

Development of Simple Machines Props Using Environmentally Friendly Materials for Junior High School

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Abstract—This study is based on the lack of frequency of application of learning media and no simple machines props. Implementation of props can help teachers in delivering material. This research and development aim to describe the feasibility of simple aircraft props made from environmental materials. The specific objectives of this study are to describe (1) the validity of props, (2) practicality of props, (3) the effectiveness of props. This research and development use ADDIE design. The resulting product is a simple machines material props using environmental materials. The props were tested in 31 students of class VIII of Canaan Christian Junior High School. The instruments used are validation sheet, response questionnaire and learning result test. Data were analyzed descriptively from quantitative data obtained. The results showed that visual aids (1) are very valid, (2) practical, and (3) effective. The result of research and development of simple machines props on science learning with sub material lever, pulley and inclined for junior high school students can be concluded that simple machines props made from environmentally friendly, suitable for students of class VIII Junior High School.

Keywords—*props, simple machine, environmentally friendly materials*

I. INTRODUCTION

The 2013 curriculum contains a mix of three domains that are the goals of national education [1]. The government hopes that education can make learners competent in their fields. This is in line with national education objectives that should include attitude, knowledge, and skill competencies [2]. Thus, teachers should be able to make learners active, knowledgeable, and skilled.

Teachers should be able to apply a tactic or strategy that helps students in learning [3]. Teachers can improve the quality of learning by making learners learn by themselves, learn more active, fun and effective [4]. Thus, learning activities are expected to foster the interest of learners to learn. Learners who have an interest in learning science will have a strong intention to stay active and participate in learning [5].

The necessity of today is about the skill of inquiry. This ability is obtained when learners do the practicum in science learning. This skill is required of learners to learn about the world of science and technology in more detail [6]. The learners will be able to solve problems in everyday life when accustomed to using scientific methods. Therefore, a learning is not just about concepts, but how to find the concept through scientific and practicum methods.

Ideal science learning had not been realized as expected until now because students only acquire theoretical material [7]. The results of observations and interviews with science teachers at SMP Christian Canaan indicate that the interest and learning outcomes of learners are low, that most of the learners in that class get a score below the minimum completeness criterion that is 75. The learning outcomes of the low learners may also due to lack of use of instructional media [8]. The school has a medium of science learning, in the form of some practicum tools. However, labs are rarely done. This is because the practical tools contained in the school is not practical, the practice tool is not arranged in one box experiment of simple machines. Simple material practicum tools contained in the school just a pulley. So, if you want to use a practicum tool requires additional time to assemble the practice tool.

Such learning ignores the involvement of the knowledge that the learners have with the world around the learners [9]. In fact, successful learning is when teachers engage learners in a scientific practice [10]. Not only in the above-mentioned schools, other studies show that there are still few schools that use laboratories, and there are schools that do not have practicum tools [11].

The laboratory and its tools have an important role in science education [12]. One of the efforts to fulfill it is by developing the appropriate learning media to increase the interest of learners and learners' learning outcomes. One of the learning media that can meet the expectation is the props. Props in teaching play an important role as a tool to create an effective learning process. The role of props play an important role because the props made concepts can be understood by students [13]. The props bring the concepts of

the material learned [14]. The props are models that are able to describe, explain, and predict natural phenomena [15].

Simple machines are the subject of the science of class VIII with sub-discussion lever, pulley, and incline. Basic competence is (3.1) Describes the usefulness of simple machines in everyday life and its relation to muscle work on the skeletal structure of man; and (4.1) Investigating of the mechanical advantages of simple machines. From the basic competence, the teacher must guide the learners to conduct an investigation on simple machines. Skills trained in simple machines are observing, identifying variables, formulating hypotheses, experimenting, measuring metrics, interpreting data, formulating, classifying, predicting, concluding, and communicating [16]. Conducting a simple plane experiment can improve student learning outcomes [14].

However, there is no simple materials kit at SMP Christian Canaan. In fact, to learn about the phenomenon of physics, learners can be assisted by directly related to the environment [9]. Therefore, researchers develop props to help learners find the concept of simple machines directly. The props to be developed are designed more practically so they can be used in learning. These props can grow the interest of the students so that students interested in learning.

Teachers can innovate by utilizing the existing tools around the learners to practice simple machines [14]. Researchers innovate by utilizing environmentally friendly materials. The props developed by the researchers are environmentally friendly that is using the rest of the furniture materials in the form of pieces of wood are used as a simple aircraft kit. Around the school site, there are many furniture factories where the remaining pieces of wood can be made into props of simple machines.

In this article, researchers will describe the feasibility of simple materials props machines using environmentally friendly materials. The feasibility of props will be seen from the research questions as follows: (1) How is the validity of props developed that are assessed by the validation sheet of props? (2) How is the practicality of props developed that are assessed by questionnaire responses of students? and (3) How is the effectiveness of props developed that are assessed by student learning outcomes?

The rest of this paper is organized as follow: Section II describes proposed research method. Section III presents the obtained results and following by discussion in section IV. Finally, Section V concludes this work.

II. PROPOSED METHOD

This research is a research and development. Research and development are a kind of research that will produce the product. Researchers have developed a simple machines props made from environmentally friendly materials. The steps in this research are using ADDIE model.

The study was conducted on January 26, 2017, until November 2017. The product trial site is SMP Christian Canaan located at Jl. Captain Pierre Tendean No. 50, Gadang, Banjarmasin Tengah, Kota Banjarmasin, South Kalimantan, 70122. The number of students is 31 students.

Data collection techniques in this study, namely: the first, the validity of props obtained through validation

results made by the expert validator. The quantitative results obtained will be analyzed descriptively and used as a validation assessment of props developed. Secondly, through the practicality of props obtained through questionnaire responses of students to learning by using props. Questionnaire responses are filled out by students at the end of the meeting after the lesson is done. Questionnaire student response has three aspects namely aspects of ease, benefits, and efficiency. Third, is the effectiveness of props obtained through the test of student learning outcomes. This test is done three times at the end of each meeting after using props. From the test results of learning, can be seen the value of individual completeness and classical completeness obtained by students after using props in learning.

III. RESULTS

The props of simple machines that researchers develop using environmentally friendly materials that are made from wood-based furniture (see Figure 1). The props developed the props developed consisted of three types of props that fit the subject, namely (1) lever experiment kit, (2) experimental pulley kit (3) experimental kit for the incline. The props are developed simply and make it easier for students to understand the concepts being taught. The props kit is a box designed so that in 1 box the learners can experiment with assembling tools and materials available in accordance with experimental props guide. The props of simple machines developed more practical that is easy to assemble according to experiments that want to be done and easy to carry. In addition, the props are interesting so that the learners are more interested in following the lesson.

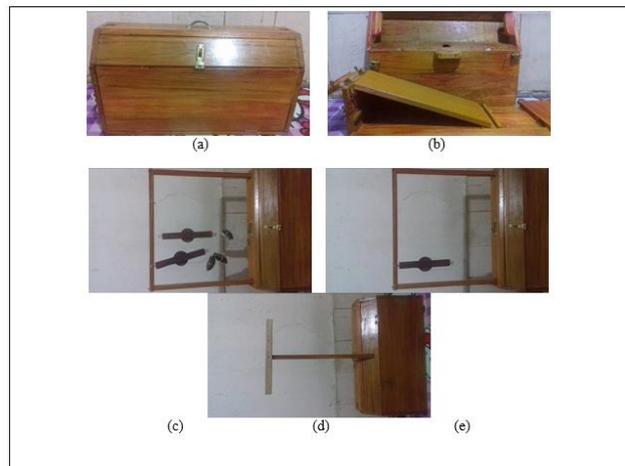


Fig. 1. Simple materials props machines using environmentally friendly materials

The props of simple machines developed are made from environmentally friendly materials. Environmentally friendly materials have the following criteria [17]: (a) In the manufacturing process does not produce hazardous substances for the environment; (b) Non-toxic, after use or before; (c) Can connect us to nature, in the sense that we are closer to nature because of the natural impression of the material; (d) Can be obtained easily and closely; and (e) Materials that can decompose easily naturally. Natural

materials such as rocks, wood, and the soil generally use less energy to produce, produce fewer toxins and produce less pollution in the environment.

Expert validation results of simple machines props can be seen in the Table I as follows:

TABLE I. RESULTS OF VALIDATION OF SIMPLE MACHINES PROPS

	Validator	
	1	2
total	89	85
Average	4.45	4.25
Percentage	89	85
Reliability	98	

The practicality of props is obtained from student responses formed through questionnaire with the following results in Table II.

TABLE II. RESULT OF PRACTICALITY OF SIMPLE MACHINES PROPS

Aspect/ Dimension	Indicator	Item	Total
Benefits	Clarify the material	11; 12; 14	3
	Motivation	9; 10	2
	Interest	5; 8; 13	3
	Attraction	2; 3	2
Efficiency	Time	15	1
	Power	16	1
Convenience	Operation	1; 4	2
	Understanding	6; 7	2

Student responses to the use of simple machines can be seen in Table III.

TABLE III. RESULTS OF STUDENT RESPONSES TO SIMPLE MACHINES PROPS

No.	Aspect	Average	Category
1.	Benefits	4.17	Practical
2.	Efficiency	3.94	Practical
3.	Convenience	4.25	Practical

Effectiveness is obtained from the student learning outcomes test. The result of classical completeness calculation and student's individual completeness is as follows.

TABLE IV. PERCENTAGE OF CLASSICAL COMPLETENESS AND INDIVIDUAL COMPLETENESS

Meetin g	The number of students			classical completeness
	Completed	Not Compl eted	Percentage of completed students	
1	29	2	94	Completed
2	25	6	81	Completed
3	28	3	90	Completed

IV. DISCUSSION

A. Validity

Validation of props of simple machines is done by two validators consisting of two expert experts namely two lecturer testers. Validation of simple machines props was done before the two research products were tested among the students. Validation is done by the validators based on validation tools that have been made by researchers.

Based on table 1, the selection of basic materials for making props is considered good, where the basic material used is wooden furniture. The efficiency of the cost of

producing props rated well from the basic materials used is cheap and easy to obtain materials. Then the innovation of the development of simple machines is considered good because the props are developed is a tool that is not yet available on the market, it is seen from the design of an attractive tool, the ease of carrying the tool, and the concept of developing the principle of props simple machines different from the props other simple machines because it is more efficient and practical in explaining the concept of simple machines.

Based on the calculation result of validation of simple machines props, it is known that the validation value given validator to props developed is 4.45 with very valid category and big reliability 98% which means a high degree of reliability. Thus, it can be concluded that the props of simple machines developed very valid and reliable because the product has a high validity. This is in accordance with research by other researchers who stated that the validation results obtained from the expert showed that the props used were appropriate and appropriate to be tested in the class after the repair [18], [19]. The props can take students to play an active role in the learning process [20]. The visual aids are expected to reduce the difficulties experienced by the students and improve students' understanding of the concept. [21].

B. Practicality

An easy and usable product can be considered practical [22]. The practicality of props can be assessed through a questionnaire of student responses filled out by students after the learning process takes place. Questionnaire response has three aspects: benefits, efficiency, and convenience. Based on Table 3 which shows about the percentage of student's overall response is 74 with good category.

First, the average benefit is 4.17 with a good category. This shows that the props of simple machines developed are useful for students. Benefits in question can clarify the concept, motivate students, and increase student interest. The props contain the concepts of the material being studied [11]. A product is said to be practical if the product can be used in the learning process so as to make students more independent in achieving the learning objectives and can help students understand the material [23].

Second, the average efficiency is 3.94 with good category. This shows that the props developed are efficiently used in learning. The meaning is efficiently seen from the time and energy used. In each experiment, the required energy is not too large, and the time to assemble the tool and carry out the practicum is shorter. The practice of using a demonstration aims to enable all students to practice and overcome a problem related to that which has been demonstrated [11].

Third, the average convenience is 4.25 with a good category. In the comments given, many students stated that the developed product is interesting, and learning is more easily understood by using props.

If the description of student assessment is good so that it can be interpreted that the props developed can help students understanding [24]. This study was in accordance

with research by other researchers who stated that the student's response can show how far the quality of props used as a medium of learning [20]. Thus, it can be concluded that the use of simple machines, which is made from environmentally friendly materials, is practically used in the learning process of science.

C. Effectiveness

The effectiveness of a learning process can be assessed by the level of achievement of learning objectives, one of which is the achievement of cognitive learning outcomes. The knowledge component remains an important learning outcome [25]. Table 4 shows the results of the percentage of complete completion of classical and individual completeness after the lesson is implemented. The test of learning results is done at each meeting. At the first meeting, the maximum score obtained by students that is equal to 65 and a minimum score of 40. The individual completeness obtained at the first meeting of the classical completeness of 94%. When compared with the completeness of individual 75% then at the first meeting can be said students have been completed.

At the second meeting, the maximum score obtained by students is 50 and the minimum score of 18. The individual completeness obtained in the second meeting is the classical completeness of 81%. When compared with the classical completeness that has been determined by the school, then at the second meeting said the student is complete. At this second meeting, students' mastery decreased. This is because students are not able to answer questions no 3 and no 4 with the form of questions C2. The matter is about elaborating the working principle of the pulley and the application of working principle of the pulley to everyday life.

At the third meeting, the maximum score obtained by students is 35 and the minimum score of 10. At the third meeting of classical completeness is 90%. When compared with the classical completeness that has been determined by the school then at the third meeting said the student has been completed above the minimum criteria.

The average percentage of the three meetings is for the classical completeness of 88 which means the students finished because the classical completeness achieved is > 70. The results obtained, it can be concluded that the product developed effectively. the learning given by using props can be judged effective, with the achievement of learning objectives. The developed product is declared effective by using the developed media is expected to achieve the desired goal [22]. The props can show the concepts and symptoms of physics being studied [21]. The props are able to optimize the function of all the five senses of the students, namely listening, seeing, feeling, and using their minds logically and realistically [26]. The principal function of the props in the learning process is preferable to enhance the quality of learning and teaching [27].

Simple machines props made from environmentally friendly materials are very helpful for students in the learning process. The props have been eligible to convey the correct concept of simple machines. The props are also practical to use because they have beneficial, efficient, and

easy properties when used. Props make students interested and active in learning. The props used are also able to improve the learning outcomes of Canaan Christian Junior High School students. Thus, the developed tool can overcome the problem of lack of laboratory practicum and limitations. So props simple machines are made from environmentally friendly materials feasible to be used for students in junior high school.

V. CONCLUSION

The result of research and development of simple machines props on science learning with sub material lever, pulley and inclined for junior high school students can be concluded that simple machines props made from environmentally friendly, suitable for students of class VIII Junior High School. This is supported by the following findings:

- a. The validity of props developed is valid in accordance with validation results by two validators with an average value of 4.45.
- b. Practicality of learning seen from questionnaire of student response is categorized practical according to result of mean of response questionnaire overall that is equal to 74% and per aspect that is benefit aspect with average 4,17, efficiency with average equal to 3, 94, and the convenience with an average of 4.25.
- c. The effectiveness of props viewed from the test of learning outcomes conducted at each meeting. The average percentage of each meeting is classical completeness of 88% and individual completeness of 81% with the achievement of these values can be concluded props are developed effectively.

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