DEVELOPMENT OF LEARNING SET BASED ON SCIENTIFIC APPROACH IN THE TOPIC OF CIRCLE TO IMPROVE STUDENTS' MATHEMATICS LEARNING ACHIEVEMENT FOR JUNIOR HIGH SCHOOL GRADE VIII

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Abstract

This study aims to produce learning set using scientific approach which comprises lesson plan and student worksheet in the topic of circle to improve students' mathematics learning achievement for junior high school grade VIII which are valid, practical, and effective. Learning set using scientific approach consists of observing, asking, collecting information, associating, and communicating. Type of this study is research and development with ADDIE model, which includes Analysis, Design, Development, Implementation, and Evaluation. The instruments which are used in the research namely the evaluation sheets of learning set to measure validity, questionnaire of response from teacher, questionnaire of responses from students, and observation sheet of learning implementation to measure the practicality, and mathematics learning achievement test to measure the effectiveness of the learning set. This research produces learning set in the form of four lesson plan and one student worksheet. Learning set complies the validity criteria for lesson plan with the average score of 1.00 from maximum score of 1.00 for guttman scale and the average score of 4.15 from maximum score of 5.00 for likert scale, while for student worksheet with the average of 4.21 from maximum score of 5.00. Learning set complies the practicality criteria with the average score of 4.44 for the questionnaire of respone from teacher, 4.15 for the questionnaire of responses from students, from maximum score of 5.00, and the average percentage of 93.33% from maximum percentage of 100% for observation sheet of learning implementation. Based on the results analysis of the mathematics learning achievement test, learning set complies the effectiveness criteria, is indicated by the percentage of students completeness in minimum completeness criteria of 87.10%.

Keywords: scientific approach, learning set, mathematics learning achievement

INTRODUCTION

Education has an important role in the progress of a nation. One of indicator of educational success can be seen from the learning achievement.Learning achievement is the result that obtained by someone after studying, while learning is essentially a conscious effort that made by someone to fulfill their needs (Mulyasa, 2014 p.189). Arifin (2013 p.12) stated that learning achievement in general is about aspect of knowledge.

Learning achievement has several main functions, one of that main function is learning achievement can be used as an indicator of students ability to understand material/content. Trends International Mathematics and Science Study (TIMSS) and Program for International Student Assessment (PISA) are international studies on education in selected countries. According to TIMSS 2015 result, Indonesia received mathematics score of 397 where the average TIMSS score about 500, placing

Indonesia at rank 45 of 50 countries (Krisiandi, 2016). PISA result in 2015 shows that Indonesia's rank for mathematics is 63 from 70 countries. Based on the description, Indonesia is still classified as a country that has less satisfactory achievement if measured from TIMSS and PISA. More specifically, according to the National Education Standards Agency or *Badan Standar Nasional Pendidikan* (*BSNP*), students ability to understand material/content of mathematics in 2016 national exam at the junior high school level also declined from the previous year, particularly in geometry. According to *BSNP*, in national level, students ability to understand material/content of mathematics in 2015 national exam at the junior high school level on geometry is 50.04%, while in 2016 for junior high school level is 47.19%.

One of the factors that influence the learning achievement is the instrumental factor (Mulsaya, 2014 p.190-191). The instrumental factor refers to the qualifications and completeness of the necessary tools. One of the required tools is learning set. Learning set is something or some preparations that prepared by teacher in implementation and evaluation so that learning can be done systematically and get result as desired (Nazarudin, 2007 p.113).

Lesson Plan (RPP) and Student Worksheet (LKS) are component of learning set. Trianto (2008 p.148) stated that student worksheet (LKS) is a guide for student that is used to do investigation activities or problem solving activities (Nurdin & Adriantoni, 2016 p.111). LKS is made by paying attention to RPP that has been made. Lesson plan is a plan that describes the procedure and organizing the learning to achieve one basic competency that applied in the Content Standards or *Standar Isi* and has been described in the syllabus (Majid & Rochman, 2015 p.261).

A good learning set needs to pay attention to several things. According to Rochmad (2012 p.68) the quality of learning set can be seen from 3 aspects, aspects of validity, aspects of practicality and aspects of effectiveness. A good lesson plan should be prepared by fulfilling terms according to Regulation of the minister of education and culture or *Peraturan Menteri Pendidikan dan Kebudayaan* No. 81 A in 2013 about requirements of lesson plan i.e. identity of RPP, indicators and learning objectivities, material, learning model/method, media/ learning resources, learning activities, and assesment. Darmodjo & Kaligis (1992 p.41-46) stated that a good student worksheet should be prepared by fulfilling 3 terms i.e. didactic requirements, construction requirements, and technical requirements.

Based on observation at *SMP Negeri 7 Bojonegoro*, RPP and LKS that used by math teachers, didn't indicate steps to assist

students in constructing the knowledge. RPP that was used by teacher is RPP with tecaher-centered learning, while LKS that was used is the form of material summary and exercises. Students become difficult to understand the material that was taught and the result is low mathematics learning achievement.

One way to understand the material is from the experience that was gained by students. One of approach that can be used is scientific approach. Hosnan (2014 p.34) stated that learning using scientific approach is process of learning that is designed in such a way that students can actively construct concepts, laws, or principles through the stages of observing, asking, collecting information, associating, and communicating (*5M*).

According to Daryanto (2014 p.59) the steps of scientific approach in the learning process include observing, asking, collecting information, associating, and communicating. Learning using scientific approach also has characteristics. That characteristics are student-center, involving the skills of science process in constructing concepts, laws or principles, involving potential cognitive processes in stimulating intellectual development, specially the skills of students' high order thinking, and can developing students character (Kurniasih & Sani, 2014 p. 33).

Mathematics topic of geometry that can be approached by scientific approach, one of them is circle. Based on the previous explanation, it is necessary to develop learning set based on scientific approach in the topic of circle to improve students' mathematics learning achievement of junior high school grade VIII.

RESEARCH METHOD

The type of research is Research and Development. This study is focused on the development of learning set using scientific approach in the topic of circle to improve students' mathematics learning achievement. Products are lesson plan (RPP) and student worksheet (LKS).

This research was conducted at SMP Negeri 7 Bojonegoro in class VIII year 2016/2017. Data retrieval was conducted in May 2017.

Subject of this research is students of class VIII G *SMP Negeri 7 Bojonegoro* that consist of 31 students.

This research want to know the use of RPP and LKS based on scientific approach in the topic of circle to student's mathematics learning achievement. Researcher uses development model ADDIE which consists of 5 steps: Analysis, Design, Development, Implementation, and Evaluation.

Instruments which are used in the research are the evaluation sheets of

learning set (RPP and LKS) to measure validity, questionnaire of response from teacher, questionnaire of responses from students, and observation sheet of learning implementation to measure the practicality, and mathematics learning achievement test to measure the effectiveness of the learning set.

The data analysis in this study aims to describe the validity, practicality and effectiveness of the learning set using scientific approach. Analysis of data validity is through calculating the average score then the average score is converted to a scale of 5. References of conversion score to a scale of 5 scale are based on Widoyoko (2009 p.238) that are presented in the following table.

Table 1. Conversion Score on a Scale of 5

Formula	Category
$X > \overline{X}_i + 1{,}8 \times sb_i$	Very Good
$\overline{X}_i + 0{,}6 \times sb_i < X \leq \overline{X}_i + 1{,}8 \times sb_i$	Good
$\overline{X}_i - 0{,}6 \times sb_i < X \leq \overline{X}_i + 0{,}6 \times sb_i$	Good Enough
$\overline{X}_i - 1{,}8 \times sb_i < X \leq \overline{X}_i - 0{,}6 \times sb_i$	Bad
$X \leq \overline{X}_i - 1{,}8 \times sb_i$	Very Bad

Description:

$\overline{X}_i$ = ideal average

= $\frac{1}{2}$ (ideal maximum score + ideal minimum score)

sb_i = standar deviation

= $\frac{1}{6}$ (ideal maximum score − ideal minimum score)

X = average score obtained

For guttman scale, ideal maximum score is 1 and ideal minimum score is 0 (Sugiyono 2016 p.139), while for likert scale, ideal maximum score is 5 and ideal minimum score is 1. Thus, we get the classification of learning set validity as follows.

Table 2. Criteria of Product Validity for Guttman Scale

Interval	Category
$X > 0.8$	Very Good
$0.6 < X \leq 0.8$	Good
$0.4 < X \leq 0.6$	Good Enough
$0.2 < X \leq 0.4$	Bad
$X \leq 0.2$	Very Bad

Description: X = average score obtained

Table 3. Criteria of Product Validity for Likert Scale

Interval	Category
$X > 4.2$	Very Good
$3.4 < X \leq 0.8$	Good
$0.4 < X \leq 0.6$	Good Enough
$0.2 < X \leq 0.4$	Bad
$X \leq 0.2$	Very Bad

Description: X = average score obtained

Practicality analysis was done by analyzing the results of the questionnaire from students, questionnaire from teacher, and observation sheet of learning implementation. The analysis of the questionnaire responses from students and teacher were performed by calculating the average score then the average score is converted according to Table 4.

Table 4. Criteria of Product Practicality based on the questionnaire from students and teacher

Interval	Category
$X > 4{,}2$	Very Good
$3{,}4 < X \leq 0{,}8$	Good
$0{,}4 < X \leq 0{,}6$	Good Enough
$0{,}2 < X \leq 0{,}4$	Bad
$X \leq 0{,}2$	Very Bad

Description : X = average score obtained

The analysis from observation sheet of learning implementation was performed by calculating the percentage average score, then the percentage average score is converted according to Table 5 based on Sudjana (2005 p. 118). Score for "yes" is 1 and score for "no" is 0.

Table 5. Criteria of Product Practicality based on the learning implementation

Interval Percentage	Category
$k \geq 90$	Very Good
$80 \leq k < 90$	Good
$70 \leq k < 80$	Good Enough
$60 \leq k < 70$	Bad
$k < 50$	Very Bad

Description : k = average score obtained

Determination of criteria for the effectiveness of the learning set is by analyzing the results of test. Effectiveness of learning set is viewed from percentage of students' learning completeness (p) refers to Table 6. Student who achieves completeness criteria is student who can reaches Minimum Completeness Criteria or *Kriteria Ketuntasan Minimal* (KKM) that is applied in school i.e. 75. Forluma of percentage of students' learning completeness (p) as follows.

$$p = \frac{n_t}{n} \times 100\%$$

Description:

p = percentage of completeness criteria

n_t= a number of students who reach KKM

n = a number of students who follow the test.

Table 6. Criteria of Learning Completeness

Interval Percentage	Category
$86 - 100$	Very Good
$76 - 85$	Good
$60 - 75$	Good Enough
$55 - 59$	Bad
≤ 54	Very Bad

(Adaptation from Purwanto, 2013 p.103)

Thus, the overall criteria for the determination of validity, practicality and effectiveness of the learning set for the topic of circle using scientific approach satisfy the following indicators: (1) the result of assesment by the validators indicate the minimum criteria for "good", (2) the results of the questionnaire of students, teacher, and observation sheet of learning implementation indicate the minimum criteria for "good", (3) the percentage of students who reach standard Minimum Completeness Criteria or *Kriteria Ketuntasan Minimal* (KKM) is more than

75% and the average test score of the class reaches more than KKM i.e. 75.

RESULT AND DISCUSSION

Description result of learning set development using ADDIE model.

Analysis

Step of analysis includes analysis of needs, analysis of curriculum, and analysis of student characteristics.

Analysis of needs is obtained through observation in the classroom. The result is learning in the classroom uses learning resources from book and LKS. LKS that is used is in the form of material summary and exercises. Presentation of material also does not lead students to construct their knowledge. Learning process is also focused on teacher so that students just listen in the learning activities. Therefore, learning set that can help students to construct their knowledge is needed. One of learning approach that can be used is scientific approach, where there are some activities that can help students actively to construct knowledge that they gained.

On the curriculum analysis obtained analyzing the basic competence or *Kompetensi Dasar* (KD) and developing of learning indicators referring to the curriculum 2013. Based on the analysis, researcher gets to know that learning process with 2013 curriculum is expected to provide five basic learning experiences to students, they are observing, asking, collecting information, associating, and communicating.

Analysis of students characteristics in this study was to determine the characteristics of junior high school students class VIII in general about the way students think. Based on the analysis of students characteristics shows that students are active learners, demonstrated by many questions from students and students' activity when answering the questions that were provided by teacher. However, students are not actively involved in constructing knowledge or concepts in mathematics learning. This situation causes students to learn math by memorizing the formula. Thus, the characteristic of students in the class is not actively involved in constructing knowledge and just memorizing the formula, so that students have difficulty to solve problems that require mathematics concepts. Based on the analysis of students characteristics, learning approach that is able to encourage students to actively construct knowledge in the learning process is needed. One of learning approach that can be used is scientific approach.

Design

The main intention of this step was developing the draft and making instruments. In the next step, this draft was reviewed. Preparation of RPP was used to

design a learning process in the classroom in order to make an effective teaching and reach the learning objectives. Each LKS is given an issue that will be resolved through the activity of the students. LKS also provide steps using scientific approach which include observasing, asking, collecting information, assosiating, and communicating. One of the indicators from learning using scientific approach is LKS. LKS is the activities of students in finding concepts of circle.

Instruments which are used in this study are the evaluation sheets of learning set (RPP and LKS) to measure validity, questionnaire of response from teacher, questionnaire of responses from students, and observation sheet of learning implementation to measure the practicality, and mathematics learning achievement test to measure the effectiveness of the learning set.

Development

Product development process is made according to the design of lesson plan and student worksheet using scientific approach to improve students' mathematics learning achievement.

At the development step, RPP and LKS have been validated by the validator. RPP. RPP and LKS are valid. RPP validation assessment is based on 7 aspects which refers to Regulation of the minister of education and culture or *Peraturan Menteri Pendidikan dan Kebudayaan* No. 81 A in 2013 about requirements of RPP. They are identity of RPP, determination of indicators and learning objectivities, determination of material, determination of learning model/method, determination of media/learning resources, learning activities, and assesment. Quality of RPP based on assessment by expert lecturer shows very good category with the average score of 1.00 from maximum average score 1.00 for guttman scale and good category with the average score of 4.15 from maximum average score of 5.00 for likert scale.

LKS validation assessment is based on 4 aspects which refers to Darmodjo and R.E. Kaligis about requirements of LKS. They are conformity with material/content, conformity with the didactic requirements, conformity with the construction requirements, and conformity with technical requirements. Quality of LKS based on assessment by expert lecturer shows very good category with the average score of 4.21 from maximum average score of 5.00.

At this step, some revisions were also made based on suggestions by expert lecturer.

Implementation

Implementation in this research is mathematics learning set implementation in

the school. This learning set is implemented in mathematics learning in class VIII F of *SMP Negeri 7 Bojonegoro*. Implementation in the school was conducted from May 10 until May 23, 2017. Mathematics learning was followed by 31 students of grade VIII G.

Learning activities begin with the preparation of students physically and psychologically and deliver learning objectives. Then, teacher was activating prior knowledge of students as preparation before studying the concept. Then, teacher invites students to join their group to solve problems in LKS. Furthermore, implementation of main activities uses scientific approach. First step is observing.Students observe problems in LKS.

In the second step, students aks directly to their group, their classmates, and teacher in the classroom if there are questions. In addition, in the LKS has provided a column to record any questions that arise after students observe previous problems.

The third step is students collect information related to the problems. At this step, students collect information by doing activities or by answering the questions. Then, at later step, students associate information that has been collected. With group discussion, students answer the questions in the LKS to build mathematics concepts in the topic of circle. In the last step, students communicate the results of their group discussion in front of the class. Students conclude the result of discussion related to the material being studied in the available column on the LKS.

The last activity is closing activity. Students solve individual tasks and communicate them in front of the class. Furthermore, teacher guides students to conclude learning today. Teacher closes learning by providing information about the next material and motivates students.

Based on the practical analysis consist of questionnaire of students responses, questionnaire of teacher response, and observation sheet of learning implementation, learning set that is used has practical quality.

Questionnaire from students response is based on 2 aspects about ease and assistance in using LKS. Students' responses to LKS that has been used show good category with average score of 4.15 from maximum average score of 5.00. Questionnaire from teacher is based on 3 aspects about material/content, RPP, and LKS. Teacher's response to learning set that has been used in learning shows very good category with the average score of 4.44 from maximum average score of 5.00. Observation sheet of learning implementation is based on 7 aspects about opening activities, main activities that

consists observing, asking, collecting information, associating, communicating, and closing activities. Based on results analysis of observation sheet of learning implementation during learning using RPP which have been developed shows very good category with percentage of 93.33%. There are several activities with average percentage about 6.67% that can not be done because some reasons, but that is not part of main activities which has to be done in learning.

Based on the effectiveness analysis of students' mathematics learning achievement test, learning set that has been used has effective quality. Briefly, the results of students' mathematics learning achievement test are shown in the following table.

Table 7. Analysis of Mathematics Learning Achievement Test

No	Calcukation	Score	
		Pre-test	Post-test
1	Lowest score	29	70
2	Highest score	61	91
3	Average Score	49.69	82.45
4	A number of students who achieve completeness criteria	0	27
5	A number of students who can't achieve completeness criteria	31	4
6	Persentage of completeness	0%	87.10%

Percentage of learning completeness of 87.10% shows very good category and the average score of students' mathematics learning achievement test of 82.45 shows good category.

Based on the results of the review of the validity, practicality, and effectiveness aspect, it can be concluded that learning set based on scientific approach to improve students' mathematics learning achievement has reached criteria of valid, practical, and effective.

Evaluation

Evaluation step is done by analyzing the errors and deficiency that occur during implementation process to be used as suggentions improvement of learning set. Improvements at this step are based on comments and suggestions of students and teacher whether written in the questionnaire or verbally delivered each time the learning is completed.

CONCLUSIONS AND SUGGESTIONS

Conclusions

Based on the results of data analysis and discussion that have been done on learning set using scientific approach to improve students' mathematics learning achievement, it can be concluded that: (1) learning set complies the validity criteria for lesson plan with the average score of 1.00 from maximum score of 1.00 for guttman

scale and the average score of 4.15 from maximum score of 5.00 for likert scale, while for student worksheet with the average score of 4.21 from maximum score of 5.00, (2) learning set complies the practicality criteria with the average score of 4.44 for the questionnaire of respone from teacher, 4.15 for the questionnaire of responses from students, from maximum score of 5.00, and the average persentage of 93.33% from maximum percentage of 100% for observation sheet of learning implementation, (3) Based on the results analysis of the mathematics learning achievement test, learning set complies the effectiveness criteria, is indicated by the percentage of students completeness in minimum completeness criteria of 87.10%.

Suggestions

Based on the results of the study, researcher suggests the following: (1) LKS that is used in learning should be able to assist students in constructing their knowledge, so that students can understand material/content very well, (2) learning using scientific approach at the step of collecting information, should not only search or find information on learning resources, but do activities so that students learn to construct knowledge from their experiences, (3) Proper time management is needed in learning activities so that learning set implementation can be carried out optimally.

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