

DEVELOPING A TEACHING KIT ON PYTHAGOREAN THEOREM WITH COMPUTER-ASSISTED MEDIA

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Abstract

This research is conducted in order to set up a mathematics learning kit for junior high school on Pythagorean theorem material with computer-assisted media, which is valid, practical, and effective in terms of students' learning achievement and mathematics self-efficacy.

This research is a developmental research consisting of four phases: define, design, develop, and disseminate. The subjects consisted: nine students in the small trial group and 30 students in the field trial group. The experiment was conducted at SMP Negeri 2 Banyubiru, Kabupaten Semarang. The instruments used in this research was a validation sheet, teacher assessment sheet, student assessment sheet, teacher activities observation sheet, student's activities observation sheet, and mathematics self-efficacy questionnaire. The data were collected from those instruments.

The results show that the developed learning kit is valid, practical, and effective in terms of students' achievement and mathematics self-efficacy scores. The developed kit consists of a syllabus, lesson plans, worksheets, and instructional media and according to expert's validation it is very valid. The evaluation of teachers and students, the observation of the activities of teachers and students show that the developed teaching kit is in the minimum practical criteria. At the end of the learning activities, a final test was administered and the questionnaire was done to see students' mathematics self-efficacy, and the results are 76.67% of the students obtained the final test score exceeding the minimum achievement criterion, and 83.34% of the students had a score of mathematics self-efficacy at high or very high criteria.

Keywords: *development, syllabus, lesson plans, worksheet, media, student achievement, mathematics self-efficacy.*

INTRODUCTION

Mathematics is one of subject which has great benefits in life. Mathematics provides the opportunity for students to practice their mental and will affect their intellectual development. Through mathematics, students will be able to learn to acquire knowledge systematically (Sunnetha, 2011: p.70).

Learning achievement is one important aspect of education in schools which can't be separated from the lives of students, however, student achievement in math is still low (Tamuri, 2005: p. 23). The low achievement in mathematic, occurs in the majority of the material being taught. One of them is in Pythagorean Theorem. It can be seen on the national exam results that show a relatively low rate, including in SMP Negeri 2 Banyubiru.

The problem of low learning achievement, the Pythagorean Theorem is a very important issue to be addressed since it is urgent material as one of the prerequisites for the other subject matter in math. Although this material is a prerequisite for the other materials, but based on the

observations of teacher in the classroom, some students are less interested in the subject matter presented by the teacher. These conditions indicate that the learning of mathematics in the classroom is less attractive. Therefore, teacher should create a fun learning in the math class.

Fun learning can improve students' achievement in mathematics, which is the main purpose of the teachers in the school. Teachers have responsibilities to develop and create meaningful, fun, creative, dynamic, and dialogical learning atmosphere. The development of teaching and learning process should lead the meaningful learning that can improve students' attitudes and interest in learning mathematics.

One implementation of meaningful learning can be done with the use of contextual teaching and learning approach (CTL). CTL is a learning approach that enables students to connect the content of academic subjects in the context of their daily lives (Johnson, 2010: p. 59). The syntax of CTL approach is abbreviated as REACT, relating, experiencing, applying, cooperating, and transferring (Crawford, 2001: p. 3; Souders, 1999; Masnur, 2008: p. 41). Relating is studied in the context of person's life experience or existing knowledge. Experiencing is learning by doing through exploration, find something that already exist (discovery), and invention. Applying is studied the concept by doing exercises using realistic and relevant material. Cooperating is a study in the context of sharing, responding to, and communicating with other students. Transferring is using the knowledge in the context of activities or a new situation, and building something based on knowledge of what has been known by students.

Contextual learning approach carried out by connecting or linking the existing knowledge with new knowledge. Through CTL as a meaningful learning approach, students are expected to have a better understanding of the subject matter. A good understanding will encourage students' self-confidence or belief in their ability in learning mathematics. The Confidence in the ability to learn mathematics is known as mathematics self-efficacy. Students who have higher mathematics self-efficacy will be better in completing math problems (Zimmermann, 2011: p. 3) the beliefs of math competence is an important factor to achieve success in learning mathematics.

Tait (2008: p.507) states that for mathematics teachers, insights of students' self-efficacy is a valuable tool. Tait says that it is important for educators to know how their learners feel, think, and act, about, within, and toward mathematics. Self-efficacy has the potential to facilitate or inhibit the motivation to learn mathematics, use of knowledge, and the setting for studying.

Zimmermann (2011: p. 3) states that mathematics self-efficacy indicate the belief of a person in his/her own competence to solve mathematical problems and tasks successfully. Furthermore, Hackett & Betz (Sengul, 2011: p. 2305) define mathematics self-efficacy as an individual's confidence in her or his ability to successfully perform or accomplish a mathematics task. The same thing is expressed by Anjum (2006: p. 63), mathematics self-efficacy was defined as an individual's judgement of his/her capabilities to solve specific mathematics problems. Belief in the self ability is essential to increase mathematics student achievement (Liu, 2009: p. 9). There are four concepts that can be measured to determine the mathematics self-efficacy, such as performance accomplishments, vicarious experiences, verbal persuasion, and physiological and emotional states (Bandura, 1995: p. 3; Bandura, 1977: p. 195, Margolis & McCabe, 2006: p. 219).

Based on the observations of researcher through preliminary studies, it show that students' mathematics self-efficacy of SMP Negeri 2 Banyubiru is on intermediate criteria and the students' achievement is still relatively low especially in the matter of Pythagorean Theorem. The problems of mathematics self-efficacy score and students' achievement need to be addressed for the purpose of learning mathematics. One effort that can be done to overcome these two problems and make math class more fun is to involve technology, especially

computers. The use of computers in learning can help students to develop basic skills and critical thinking skills (Moore, 2009: p. 53).

This research is conducted in order to set up a mathematics learning kit for junior high school on Pythagorean theorem material with computer-assisted media, which is valid, practical, and effective in terms of students' learning achievement and mathematics self-efficacy. The development of mathematics learning kit in this study includes syllabus, learning plan, student worksheet, and computer assisted media. Developed learning kit is equipped with a final test instruments and mathematics self-efficacy instruments which are used to determine the effectiveness of the products. Learning kit is a set of learning resources that allow teachers and students implement learning activities. Learning kit is designed and constructed to support the implementation of the learning process so that can achieve the expected goals (Omrod, 2003: p. 429).

The matter to be discussed in the classroom is the Pythagorean Theorem for eighth grade. According to Skemp (1971: p. 216), Pythagoreas' theorem: that in any right-angled triangle, if we draw squares on the three sides, the area of the square on the hypotenuse (the side opposite the right angle) is equal to the sum of the areas of the square on the other two sides.

METHODS

Types of Research

This is a research and development which develop a learning kit in mathematics with computer assisted media. These are include syllabus, lesson plan, student activity sheets, and media. The development models used in this research were 4-D models of Thiagarajan, Semmel, and Semmel. The experiment was conducted in October-November 2013. The subjects are eighth grade students of SMP Negeri 2 Banyubiru consisted: nine students in the small trial group and 30 students in the field trial group.

Procedure

The procedure in this research consisted of 4-D, which is explained in detail in the following steps.

1. Define, the purpose of this stage is to set and define the conditions of learning. Setting and defining the conditions of learning begins with an analysis of the purpose and limitations of the material. This level includes five principal steps: front-end analysis, learner analysis, task analysis, concept analysis, and specifying instructional objectives.
2. Design, the purpose of this stage is to design prototype instructional material. This phase can be started after the set of behavioral objectives for the instructional material has been established. The election of the media and the formats for the material and the production of an initial version are the major aspects of the design stage.
3. Develop, the purpose of this stage is to modify the prototype instructional material. At this stage two experts are asked to make a validation of the learning kit and the instruments of the first draft which has been prepared in the previous stage. The revision of the first draft is done based on feedback and suggestions are used to carry out a small trial group. The trials are conducted on a small group of nine students who perform assessments and provide suggestions for revising the development learning kit. Teachers also provide assessment and feedback to improve learning device. Results of revision at this stage are referred to second draft to be used for field trials. Field trials conducted in class VIII E which is randomly selected from five class in SMP Negeri 2 Banyubiru. Field trials conducted in seven meetings and closed with final test and mathematics self-efficacy questionnaires in the eighth meeting. The results of the final test and mathematics self-

efficacy questionnaires are analyzed to determine the effectiveness of the learning kit. If the effectiveness criteria have been met then the second draft can be used as the final product. But if it is not effective, it needs to be revised and re-conducted field trials.

4. Disseminate, is the final stage of the 4-D development models. Learning kit that has been developed into the final product is ready for use or applied to another class. However, in this research this last stage is not implemented.

Data and Instruments

The data in this research is qualitative and quantitative. The qualitative data is obtained from the mathematics self-efficacy questionnaire, while the quantitative data is obtained from the final test. The instruments in this research were classified into three types, each of which is used to measure the validity, practicality, and effectiveness criteria in terms of learning achievement and mathematics self-efficacy scores. Instruments which are used to measure the validity are a validation sheet of syllabus, lesson plan, student activity sheet, and media, as well as the final test validation sheet and mathematics self-efficacy questionnaires validation sheets. Instruments which are used to measure the practicality are the form of teacher's assessment sheets, the observation sheets of the learning implementation, and students' assessment sheets. Instruments which are used to measure effectiveness of learning outcomes are final test and the mathematics self-efficacy questionnaires.

Data Analysis Techniques

- a. Analysis of validity of the learning kit and mathematics self-efficacy instruments
The syllabus, lesson plans, student activity sheet, media, and mathematics self-efficacy sheet that have been validated then analyzed by descriptive or qualitative. The steps are performed to analyze the data using descriptive statistical techniques.
- b. Analysis of practicality
The analysis is conducted on the practicality of teacher assessment data, data of the observation sheet of learning activity, and student assessment data on small group trials and field trial.
- c. Analysis of the effectiveness of learning
Effectiveness analysis is conducted on the final test results as the student achievement and the results of the mathematics self-efficacy questionnaires.

RESULT AND DISCUSSION

Development Result

The results of this research is learning kit with computer-assisted media which is valid, practical, and effective in terms of student achievement and mathematics self-efficacy scores. Learning kit that are developed are syllabus, lesson plans, student activity sheet, and computer-assisted media. Validation of learning kit is done by two experts who provide an assessment of the developed learning kit and provide feedback or suggestions for improvement. The results of the experts' assessment show that all of learning kit is valid.

The practicality of the product is based on assessment by teachers as practitioners and by the students, and also by the results of observations of the activities in the class. As the results, it is known that the learning kit is on practical criteria. The effectiveness of learning kit in terms of student achievement and mathematics self-efficacy scores are in the effective criteria. More than 75% of students have exceeded minimum practical criteria. In addition, students who have mathematics self-efficacy scores high or very high category amounted 83.34%.

Results of Trial Product

1. Data of Expert Validation Results

Validation is conducted by two experts from mathematics education lecturers Yogyakarta

State University. Revisions were made based on feedback and suggestions given by them. The results show that the syllabus, lesson plans, student activity sheets, and media are very valid.

2. Data of Small Group Trial Results

Learning kit which is assessed by teachers is syllabus, lesson plans, student activity sheets, and media. Teacher assessment is used to determine the practicality level of learning kit. Teacher assessment results on small group trial showed that the development of learning kit have very practical criteria. The students' assessment results including assessment of student activity worksheets, media, and final test instrument are three students gave very practical criteria and six others gave practical criteria. The results of teacher activity observation are very practical criteria and students activity observations are practical criteria.

3. Data of Field Trial Results

Teachers' assessments towards the learning kit on the field trial showed that syllabus, lesson plans, student activity sheets, and media have very practical criteria. Student assessment is conducted after they follow the whole learning process. Students are asked to provide an assessment of student activity sheets, final test instrument, and media. The results are 30% of students assess highly practical and 70% assess practical. The results of the research are carried out observation in seven meetings in the field trials are on practical criteria for teacher activities. Students' activities are on practical criteria for the first meeting based on observer1, but for observer 2, the first and third meetings are on practical criteria, and the others meeting are very practical. Final test results showed that 23 of 30 or 76.67% of students have reached minimum practical criteria. The results of mathematics self-efficacy scores indicate that 6.67% of students have very high criteria, 76.67% of students have high criteria, and 16.67% of students have medium criteria.

Data Analysis of Trial Results

1. Data Analysis of Expert Validation Results

Experts' validation showed that the development syllabus has very valid criteria. The results of syllabus' validation were analyzed based on each aspect, namely 1) the formulation of standards competencies and basic competencies, 2) learning materials, 3) learning activities, 4) achievement indicators of competencies, 5) assessment, 6) time allocation, 7) learning resources/media. All of these aspects were on very valid criteria.

Results of lesson plans validation showed that the lesson plans were on very valid criteria. More clearly, the nine aspects of the lesson plans assessed are 1) the identity of subjects, 2) indicator formulation, 3) material selection, 4) learning method, 5) learning activities, 6) closing, 7) learning resources/media, 8) assessment, and 9) language, in which the sixth and the ninth aspects have valid criteria and the others have very valid criteria.

The analysis results of student activity sheets showed that for procedural activity aspect and questions aspect have valid criteria, while the other aspects have very valid criteria. The nine aspects of student activity sheets are 1) the identity and direction, 2) time allocation, 3) learning objectives, 4) tools and materials, 5) procedural activity, 6) display, 7) language, 8) contents, and 9) questions/problems.

The results of computer-assisted media assessment were very valid criteria. Assessment results per aspects for media, performance and the interactivity of media were very valid criteria.

2. Data Analysis of Small Group Trial Results

Teacher assessment of syllabus, lesson plans, and student activity sheets, and media on small group trial has very practical criteria. Assessment for lesson plan by assessor 1 gave maximum score for all indicators. Therefore, assessor 1 does not provide suggestion for lesson plans'

revision. Assessor 2 gave score of 4 (good) for four indicators and score of 5 (very good) for other indicators. Assessment for student activity sheets specified in 7 indicators. Assessor 1 gave score of 5 (very good) for 6 indicators, while indicator of language clarity used, he gave score of 4 (good). Assessment for media is basically good. Assessment results for media in small group trial were very practical. Analysis of the assessment results by nine students with diverse ability as a sample in small group trial was conducted to determine the practicality of developing learning kit.

Assessment of practicality of the learning kit was also conducted based on the observation of the activities of teachers and students. Observations carried out by math teacher. Teacher activity has 15 total score of 15 existing descriptors. This means that teachers teach in accordance with the expected steps in the learning plan and included in the very practical criteria. The activities of students seem only 5 of 8 descriptors and have practical criteria.

3. Data Analysis of Field Trial Results

In field trials, nearly all aspects of teacher assessment were very practical criteria. The media is also a very practical. Students' assessment towards student activity sheets and final test instrument is practical. The media has very practical criteria.

The results of teacher activities have very practical criteria for almost existing descriptors. The observation of student activity, there are some descriptors that do not seem at the first and the third meeting.

Product Revised

1. Syllabus Revised; Syllabus revised repairs the instrument indicator and improvement in the form of the writing error.
2. Lesson Plans Revised; Lesson plans revised include improvements in indicators, teaching materials, and homework questions.
3. Student Activity Sheet Revised; The revisions include indicator, repair work steps in the activities of finding Pythagorean Theorem, and improvements to the problems presented which provides more contextual problems.
4. Media Revised; some suggestions for the computer-assisted media are an improvement on image and in several writing error.

Final Product Study

Based on the validation experts' results, small group trial, field trial, and revision, as well as data analysis can be seen that the research is valid, practical, and effective in terms of student achievement and mathematics self-efficacy score.

1. Validity

Validity criterion is determined by expert assessments as an assessor which consists of two lecturers from Mathematics Education Yogyakarta State University. The assessment was conducted on the syllabus, lesson plans, student activity sheets, and media. The results of the validation and analysis of the data showed that the four learning kit that have been developed have very valid criteria.

2. Practicality

Practicality criteria determined by teacher assessment and student assessment, as well as data on the observation of teacher activities and students activities. Based on teachers' assessment, the learning kit is in very practical criteria. The results of assessment are 9 of 30 students state that the student activity sheet, final test instrument, and media are in very practical criteria, while 21 other state that these learning kit are in practical criteria.

The results of teacher observation showed that the learning process is very practical for entire meeting. The criteria for students' activities observation have practical and very practical. Based on the teacher assessment, students assessments, and learning activities observation, it

can be said that the development meets practicality criteria.

3. Effectiveness

a. Effectiveness in terms of student achievement

Effectiveness criteria in terms of student achievement that have been specified in this research are if the number of students who exceed minimum practical criteria for the final test is more than 75%. The results are 76.67% of the students obtained the final test score exceeding the minimum achievement criterion, so it can be said that this development research are effective in terms of students' achievement.

b. Effectiveness in terms of mathematics self-efficacy

Effectiveness criteria in terms of mathematics self-efficacy score hat have been specified in this research are if the numbers of students who have mathematics self-efficacy score in high or very high criteria are more than 75%. The results are 83.34% of the students had a score of mathematics self-efficacy at high or very high criteria, so it can be said that this development research are effective in terms of mathematics self-efficacy.

CONCLUSION AND SUGGESTION

Conclusion

The conclusion of this research are (1) the development of learning kit in this research such as syllabus, lesson plan, student activity sheet, and computer-assisted media have been validated by the experts and the result are very valid. (2) Practical criteria of the learning kit in this research such as syllabus, lesson plan, student activity sheet, and computer-assisted media have been exceed, as known from teacher assessment analysis, observation sheet of teacher and student activities, and student assessment analysis. (3) The development of learning kit in this research such as syllabus, lesson plan, student activity sheet, and computer-assisted media are effective in the term of student achievement and mathematics self-efficacy score and the results are 76.67% of the students obtained the final test score exceeding the minimum achievement criterion, and 83.34% of the students had a score of mathematics self-efficacy at high or very high criteria.

Suggestion

Based on the results and the conclusion, some suggestions for increasing mathematics lesson qualities are (1) teacher needs to make the students more active in math class, encourage students to ask questions, and answer all of the teacher's questions. (2) Teacher needs to emphasize the application of Pythagorean Theorem.

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