Development of simple machines props to train student’s science process skills

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Abstract. Researchers had conducted research and development to produce simple machines props and its usage worksheet. Simple machines props were developed aimed at trained students' science process skills. The researchers also describe the feasibility of simple machines props. The feasibility was seen from the validity of props and worksheet; practicality; the effectiveness; and student’s science processes skill. The props are tested by 34 students of class VIII SMPN 26 Banjarmasin. The research method was the ADDIE development model. The data collection techniques were through pretest-posttest, response questionnaires, and questionnaires of validation for 2 media expert and 1 learning expert. The result shows that the simple machines' props were highly valid criteria (4.225) and the worksheet had a valid criteria (3.85); the practicality of the props was considered practical based on student response with good category (benefit= 78.24, efficiency= 68.32, convenience= 73.87); The effectivity of the props was effective based on the N gain score with high criteria (0.69); and the student’s science processes skill had good criteria. The conclusion is the simple machines props is feasible to use as media to train and improving science processes skill of junior high school's students.

1. Introduction

Law No. 20 of 2003 on National Education System states that education is a conscious and well-planned effort to create an atmosphere of learning and learning process so that learners actively develop their potential to have spiritual power, self-control, personality, intelligence, noble character, as well as the skills that he needs, society, nation, and country [1]. There are things that need to be considered is to realize the learning atmosphere and the learning process so that learners can actively develop their potential. Students are required to play an active role in the learning process, not just centered on teachers or educators.

Learning is not only aimed at achieving learning success but also how the process of learners gain knowledge and can develop their potential. Meaningful learning is learning that makes students active in learning [2]. Teachers must develop student skills [3]. Process skills are trained in all chapters in junior high [4]. One of the chapters in junior high school is a simple machines prop.

Skills that must be possessed are basic science process skills that observe, measure, classify, predict, infer, and communicate [4-5]. Students desperately need the science process skills to learn about science and technology in detail [5]. The science process skills of students are the skills to discover, to verify, and to prove [6]. This is in line with the objectives of science learning, which equips students with the knowledge and develops students' skills from a scientific approach (Science Process Skills) [7-8].

Researchers have made observations during the field experience program at SMPN 26 Banjarmasin. This occurred in mid-August to mid-November 2016 and the results of interviews on February 8, 2017. Results show that the learning process conducted in the classroom is only centered
on the teacher so that students only receive information provided by the teacher without an active role in the learning process. Students are not accustomed to practicum or use laboratory tools in learning. So the students' science process skills have not been trained.

Therefore, researchers feel the need to trained SPS to learners to explore and develop its potential, it takes a medium of learning that can facilitate SPS. The medium is a simple aircraft prop. Teachers can use teaching aids in learning so that students learn to gain hands-on experience in building their knowledge [9]. The use of instructional media in the learning process can support teachers in trained SPS. The selected learning media is simple aircraft props media is the subject of the science lesson in junior high school class VIII.

The props are a picture of the work system of an object [10]. Props is a representation that connects theory and phenomena [11]. The props can make learning fun [12]. Props can explain more about concepts or theories or certain ways of working that are used in the learning process [13]. Props can help teachers clarify the teaching materials are provided to students so that students can easily understand what is described by the teacher [14].

The authors will describe simple machines props to practice the science process skills of junior high school students. The research questions in accordance with the formulation of these common problems are as follows: (1) How the validity of simple machines and student's worksheet props are developed? (2) How practical the props of simple machines are developed? (3) How is the effectiveness of simple tools developed? (4) How is the student's science process skill?

2. Methods
Type of research conducted by the author is a research and development. Research and development is a research method to produce a specific product and test the effectiveness of the product [15].

The steps of this research are using the ADDIE model. The ADDIE model is a model of systematic learning design consisting of five stages (Analyze, Design, Development, Implementation, Evaluation). The selection of this model is based on the consideration that this model is developed sequentially and based on the theoretical foundation of instructional design. This model is structured in such a way with systematic sequential activities to solve learning problems related to learning resources that are appropriate to the needs and characteristics of learning [16].

The first stage is the analysis. Researchers analyzed issues related to low learning interest and low student activity in the learning process. Then, learning media simple machines are still very simple and no updates. Thus, developing props simple machines can be a solution.

The second stage is the design. Researchers designed simple machines. The props are designed in accordance with the learning objectives or basic competencies that exist in simple machines materials.

The third stage is the development. Researchers develop learning media in the form of simple machines props accompanied by student worksheets as guidance in the use of props.

The fourth stage is implementation, prior to field trial. Research subjects are simple tools. The object of research is the feasibility of props simple machines were tested on 34 students of class VIII SMP Negeri 26 Banjarmasin A school year 2016/2017.

The props of simple machines are considered feasible if they meet three aspects, namely aspects of validity, aspects of practicality, and aspects of effectiveness. The validity of simple machines and worksheets developed by researchers refers to internal validity that includes content and constructs validity, which is related to the suitability of props developed with the concept of the actual material. So, the media developed in accordance with the concept or principle or law or physical theory associated with simple machines. The validation instrument in this research uses a rating scale with the highest score 5 and the lowest value is 1. If it is less valid based on theory and suggestion from the validator, it is necessary to make the improvement to the props.

Practicality can be reviewed from whether the teacher can implement the learning that has been developed or not through the observation in the classroom when the implementation of teaching and learning activities have been implemented [17]. The props are said to be practical when they are usable and easy to use [18]. Akker states practicality refers to the level of consideration of
interventions that can be used and preferred under normal conditions by the user [19]. The practicality of simple machines is measured using a student response questionnaire. Questionnaire response student contains a statement with scale with choice strongly agree, agree, disagree, and disagree. Data analysis technique is descriptively quantitative with percentage technique. Assessment questionnaire responses students by taking the average results of respondents' assessment of students as users when compared with Table 1 [20].

| No. | Percentage | Criteria |
|-----|------------|----------|
| 1.  | 20.00 % < x ≤ 36.00 % | Not good |
| 2.  | 36.01 % < x ≤ 52.00 % | poor     |
| 3.  | 52.01 % < x ≤ 68.00 % | Good enough |
| 5.  | 68.01 % < x ≤ 84.00 % | Good     |
| 6.  | 84.01 % < x ≤ 100 %   | Very good |

A measure of success to achieve the learning objective of the process of relationship between students with teachers and fellow students in educational situations called the effectiveness of learning [21]. The effectiveness of props developed in this study is seen from the student gain-score data. The effectiveness of learning is the level of achievement of learning goals or students' learning completeness expressed in the average score of students and adjusted to the predefined criteria and indicators [22]. The effectiveness of props is seen from students' pretest and posttest in the form of knowledge and skill aspect. Pretest and posttest analyzes have been widely used in assessments in education [23]. Learning outcomes in the form of knowledge aspects were observed using the N-gain test.

| Gain Score | Category |
|------------|----------|
| (<g>) > 0.7 | High    |
| 0.3 < (<g>) < 0.7 | Medium |
| (<g>) < 0.3 | Low     |

Analyze the results of students' science process skills by calculating and categorizing the percentage of scores on their science process scores. The skills of the scientific process are limited to 4 aspects of observing, trying, reasoning, and communicating. The science process skill category is also shown in Table 1.

3. Result and Discussion

Research and development that has been done by the researcher produce a product in the form of props of simple machines with worksheet manual of props usage. Simply developed auxiliary props aimed at training students' SPS. Simple tool props are designed in such a way and packed in a box-shaped container and made of meranti wood for durability, easy to carry, and easy to store. Products resulting from research and development of simple machines props can be seen in Figure 1.
3.1. Validation of simple machines props
The simple machines props which the researchers developed are designed in such a way that they can be used to experiment on simple machines, consisting of lever or lever, pulley, and inclined planes. The validation results show that the tools of simple machines viewed from 3 aspects, this is as follows: the first aspect of conformity consisting of 3 indicator that is the purpose of learning, student, and learning resource. Second, quality aspect consists of 6 indicators that is material selection, innovation, endurance, multifunction, security, an efficiency of usage. Third, the usability aspect consisting of 3 indicators is developing potential, giving real experience, and supporting learning. The validation results of simple machines props can be seen in Table 3.

Table 3. The validation results of simple machines props

| No. | Aspect     | Average (X) | (%)  | Criteria |
|-----|------------|-------------|------|----------|
| 1.  | conformity | 20.5        | 4.10 | 82.00    | Good     |
| 2.  | Quality    | 31          | 3.88 | 77.50    | Good     |
| 3.  | Usability  | 33          | 4.12 | 82.50    | Good     |
|     | Validity   | 84.5        | 4.03 | 84.50    | Good     |

The conformity aspect on 1 indicator meets the category is very valid, and 2 indicators that calculated the validity value meet the valid category. This means that the developed props meet both suitability aspects. On the quality aspect, all indicators meet the valid category. In the aspect of usability 1 indicator has a very valid category and 2 indicators meet the valid category which means the developed props can be used. In this aspect, there is no revision or repairs to the development tools of simple machines developed.

Overall, the validity of the simple machines’ props developed by the researcher obtained the percentage of 84.5% which is included in the valid category or can be used with little revision, the revision is done in accordance with the suggestions from the validator in order to obtain better props than ever before. The use of props will make it easier for students to understand a concept[13], [25].

Thus, the props developed are expected to function as a learning media that can support the learning process, provide information, generate student motivation, trained SPS, and can improve students’ understanding of the material being taught.

3.2. Validation worksheet simple machines
The simple machines developed by researchers are equipped with student worksheets that serve as guidelines for the use of visual aids with the aim of assisting teachers and students in using props developed for experiments. Therefore, the validation process is also performed on the student's worksheet which includes 5 aspects.
Table 4. The result of validation of student worksheet

| No.  | Aspect                | Average | \(X\) | (%)  | Criteria |
|------|-----------------------|---------|-------|------|----------|
| 1.   | Eligibility of content| 16      | 4     | 80   | Good     |
| 2.   | Work procedures       | 4       | 4     | 80   | Good     |
| 3.   | Language              | 11      | 3.66  | 73   | Good     |
| 4.   | Question              | 4       | 4     | 80   | Good     |
| 5.   | Physical appearance   | 3.5     | 3.5   | 70   | Good     |
|      | Validity              | 38.5    | 3.83  | 77   | Good     |

The content eligibility aspect consists of 4 criteria that is the problem proposed in accordance with the purpose of learning, the activities undertaken can cultivate curiosity, the presentation of student's worksheet with drawings, and student's worksheet presented systematically. All of them are categorized so they can be used with small revisions. The revisions made are to adjust the experiment with the purpose of learning and delete the definition of operational variables on the student's worksheet.

The aspect of work procedure consists of 1 criterion that is effectiveness step work in observation. In this aspect, the existing criteria have a valid category that can be used with small revisions. Thus, the revision is done so that student's worksheet is better than before.

The language aspect consists of 3 criteria that are the use of language according to the enhanced spelling, the language used communicative and interactive, the sentence used is clear and easy to understand. All of them have valid validity values that allow for small revisions. Criteria included in the valid category is the use of language as per the enhanced spelling, the language used communicative and interactive, and the sentences used are clear and easy to understand. Therefore, a review and a little revision of some sentences and words in the student's worksheet was developed.

The aspect of the question consists of 1 criterion that are the suitability of the questions with the learning objectives in student's worksheet and lesson plan. The fourth aspect obtains a valid value so that a small revision is made. The revision is to improve the form of questions to fit the experiment.

Aspects of physical appearance that consists of 1 criterion of clarity of writing and drawing. The physical appearance aspect obtains a valid value or can be used with small revisions. In this aspect revisions or improvements are made by adding a clearer visual drawing tool in the student's worksheet.

Based on the above explanation, note that the student worksheets included in the category valid. Student's worksheet is very important that use the investigation activities in finding the physics concept can invite students to conduct the process of science activities [26]. Skills of students' science processes can be trained by utilizing worksheet-oriented science process skills equipped with supporting media such as visual aids [27]. So the student's worksheet developed by the researcher is very supportive of simple tools developed.

3.3. The practicality of props simple machines

The practicality of props of simple machines developed is determined based on the results of the assessment of the student response questionnaire. Questionnaire student response consists of 3 aspects with 21 statements namely, aspects of benefits, aspects of efficiency and convenience aspects with each aspect is divided into 7 statements.

Table 5. The result of the questionnaire of student response

| No.  | Aspect   | (%)     | Criteria |
|------|----------|---------|----------|
| 1.   | benefits | 78.24   | Good     |
| 2.   | Efficiency | 68.32  | Good     |
| 3.   | Convenience | 73.87 | Good     |
First, the benefits aspect includes 7 statements related to the benefits of visual aids in learning. In this aspect, there are 3 statements that received a response with very good category and 4 statements that received a response with a good category. The overall percentage of student responses to the benefits aspect of 78.24 are included in either category. Thus the props are developed can be perceived benefits both by students and teachers. The use of visual aids can help students to construct their own knowledge [9]. The props can clarify the concepts that teachers give to students [14] and attract students' attention in science lesson.

Secondly, the efficiency aspect consisted of 7 statements which all received good category responses. These statements include the efficiency of time and effort. In this efficiency aspect, all statements get good category responses. The overall percentage of student responses to the aspect of efficiency reached 68.32 value included in the good category, which means the developed tool has been perceived as efficient by students as respondents. The visual aids are able to optimize all the senses of the students by hearing, seeing, touching and using the students' minds [28].

Finally, the convenience aspect consisting of 7 statements contains statements relating to the ease of use of props. In the aspect of convenience, there are 1 statement categorized very well, and 6 other statements categorized well. Overall the student response on the convenience aspect has a percentage value of 73.87 included in either category. This means that developed props have been felt easy to use by students. The visual aids enable students to develop students' psychomotor creativity and skills to solve problems in simple machines[14].

The props can make students motivated and enthusiastic and can work together when experimenting [29]. Based on the results of research, both on the aspects of benefits, aspects of efficiency, as well as convenience aspects obtained that the practicality of simple machines props have reached the category of good which is the minimum limit of the feasibility of props developed. This shows that the props developed are easy to use as student respondents and can be said to be practical in its use during the learning process in class VIII A SMPN 26 Banjarmasin.

3.4. The effectiveness of simple machines props
The effectiveness of props of simple machines developed can be seen from the assessment of student learning outcomes through pretest and posttest calculated through the gain test. Based on the result of pretest which was attended by 34 students of class VIII A SMP Negeri 26 Banjarmasin, obtained data that no students can achieve minimum completeness criterion that is at least 70 that has been determined by the school, but based on posttest result done after learning process with props simple machines there are 17 students with a percentage of 50 that scores above the minimum completeness criteria and there are 17 students with percentage 50 who still have not reached the minimum completeness criteria.

The effectiveness of props is seen from the pretest and posttest values calculated using N-gain of 34 students. The calculation results show the overall N-gain score included in the medium category with a value of 0.69. Thus the simple tools developed props have fulfilled the feasibility of developing props on the effectiveness aspects with the medium category and can help students achieve learning objectives. The props can improve student learning outcomes [30-31].

3.5. Skills of the science process
Scientific process skills are essential in teaching the ways of constructing knowledge [8]. This is in harmony with the purpose of the lab, i.e. to form the concepts of physics and explain the various phenomena associated with the concepts studied [6]. If the teacher teaches natural science subject matter without the skills of the science process, then the teacher does not teach the true nature of science.
Table 6. Results of calculation of students' science process skills

| No | Aspect       | Meet | I | II | III |
|----|-------------|------|---|----|-----|
| 1  | Observing   |      | 88.24 | 87.50 | 86.76 |
| 2  | Trying      |      | 88.24 | 89.71 | 88.97 |
| 3  | Reasoning   |      | 75.74 | 82.35 | 76.47 |
| 4  | Communicating |  | 72.79 | 72.79 | 75.74 |
|    | Average     |      | 81.25 | 83.09 | 81.99 |

The development of simple tools is aimed to train students' science process skills. There are 4 aspects of science process skills that are trained in the development of simple tools of this tool are: observing, trying, reasoning, and communicating. The first aspect observed at the first meeting has the percentage of 88.24 and meeting 2 equal to 87.50 and third meeting 86.76. Despite the decline but the overall average value of the percentage on the observed aspect was 87.5 which was included in the criteria very well. Observation is very useful for the fulfillment of the curiosity of learners [32]. Students will also learn when observing the physical phenomena directly [33].

Then the second aspect is to try, at the 1st meeting the percentage is 88.24 and the second meeting is 89.71 and the last third meeting is 88.97. At the 2nd meeting to the 3rd meeting decreased the percentage by 0.74 but the average percentage value on the try aspect included in the very good criterion that is equal to 88.97. Experiments are detailed things that are planned to get data to solve a problem or test a guess [32]. Practicum using props will train students' skills using the scientific method [9]. So this Practicum will also develop students' science process skills [34–37].

The third aspect of the science process skill is the reasoning skill. At the 1st meeting obtained a percentage of 75.74 and meeting 2 of 82.35 and meeting 3 of 76.47. At the 1st meeting to the 2nd meeting, there is an increase in percentage later when to the 3rd meeting decreased. After averaging, the percentage of the reasoning skill is 78.18 which is included in either criterion. The reasoning is defined as a logical and systematic process of thinking from empirical evidence that can be studied to derive conclusions about knowledge [32]. The function of props is to bring messages from what the teacher tells the students [28]. So that students are able to analyze and reason according to what it finds.

The fourth aspect is communicating. Students are expected to explain the conclusions and data of the experimental results and can respond appropriately to other groups. The acquisition of the use of knowledge from students in a process to explain the process itself must be considered in the science lesson [3]. Communicating activities can be done by writing or telling about what is found in the activities of seeking information, reasoning and get the pattern [32]. Other learners can provide comments and suggestions or improvements from the results presented. At the first meeting obtained a percentage score for aspects of communicating as much as 81.25 meeting 2 of 83.09 and meeting 3 is the last meeting of 81.99. After averaging, the percentage score is 82.11 with very good criteria.

Research by another researcher that aims to know the feasibility of integrated IPA props to the improvement of SPS in the theme of separation of the mixture, it can be concluded that the learning media in the form of props developed can increase student's SPS [38]. SPS students which are an assessment of the process of learning activities in this study has been stated to obtain excellent results so that the props of simple machines developed can be said to be effectively used in the learning process. SPS has the following advantages [39]: (1) SPS can provide scientific stimulation, so students can understand the facts and concepts of science well; (2) making students work with science, not just telling or hearing stories about science. This is what causes students to become more active; and (3) SPS makes students learn the processes and products of science as well.

4. Conclusion
The researchers concluded that simple machines are suitable for use in trained students' science process skills. This is supported by: (1) The Simple Tools Teaching tool on Simple Works Materials for Junior
High School students is considered valid based on the validator's judgment with good criteria (4.225). (2) Practicality of Simple Tools in Simple Learning Materials for Junior High School Students who are developed are considered to be practical based on students' responses with good criteria (benefit = 78.24, efficiency = 68.32, convenience = 73.87). (3) The Effectiveness of Simple Tools in Simple Works Materials for Junior High School Students was declared effective based on gain score of measurement using pretest and posttest with medium criterion (0.69). (4) Simple tools developed tool can be declared to be able to trick the science process skill (SPS) to the students based on the average SPS score of students with very good criteria.

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