DEVELOPING MATHEMATICS LEARNING EQUIPMENT USING INVESTIGATION APPROACH FOR JUNIOR HIGH SCHOOL STUDENT GRADE IX AT CURVED SURFACE SOLID MATERIAL.

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Abstract
The research aim is to descript the quality of Mathematics Learning Equipment using investigation approach for junior high school student gader IX at curved surface solid material. This is a R&D research using ADDIE development model which consists of five steps i.e. Analysis, Design, Development, Implementation, and Evaluation. Research instruments consist of assessment sheet (for lesson plan and student worksheet), students' response questionnaire, and student test sheet. Implementation step in this research was held in SMP N 1 Kalikotes, Klaten. The number of lesson plan and student worksheet developed in this research is six each. The learning equipment fulfill valid criteria by assessment from validators which scoring 3,52; 3,73; 3,65 in scale of 5. 75% students pass the student test with the average score was 72,64 which means the learning equipment meets effective criteria. Students' response questionnaire scored 4,26 average in scale of 5 which means the students worksheet fulfill very practical criteria.

Keyword: Learning equipment, investigation approach, curved surface solid

INTRODUCTION

Mathematics should be given to all students ranging from elementary school to senior high school in order to think logically, analytical, systematic, critical, and creative, as well as the ability to cooperate. The competencies required for students to have the ability to acquire, manage, and use information in order to survive in global era which is always changing, uncertain and competitive. Problems encountered in mathematics learning in Indonesia is the mastery of mathematics courses are still very poor. Low mastery of mathematics by students Indonesia is reflected in the poor performance of Indonesian students both of international level although at the national level. Indonesian student achievement at the international level is still lagging behind on comparison with other countries.

According to the TIMSS 2011, ranked Indonesian children perched on the top 38 of the 42 countries for math achievement, and occupy 40 of the 42 countries for science achievement. The average score in mathematics and science achievement are respectively 386 and 406, are still significantly below the average score internationally (Hari, 2012: 4).

Researchers listened TIMSS data in 1999, 2003 and 2007. Outstanding student mathematics achievement Indonesia respectively perched at position 34 of the 38 countries (score 403), 35 of 46 countries (score 411), 36 of 49 countries (score 397).

At the national level, implementation of the National Examination starts at the level of junior high school, mathematics along with three other subjects there are English, Bahasa Indonesia, and nature science tested in the national examination to measure students' graduation competency. Low competence of student mathematics Indonesia is also reflected in the results of national examinations. During several years, the lowest score of the junior high school examination achieved by mathematics.

Curriculum educational unit of mathematics courses has aspects of the following topics: 1) Numbers, 2) algebra, 3) geometry, and 4) Measurement Statistics and Opportunities mapping results junior high school math curriculum showed that the topic of geometry includes most aspects of a topic that is of 41%. Topics include algebra 37% of the aspects of the topic, numbers and statistics and a 15% chance of 7%. The solid geometry has been studied since elementary school, but it the students' ability in solving problems of three-dimensional still low. For example, sometimes students can not identify a square pyramid just because the presentation in the image requires a square shape into a parallelogram shape(BNSP).

In daily life the students actually meet many solid geometry forms, but in fact the students are still difficult to imagine it the space. The survey results Programme for International Student Assessment (PISA) 2000/2001 indicates that the student is weak in geometry, particularly in the understanding of space and form. As an illustration, students face difficulty in imagining a cube which is hollow inside. When associated with the applicable curriculum, geometry portion is plentiful but usually only taught as a memorization and calculation (Hendra Gunawan, 2006: 14).

With regard to learning geometry, described by Kerans (A. Kisworo 2000: 3), that the weakness of mastery of teaching geometry by students due to: 1) Teachers weaknesses to understand the concept, 2) The learning method applicated was less involving student activities, 3) Mistreatment learning books. The success of student learning is influenced by many factors, that can come from the students and from the teacher as a fasilitator. A teacher among others, must have sufficient competence as a manager of learning. A teacher who has the competencies expected to be better, and is able to create an atmosphere and an effective learning environment, so that student learning outcomes will be optimal. This is explained by Ruseffendi (1991: 8) that in addition to the factors that partly depends on the students, there are also factors that come from teachers, among other abilities (competencies), learning atmosphere and teachers as a learning center.

Curved surface solid is the material given in junior high school consists of cones, tubes and sphere. National examination results showed that students' mastery associated with Curved surface solid material needs to be improved. Measurement mastery of the material shown curved surface solid of national examinations of absorption issued BNSP in Table 1.1 below:

Ability tested	Absorption	
	Klaten	National
Determine the elements of solid geometry	67.57%	76,65%
Resolving the problem of the framework or net of solid geometry	89.99%	88,11%
Resolving the problem is related to the volume	57.48%	70,53%
Resolving the problem is related to the surface area	44.87%	63,93%

Addressing the problem of low quality of junior high school students' mathematical

understanding, we need an alternative learning approach that does not rely on memorization, but the meaning of the subject material and is able to improve student understanding. The existence of an approach to learning that changing views on how to acquire knowledge, ie from delivery formulas, definitions, procedures and algorithms into submission mathematical concepts are meaningful and useful context for students (Turmudi, 2008: 83). Learning is done with an approach that enables students can deduce logically; provide explanations using pictures, facts, properties and relationships that exist; estimating solutions; see the pattern of the problems presented in the study, filed conjecture, test it, and make generalizations; provides a valid argument in simple verification process that is an indicator of the ability of students.

One alternative approach to learning that can be selected is the investigation approach. Learning with investigation approach encourages students can work freely, encouraged to take the initiative, creative and active, self-confidence can be further increased (Setiawan, 2006: 9). Students can learn to work together, communicate with friends and also with teachers themselves, and learn to respect the opinions of others (Setiawan, 2006: 9). In addition, through the phases learning with investigation approach, students can observe the problems, see patterns, make conjectures and drawing conclusions from the results of the investigation (Setiawan, 2006: 10).

Investigation approach chosen from the many approaches to applied mathematics learning in the learning process of mathematics. investigation approach, the teacher's role as a facilitator only. Students in these learning methods are required and trained to be able to think for themselves, analyze themselves, and reach their own conclusions on the main points of the material based on the data provided by the teacher. Teachers help answer questions and serve students who are having difficulty.

In investigation approach the role of students is quite large, because the learning is no longer centered on the teacher, but the students. Based on this statement, then the Investigative Approach students have greater freedom in learning to develop all ideas and capabilities through the of investigation activities.

Implementation Approach in this study contained in the student worksheet form. The student worksheet that arranged by author, there are problem formulas that must be answered by the students based on structured measures contained in the student worksheet. Through student worksheet is expected of the students becomes easier to make conclusions and to understand a subject of mathematics given. The ultimate goal to be achieved which is to obtain a general conclusion from the material being discussed based on the student's own thinking.

Based on the description above the problem, the researchers felt the need for research on development of mathematics learning equipment with investigation approach.

RESEARCH METHODOLOGY

This research was a development (Research and Development). Products depeloped in this study a learning equipment which is based on investigation approach that consists of a lesson plan (RPP) and student worksheets (LKS) on the curved surface solid material. The development model used in this study is the ADDIE which consists of five stages: analysis, design, development, implementation, and evaluation.

Research Time and Place

This research was conducted at SMPN 1 Kalikotes, Klaten on December 3rd 2013-Deseber 15th 2013.

Research Subject

Respondents in this research were validator and students of SMP N 1 Kalikotes, Klaten Grade IX students.

Research Object

Research object of this study was a learning equipment that consist of lesson plans and student worksheets with investigation approach on curved surface solid.

Procedure

In this study, the products that will be developed include lesson plan (RPP) and student worksheets (LKS) on the curved surface solid material. The procedure will be adapted to the development of ADDIE development model which is described as follows.

1. Analysis

a. Needs Analysis

The aim of needs analysis stages was for knowing the problems that occur in mathematical learning material with curved surface solid material on junior high school students of grade IX so that required the development of a learning equipment.

b. Analysis Curriculum

Researchers analyzed the standard of competence, basic competences and achievement indicators of competencies in curves surface solid material as the basis for the development of a learning equipment. Then learning process conducted according to the learning objectives.

c. Students Characteristics Analysis

Students Characteristics Analysis was aimed in order to identify the student characteristics associated with the learning process on curved surface solid material.

2. Design

Based on the analysis stage result, researcher did several work i.e. make a draft of lesson plan and student worksheet, determine student worksheet title, developing student worksheet design.

3. Development

At this stage the researcher developed a learning equipment (lesson plan and student worksheet) based on draft that had been done before. Then the draft was evaluated and revised by preceptor lecturer. After that researcher meet a worksheet would be assessed by falidators (material expert and media expert) for validity assesment. Learning equipment validity assessment done using validity assessment sheet that contin several aspect i.e. material compatibility aspect, didactical aspect, construstional aspect, technical aspect, and investigation approach compatibility aspect. The learning equipment (lesson plan and student worksheet) was going to be approved as valid or revised until it got approval from validators and yield final products.

4. Implementation

Furthermore, learning equipment that have been approved as valid products buy material expert and media expert are printed in numbers for implementation stage. Then the find products were implemented in learning activity at school.

5. Evaluation

The next stage was the evaluation of learning equipment that have been tested. Evaluation was done by analyzing the data from the questionnaire responses of students to assess the practicality aspect and the student test results to determine the effectiveness of learning equipment product.

Data Analysis Technique

1. Learning Equipment Validity Analysis

The data obtained from the assessment sheet learning equipment for material experts and media experts analyzed with the following steps.

a. Calculating the average score of assessment resut from each aspects with formula.

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Information :

$\bar{x}$: The average score of the observed aspects

$\sum_{i=1}^{n} x_i$: Total score of each aspect observed

n : The number of item in each aspect

b. Converting the average score into qualitative data according to Table 1.

Table 1. Validity Criteria

Score Range	Category
$\bar{x} > 4$	Very Valid
$3{,}33 < \bar{x} \leq 4$	Valid
$2{,}67 < \bar{x} \leq 3{,}33$	Less Valid
$2 < \bar{x} \leq 2{,}67$	Not Valid
$\bar{x} \leq 2$	Very Not Valid

Information : $\bar{x}$ = the average score of each aspect.

2. Student Workseet Practicality Analysis

The data obtained were analyzed student questionnaire responses with the following steps.

a. Calculating the average score of each observed by formula

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Information :

$\bar{x}$: The average score of the observed aspects

$\sum_{i=1}^{n} x_i$: Total score each aspect observed

n : The number of item each aspect

b. Converting the average score obtained into qualitative criteria assessment scale of 5. To analyze the practicality of learning equipment, researchers used Table 2.

Score Range	Category
$\bar{x} > 4$	Very Practical
$3{,}33 < \bar{x} \leq 4$	Practical
$2{,}67 < \bar{x} \leq 3{,}33$	Less Practical
$2 < \bar{x} \leq 2{,}67$	Not Practica
$\bar{x} \leq 2$	Very Not Practical

Information : $\bar{x}$ = the average score of each aspect

c. Learning Equipments Effectiveness Analysis

The data used to measure the effectiveness of the learning equipment was test result after using the learning equipment developed by researchers. The test results are analyzed to determine student mastery learning students (individual) based on the standard value applicable mastery learning students in schools where research is conducted that is equal to 70. Furthermore, the calculation of the average test result data and converting it with Table 3. (Oemar Hamalik, 1989).

Table 3. Assessment of achievement test

The range of average value	Category
$85 - 100$	Very Effective
$70 - 84$	Effective
$55 - 69$	Less Effective
$40 - 54$	Not Effective
0-39	Very Not Effective

Results and Discussion

Based on data analysis techniques used by researchers, the overall quality of the learning equipment was described as follows:

1. Product Validity

Validity assessment was done by validators (material expert and media expret) using validity assessment sheet.

a. Student Worksheet by Material Expert

material expert assessed the student worksheet toward some aspects that are didactical, material quality, and compatibility with investigation approach. Each aspect was scored in score range 1 to 5. Te scoring result is shown in Table 4.

Table 4. Results of Material Experts Assessment

No	Aspects Rating	Scores	Category
1.	Didactical	3,5	Valid
2.	Materials Quality	3,81	Valid
3.	Investigation approach compatibility	3,66	Valid
Average Score		**3,73**	**Valid**

b. Student Worksheet by Media Experts

media expert assessed the student worksheet toward two aspects that are construction and technical aspects. The assessment result is shown in Table 5.

Table 5. Results of media expert assessment

No	Aspects Rating	Score	Category
1.	Construction aspects	3,77	Valid
2.	Technical aspects	3,5	Valid
Average Score		**3,65**	**Valid**

c. Lesson Plan Assessment

lesson plan assessed toward some aspects i.e. language, objectives, materials, compatibility with investigation approach, learning resources, and assessment. Is aspect was assessment using scoring 1 to 5. Lesson plan assessment result is shown in Table 6.

Table 6. Results of Lesson Plan Assessment

No	Aspect	Score	Category
1.	Language	3,75	Valid
2.	Learning Objectives	3,8	Valid
3.	Material	3,75	Valid
4.	Compatibility with the investigation approach	3,28	Less Valid
5.	Learning Resources	3,5	Valid
6	Assessment	3	Less Valid
Score Average		3,52	Valid

2. Student Worksheet Practicality

To determine the student worksheet practicality, resercher used student respond questionnairen that given after learning implementation. Is aspect scoring was using score range 1 to 5. The score obtined from the questionnaire is shown in Table 7.

Table 7. Results of Student Respond Questionnaire

No	aspect	Score	Category
1.	suitability language	4,25	Very Practical
2.	helpfulness	4,22	Very Practical
3.	display presentation	4,27	Very Practical
4.	Condition	4,42	Very Practical
	Average Score	**4,26**	Very Practical

The average score from students respond questionnaire is 4.26 so that according to table 2 the student worksheet satisfy very practical criteria.

3. Product Effectiveness

Rate the effectiveness of the learning equipment is based on the test scores after the implementation. The test results are shown in Table 8.

Table 8. The results of student test

test results		
students completed	21	percentage of completeness $= \frac{21}{28} \times 100\% = 75\%$
Students are not complete	7	
Student amount	28	
Average Score	72,64	

The percentage of students in the mastery achievement test was 75% with an average of 72.64 so by Table 3, the device is considered effective learning.

CONCLUSIONS AND SUGGESTIONS

Conclusions

Based on the assessment that has been done, it can be concluded the quality of the learning equipment with investigation approach was described as follows.

1. Review from the validity aspect, the learning equipment was approved to be valid. The validness was approved based on assessment result from validator. The lesson plan product had score 3,52 in scale satisfy valid criteria. The student worksheet had score 3,73 by material

expert and 3,65 by media expert both in 5 scale quotionnaire assessment which mean the student worksheet satisfy valid criteria.

2. In term of effectivenes, the learning equipment was approved to be effective based on the student test result which up to 75% student post the tes with 72,64 average score.

3. the review of practicality aspect, student worksheet satisfy very practical based on questionnaire respones that score 4,26 in scale of 5.

Suggestion

Suggestions given by researcher based this stude were described as follows.

1. The product of this research was a mathematics learning equipment using investigation approach could be used in mathematics learning activity at school especialy 9^{th} grade junior high school.

2. Readers or other researchers could conduct further study about mathematics learning equipment with any innovative learning method or approach implemented in other to improve student learning achievement.

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