table 2. Results validation expert media worksheet based Skills process science on material wave eye studying physics base II

No.	Assessment indicators	Statement	Stage I	Stage II	Stage III
1.	Cover design worksheets	The layout design is attractive and uses good colour combinations	Colours should not be monotonous	Can be used	Can be used
		Layout and images are relevant to the title	Add application images in daily life	Can be used	Can be used
		The font size and layout are correct	Be consistent with the letters and correct the title according to the material	Can be used	Can be used
2.	Design the contents of the worksheet	The layout design is equipped with the right colours so it looks attractive	Colour doesn't match	Readjust the colours	Can be used
		The size and layout of the writing is correct	Pay attention to the layout in as much detail as possible	Can be used	Can be used
3.	Presentation Components	Consistency and orderliness of presentation on the worksheet	The structure of the worksheet is clarified	Explain the structure again	Can be used
		Aspects of science process skills are presented sequentially in each worksheet	Aspects of Science Process Skills are clarified	Can be used	Can be used

In table 2, it is known that the media expert validation carried out from stage I to stage three can be seen in the third stage stating that there were no more suggestions from the validator and it was declared suitable for use.

This research was conducted to develop worksheets based on science process skills in wave material for basic physics II courses and to determine student perceptions of worksheets based on science process skills in wave material for basic physics course II. The product resulting from this research is a worksheet based on science process skills in wave material for basic physics II courses with product specifications, namely the worksheet is designed with an attractive cover appearance and is equipped with

images that are appropriate to the material on diffraction and interference. Form of a worksheet based on science process skills in waves in basic physics courses II is print media. The paper used to print the worksheet is A4 paper with dimensions of 21 cm x 29.7 cm. This worksheet has a thickness of 0.5 cm with 30 pages so it is light to carry anywhere.

Design the layout of each worksheet page based on science process skills in wave material for basic physics II courses using Corel Draw and Adobe in Design. The worksheet cover design has the right font size, layout and colour combination. The worksheet content layout design is equipped with the right colours so that it looks attractive and aspects of science process skills are presented coherently in each worksheet.

Worksheets based on science process skills in wave material for basic physics II courses have several parts which are divided into three parts. The introductory part of the worksheet contains a foreword, instructions for using the worksheet which can make it easier for students to use the worksheet before starting learning, competency standards, basic competencies and concept maps. The learning section of the worksheet contains titles and steps for learning activities based on aspects of science process skills. Identifying variables in the worksheet is an explanation of the concept before starting the experiment. A hypothesis is a temporary assumption from an experiment. Planning an experiment is the work steps of an experiment. Data analysis describes the discussion of the experiments that have been carried out. Concluding is the essence of an experiment. The evaluation section is equipped with a pre-test and evaluation.

Worksheets based on science process skills in wave material for basic physics II courses are useful, namely as additional teaching materials for basic physics II courses on the subject of interference and diffraction and as a guide for conducting practicums. The advantage of this product is that it is a worksheet based on science process skills in wave material for basic physics II courses so that students who use this worksheet can be independent in carrying out practical work. This worksheet helps students develop aspects of science process skills. The drawback of this worksheet is that the video presented is still not clear enough to understand the material and the skill aspects of the science process are not all included in the steps of the learning activities.

CONCLUSION

The development of a worksheet based on science process skills in wave material for the basic physics II course was carried out using a 4D model consisting of several stages. First, Define, where at this stage several analyzes are carried out to obtain information about student needs. Second, Design, where at this stage the test preparation, media selection, format selection and initial worksheet design are created based on science process skills. Third, development, where at this stage material validation and media validation are carried out. The product resulting from this research is a worksheet based on science process skills which is designed with an attractive cover appearance and is equipped with images that correspond to interference and diffraction materials.

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