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Development of Student Activities Sheet Based on Problem Based Learning in Improving Mathematical Learning Effectiveness

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Abstract
The low effectiveness of mathematics learning is an indicator of the lack of activity of students in the learning process which has an impact on the low learning outcomes of students. Through the development of products based on problem-based learning activities students are expected to increase the effectiveness of mathematics learning. The research design used was the research on the development of Borg and Gall. The population in this study were all fourth grade students with a sample of two selected classes. The results of the study obtained a sheet of problem based learning based student activities that can be used to improve the effectiveness of mathematics learning. The difference test was obtained for the effectiveness of mathematics learning in the experimental class and the control class. Furthermore, the experimental class N-Gain was obtained by 0.64 with the medium category, while the control class N-Gain was 0.29 in the low category.
Keywords: student activity sheet, problem based learning, effectiveness.

1. Introduction

Education is important in the process of human life. To form humans to be individuals who have good personalities and have the ability to be able to compete in the current era. Through education, someone will be able to develop their own potential to the fullest. Carter (1959) education is the process of developing individual skills in community attitudes and behavior. Social processes in which a person is influenced by an organized environment, such as home or school, so that he can achieve self-development and social skills.

Mathematics is an important science for students. Sriwongchai et.al (2015) mathematics is the science of thinking and things that are important to increase the potential of thinking in the learning process. It is closely related to the effectiveness of learning carried out. The effectiveness of learning can be seen through many things, one of which is through the achievement of learning outcomes measured through student learning outcomes tests. Trianto (2009) revealed that knowing the effectiveness of learning can be done by giving a test, because the test results can be used to evaluate various learning processes.

In fact the effectiveness of learning in the context of mastering mathematics knowledge by students in the world is still low. This can be seen from the results of the PISA tests and surveys conducted in 2015 involving 540,000 students in 70 countries. The average score of all participating countries in the survey was 490. Of the 70 countries that took part in the survey there were 39 countries that scored below average. Including Indonesia which obtained a score of 386.

The low effectiveness of learning in the achievement of mathematics learning outcomes in Indonesia includes the mathematics learning class IV in the Raden Intan four-class teacher working group, Blambangan Umpu District, Way Kanan District, Lampung Province. From the observations, the average score of the odd midterm in the 2017/2018 academic year of 57.12 is still below the minimum learning completeness which is determined to be 65. The percentage of students completing the mathematics learning outcomes that achieve learning completeness is at least 52 % or 80 students from 153 students.

Based on the results of observations, several things that led to the low effectiveness of students' mathematics learning are (1) mathematics learning that is still teacher-centered, (2) students have not been actively involved in learning, (3) the use of learning models that have not been appropriate, and (4) the student activity sheet used has not supported students to be active in learning activities.

Looking at the above problems, it is necessary to improve the learning process to improve the effectiveness of students' mathematics learning. Improvement of the learning process is carried out by creating an atmosphere of learning that is centered on students, so that they are active in learning activities. The teacher is no longer a center of learning, but a facilitator. To create an atmosphere of learning can be done by choosing the right learning model and improving the activity sheet of students used.

The problem based learning model is a learning model that presents contextual problems so that it stimulates students to be actively involved in learning. Savery (2006) revealed that problem based learning is learning with a student-centered approach to empower students to conduct research, integrate theory and practice, and apply knowledge and skills to develop viable solutions to defined problems. Through a problem-based learning model will train active students and develop their skills in problem solving. Arends (2007) revealed that problem based learning consists of five steps, namely (1) the orientation of students on the problem, (2) organizing students to learn, (3) guiding individual investigations and groups (4) developing and presenting the work, (5) analyze and evaluate the problem solving process. Through the activities contained in the problem

based learning learning model, it is expected to increase the effectiveness of students' mathematics learning. As the results of Fatade's research (2013) suggest the use of problem based learning as a learning strategy to improve student performance in both cognitive and non cognitive outcomes. Furthermore, the results of the study by Padmavathy & Marees (2013) show that problem based learning has an effect on knowledge content, by giving students greater opportunities to learn with more involvement and increase active participation of students.

As with the above problems besides choosing the right learning model, improvements to the student activity sheets that are used also need to be done. The student activity sheet is a teaching material that can be used by the teacher in the learning process to create an active learning atmosphere. Sands & Ozcelik (1997); Atasoy & Akdeniz (2006) in Celikler (2010) a sheet of student activities is defined as written material that contains the necessary process steps and helps students to configure knowledge and gives students full participation in classroom activities. Through the student activity sheet with the guidance of teacher guided students to carry out learning activities. So that the teacher is no longer a learning center but as a facilitator for students in conducting learning activities. The results of the Podolak and Danforth study (2013) show that by using the activity sheet students are able to provide experience to students, the activity sheet of students makes students learn more actively and overcome learning difficulties of students. Furthermore, the results of the study by Toman et al. (2013) show that the activity sheet consisting of the material of individual activities of students is carried out when learning a topic. Allows learners to take responsibility for their own learning with the steps and processes given related to the activity.

Based on the explanation above, choosing the right learning model and improving the students' activity sheet to create the effectiveness of mathematics learning is something that needs to be done. This can be done by collaborating the problem based learning learning model with the student activity sheet. Thus, this study aims to (1) realize the problem-based learning activities sheet of students in increasing the effectiveness of mathematics, and (2) find out the differences in learning effectiveness of students who use problem based learning student activity sheets with those who do not use participant activity sheets problem based learning based students.

2. Methodology

The research method used in this study is the research and development of Borg and Gall (1989) which consists of 10 steps, namely 1) Preliminary Information Research and Collection, 2) Planning, 3) Early Product Development, 4) Early Trial, 5) Revision Main Products, 6) Small-Scale Field Tests, 7) Revision of Operational Products, 8) Large-Scale Field Test, 9) Final Product Revisions, and 10) Implementation.

The population in this study were fourth grade students of elementary school in the Raden Intan IV group working group of 153 students. The sample selection in the study was conducted with multi stage random sampling, the sample selected as a fourth grade student of SDN 01 Sidoarjo consisting of 2 classes namely IVA as the experimental class and IVB class as the control class, each of which consisted of 20 students.

Data collection techniques used in this study are non-test and test techniques. The research instruments used were questionnaires and test questions about student learning outcomes. Questionnaires are used to obtain product validation data for developing problem based learning based student activity sheets. Validation data was obtained through expert and teacher validation tests, validation was carried out on components of several aspects which included material, media, and language. The learning outcome test problem is used when carrying out the implementation stage through experimental activities at the pretest and posttest. The results of the pretest and posttest were tested for the normality and homogeneity of the data. After knowing the normality and homogeneity of the data, the t-test of the two samples was then carried out to find out the effectiveness of learning in the experimental class and the control class. Furthermore, to find out the magnitude of the increase in learning effectiveness, a normalized N-Gain test was conducted. Hake (1998) gain test is calculated manually with the following calculation formula.

(g) =(% (Sf) -% (Si)) / (100 -% (Si))

Information:

(g) = Gain normalized

(Sf) = Posttest score

(Si) = Pretest score

Furthermore, the Category of N-Gain according to Hake (1998) is as follows.

Table 1. Category N-Gain

Average N-Gain	**Category**
N-Gain ≥ 0,7	Height
0,7 > N-Gain ≥ 0,3	Medium
0,3 >N-Gain	Low

3. Results

3.1 Collection of Materials and Preparation of Initial Products

3.1.1 Research and Collection of Initial Information

The initial research and information gathering was carried out through observation and questionnaires. From the results of observations and questionnaires, it was found that the effectiveness of learners' mathematics learning was still low and needed the development of a sheet of activity based on basic problem learning.

3.1.2 Planning

Some of the activities carried out from the planning stage are the first defining the skills learned is done by determining the basic competencies that will be developed into sheets of activities based on problem based learning. The basic competencies chosen to be developed are "Explaining the personal data of students and their environment which are presented in the form of bar charts", and "Collecting the data of students and their environment and presenting in the form of bar charts". The second formulates learning objectives derived from selected basic competencies which previously made indicators. The third determination of the sequence of learning is done by determining the learning activities according to the order of the learning objectives that have been determined according to the steps of problem based learning.

3.1.3 Development of the Initial Product Format

In the initial product format development activities carried out three main activities, namely the first preparation of learning material carried out by collecting learning material about "Data Processing" obtained from books supporting learning and from internet media. In addition to collecting learning material researchers also collected images sourced from the internet, images that have been used can be used so that a sheet of student activities can be drawn and clarified the material presented in the student activity sheet.

The second is to arrange the product done by compiling part by section. The product development sheet of student activities that have been compiled consists of (1) cover page, (2) introduction, (3) instructions for using student activity sheets, (4) graduate competency standards, (5) core competencies, (6) list content, (7) basic competencies, (8) learning indicators and objectives, (9) steps for learning problem based learning, (10) concept maps, (11) learning activities, (12) summaries, (13) evaluations, and (14) references.

The third composes an evaluation instrument that is used to evaluate the student activity sheet that has been compiled. The evaluation instrument used was in the form of a questionnaire valid in the form of student activities that were arranged using a Likert scale. The questionnaire consists of 5 answer choices, namely 1, 2, 3, 4, and 5, each of which states very lacking, lacking, sufficient, good, and very good that is used to assess the quality of the student activities developed. Questionnaire for validation of the participants' activities sheet consists of three validation questionnaires, namely material validation questionnaire, language validation questionnaire, and media validation questionnaire.

3.1.4 Early Trials

The initial test was conducted by validating the product sheet of student activities based on problem based learning. Product validation was carried out on three aspects which included material, media, and language conducted by three expert lecturers who had competencies and backgrounds in accordance with the validated aspects.

Validation by material experts is done to get assessment, suggestions, and conclusions on the material found in the product development. A sheet of student activities based on problem based learning has been prepared whether it can be used or not. Material validation in this study was conducted by Dr. Alben Ambarita, M, Pd. as Postgraduate Lecturer at Lampung University. The results of the first material validation expert obtained a value of 36 with a fairly good category. The suggestions given are (1) the material is adjusted to tujan indicator, (2) syntax is adjusted to problem based learning, (3) Use images that are in accordance with indicators, (4) practice viewing activities per meeting, (5) improve sentence structure . The material expert concluded that the student activity sheet prepared could be used with revisions.

Media validation is done to get the assessment, suggestions, and conclusions on the media found in the product development sheet of student activities based on problem based learning that has been prepared whether it can be used or not. Media validation in this study was conducted by Ms. Dr. Dwi Yulianti, M, Pd. as Postgraduate Lecturer at Lampung University. The results of media expert validation obtained a score of 129 with a very good category. The advice given is "very good and feasible to use". Media experts conclude that a set of student activities arranged can be used with revisions.

Language validation is done to get ratings, suggestions, and conclusions on the language found in the product development sheet of activity based problem-based learning that has been prepared whether it can be used or not. Language validation in this study was conducted by Dr. Mulyanto Widodo, M, Pd. as Postgraduate Lecturer at Lampung University. The results of the linguist validation obtained a score of 40 with a good sagat category. The advice given is "please correct the language used". Linguists concluded that the student activity sheet prepared could be used with revisions.

3.1.5 Revision of Main Products

Product revisions are based on suggestions for improvements from material, media, and language validators. Product revisions made on the product development of student activities based on problem based learning as a whole are (1) improvement of material adapted to the indicator indicator, (2) syntax improvement adapted to problem based learning, (3) improvement in the use of images that are suitable for indicators, (4) improvements to practice questions in accordance with learning activities per meeting, (5) reading the language used.

3.2 Empirical Trials

3.2.1 Small Scale Field Test

Small-scale field tests were conducted on six grade IV elementary school teachers to assess the product development of a sheet of student activities based on problem based learning which included material, media, and language. The results of the small scale field test obtained an average material test score of 43 in the good category, the average media test score was 125 with a very good category, the average score of the language test was 39 with a very good category of comments and suggestions for improvements given in small scale trials are (1) the material is good but needs to be adapted to the environmental conditions of the students to be more relevant, (2) add images to make them more interesting, (3) the language used is good but needs to be translated into double letters.

3.2.2 Revision of Operational Products

Based on a small-scale field test the product revision was carried out with a number of comments and suggestions given. Product revision is done by making improvements namely the material adapted to the environmental conditions of the students, adding images to be more attractive, and improving writing on double letters. The conclusions of small-scale field tests are the student activity sheets that are arranged can be used with revisions.

3.2.3 Large-Scale Field Test

A large-scale field test was conducted on twelve grade IV elementary school teachers to assess the product development sheet of student activities based on problem based learning which included material, media, and language. The results of the small scale field test obtained an average material test score of 49 in the good category, the average media test score of 127 with a very good category, the average language test score of 43 with a very good category. Comments and suggestions for improvements given to the broad-scale trial are "LKPD based on problem-based learning is good and feasible to use".

3.2.4 Final Product Revisions

The results of a broad-scale trial show that the product development sheet of student learning activities problem-based learning is good and feasible to use and there are no suggestions for improvements to the product. So that at the revision stage the final product is not repaired.

3.2.5 Implementation

The implementation phase was carried out through the experimental activities of pretest-posttest control group design at SDN 01 Sidoarjo. The research sample as an experimental class is IVA class which amounts to 20 students. The research sample as a control class was IVB class which amounted to 20 students. At the implementation stage the researcher obtained data from the pretest and posttest conducted on the experimental class and the control class. The following are presented data from the pretest of the experimental class and the control class.

Table 2. Data on Pretest Results of Experimental Classes and Control Classes

Class	Number of Students	Average Value	Category	Complete	
				Total	(%)
IV A (Experiment)	20	37.25	Need Guidance	0	0
IVB (Control)	20	36.00	Need Guidance	0	0

The table above shows the results of the experimental class pretest and control class did not differ significantly. It can be seen from the average value obtained by both classes, namely 37.25 for the experimental class and 36.00 for the control class with the same category namely "Need Guidance", with the percentage of completeness of 0% each. So that it can be continued to carry out experiments on the two groups. The following table presents the results of the experimental class and control class posttest.

Table 3. Data on Posttest Results of Experimental Classes and Control Classes.

Class	Number of Students	Average Value	Category	Complete	
				Total	(%)
IV A (Experiment)	20	77	Good	19	95
IVB (Control)	20	60	Need Guidance	8	40

The table above shows the results of the posttest of the experimental class and the control class differ significantly. It can be seen from the average value obtained by both classes, namely 77 for the experimental

class with the categories "Good" and 60 for the control class with the category "Need Guidance", the number of completeness of the experimental class as much as 19 or 95% while the total completeness of the control class as many as 8 or 40%. So that it can be concluded that the product sheets of student activities developed can improve the effectiveness of mathematics learning for fourth grade elementary school students.

The pretest and posttest results of the experimental class and the next control class were tested for normality and homogeneity. The results of the normality test obtained L0 (0.1487) <Label (0.190) which means the data are normally distributed. In the control class L0 (0.1120) <Ltabel (0.190) which means the data is normally distributed. The homogeneity test results obtained Fcount (2.554) <Ftable (4.09) which means the two samples have homogeneous variances.

After it is known that the data is normally distributed and homogeneous, the t test is carried out. The results of the t test are obtained tcount (3.79)> t table (1.69) which means there are differences in the effectiveness of learning between experimental classes using product development activities sheet based problem based learning and control classes that do not use the product development of student activity sheets problem based learning based on fourth grade elementary school students. Then the results of the N-Gain calculation obtained the value (g) of 0.64 with the medium category, while the control class obtained a value (g) of 0.29 with a low category.

4. Discussion

4.1 Development of Student Activity Sheets Based on Problem Based Learning

The development of problem based learning student activity sheets was focused on mathematics subjects in data processing material. The development refers to the steps of Borg and Gall development research which consists of ten steps, namely stage 1) Research and Initial Information Collection, 2) Planning, 3) Initial Product Development, 4) Early Trial, 5) Revision of Main Products, 6) Small Scale Field Test, 7) Revision of Operational Products, 8) Large-Scale Field Test, 9) Final Product Revisions, 10) Implementation. After going through the ten stages, the results of the products that have been tested and implemented are obtained which show that the products produced can be used. The results of testing the product are presented in the bar diagram below.

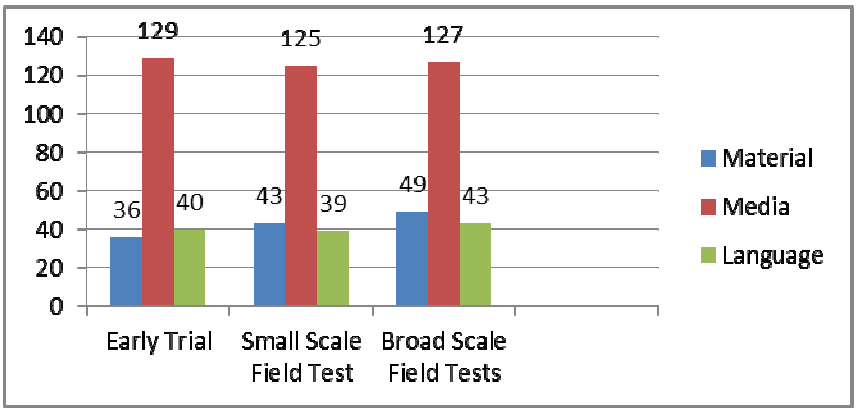

Figure 1. Product Test Results.

The bar chart above shows an increase from initial trials, small-scale field trials, and large-scale field trials. In the initial trial, the score of the material expert validation score was 36 with a fairly good category, the media expert validation score of 129 was very good, and the media expert's validation score of 40 was very good. In the small-scale field trials obtained scores of material validation of 43 with good categories, media validation scores of 125 with very good categories, and language validation scores of 39 with very good categories. The results of a large-scale field test obtained a material validation score of 49 with good categories, a media validation score of 127 with a very good category, and a language validation score of 43 with a very good category.

Meanwhile the implementation activities that have been carried out through experimental activities show that the learning outcomes in the experimental class are better than the control class which can be seen from the results of the N-Gain test. The experimental class N-Gain test results obtained a value (g) = 0.64 with a medium effectiveness improvement category, while the control class obtained a value (g) = 0.29 with a low effectiveness increase category.

4.2 Differences in the Effectiveness of Mathematics Learning

The difference in the effectiveness of learning is known by doing a difference test or t test on the results of the experimental class posttest and the control class. The difference test is conducted to find out whether the product that has been developed using problem based learning is more effective than the product sheet of activities of students who are not developed with problem based learning.

The results of the t test show that t_{table} (3.79)> t_{count} (1.69) which means there is a difference in effectiveness

of learning between experimental class students who use products developing a sheet of activity based on problem based learning with control class students who do not use development products sheet of problem based learning based student activities. This is reinforced by the results of research by Mellyani F, and Mitarlis (2015) which states that one of the learning media that can help students and teachers in the learning process is the activity sheet of students. Furthermore, the results of Tillman's study (2013) concluded that second-grade students who used problem based learning in the context of mathematics gained higher levels of activity and helped their classmates compared to traditional classmates.

5. Conclusions

The conclusion of this research and development is that the product development of the problem based learning based student activity sheet has been realized which can be used to increase the effectiveness of mathematics learning. In the experimental class that uses a sheet of activity based on problem-based learning to obtain better learning outcomes than the control class that does not use a problem-based learning activity sheet.

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