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## DEVELOPING INSTRUCTIONAL MATERIALS OF TANGENTS TO TWO CIRCLES USING MULTIMEDIA WITH PMRI APPROACH IN 8TH GRADES

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### Abstract

*This study aims to develop instructional materials in the form of tangents to two circles student worksheet and multimedia PowerPoint with PMRI approach which categorized valid, practical and have a potential effect on students' understanding of internal and external tangents concept in 8<sup>th</sup> grades of Senior High School 6 Kayuagung. The study consisted of two stages are preliminary and formative evaluation. In the preliminary stages performed analysis and design instructional materials according to characteristics and principles of Realistic Mathematics Education in Indonesia (PMRI). In the formative evaluation stages performed expert review, one to one, small group, and field test. Field test conducted in 8.2<sup>th</sup> grades of Senior High School 6 Kayuagung which class consisting of 33 students. Based on the analysis of the test is known that most students are having good concept understanding. Then also obtained the results of observational analysis of students' activity based on characteristics PMRI which are students active learning. It is identified that the instructional materials of tangents to two circles using multimedia with PMRI approach that has been developed meet the criteria valid, practical and effective.*

**Keywords:** instructional materials, multimedia, pmri approach, tangents to two circles

### INTRODUCTION

One of the goals of learning mathematics contained in the education unit level curriculum (KTSP) is to understand mathematical concepts, explains the relationship between concepts and apply concepts or algorithms, flexibly, accurately, efficiently, and appropriately, in solving the problem. There is competency standard (SKL) of secondary school which standards of competence are determine elements, parts of the circle and size, with one of the basic competencies that calculates the length of the tangents to two circles.

Iryanti (2012) states that the beginning concept of drawing on tangents is very important. Drawing the right tangents to two circles will allow students to apply the Pythagorean theorem to calculate the length of a tangent to two circles and generalize it into the general formula. After the students through this stage, they can already imagine which part is right-angled triangle and where the right-angled and the hypotenuse. If this does not happen emphasized that students often have problems deciding which side of the right-angle and the hypotenuse.

Based on the results of interviews with one of the mathematics teacher in Senior High School 6 Kayuagung, known that the drawing of tangents to two circles was never taught by the teacher. The reason is because the efficiency of time, so that is the

formula taught by teachers, then giving exercises. Learning process provided by teacher to student is less interactive so far.

Regulation of national education minister of the Republic of Indonesia Number 41 (2007) states that the process of learning in each unit of primary and secondary education should be interactive, inspiring, fun, challenging, and motivating students to actively participate and provide enough space for innovation, creativity, and independence according to their talents, interests and physical and psychological development of students. In order to comply with these regulations, teachers are required to be creative in creating classroom learning.

One of the approach learning that will bring up student interactivity is Realistic Mathematics Education Indonesia (PMRI). PMRI emphasizes skills "process of doing mathematics", discussing, argue, collaborate with classmates, so they can find their own and eventually use it to solve math problems either individually or in groups (Zulkardi, 2000). PMRI is one approach to learning that will lead students to understand mathematical concepts by constructing itself through prior knowledge related to their daily lives, finding themselves with the concept, it is expected that student learning become meaningful (Ilma, 2011).

In the learning process, aspects that also need to be considered by teachers is the use of instructional media. Rusman (2011) states that to improve the high levels of learning outcomes is supported by the use of instructional media, one of it is multimedia. A computer program that can be used to develop multimedia is Microsoft Office PowerPoint. According Iryanti (2012), the use of PowerPoint with animation will be very interesting and could solve the problem of time in drawing tangents two circles activities.

From the discussion above, the formulation of the research problem is how the characteristics of valid and practical instructional materials of tangents to two circles using multimedia with PMRI approach in the VIII grade, As well as how the potential effect of instructional materials that have been developed for students' understanding of internal and external tangents concept in 8th grades of Senior High School 6 Kayuagung.

### **Method**

This study is a development research uses a type of formative evaluation. The research was conducted in the second semester of 2012/2013 in Senior High School 6 Kayuagung. Research subjects were 33 students of eighth grades students.

### **Research Procedure**

The study consisted of two stages: a preliminary stage includes analysis and design, and formative stages Evaluation which includes self evaluation, expert reviews, and one-to-one (low resistance to revision), and a small group, as well as field test (high resistance to revision) (Tessmer, 1993; Zulkardi, 2006). These stages can be seen in Figure 1 below:

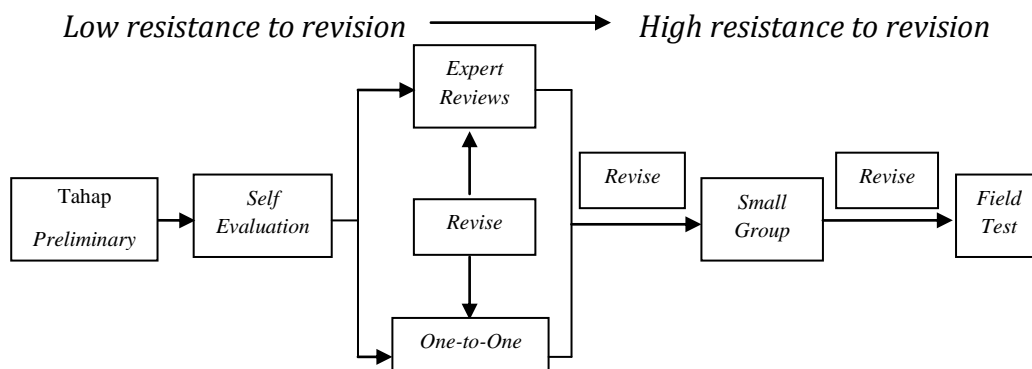


Figure 1. Flow Charts of Development Research

### 1. Preliminary

This stage includes the analysis curriculum and designing. Junior high school mathematics curriculum is analyzed to see which parts of the curriculum with the opportunity to develop multimedia technology. The next stage, researchers searching support materials, such as, images, animations, sounds, and others. Then the researchers made a story board of mutimedia and iceberg for.

### 2. Formative Evaluation

This stage includes:

- a. Self Evaluation  
Self-assessment by the design of instructional materials (prototype I).
- b. Expert Review and One-to-One  
Prototype I in the form of worksheets and multimedia validated by three experts, the expert material, design and media. Experts will provide a review of the prototype I based format, content and language. Then, parallel with the expert review stage, also conducted one to one. Researchers tested the prototype to two junior high school students. This is done to see how far instructional materials can be understood by students.
- c. Revision  
Expert validation results and suggestions/comments from students one to one become the basis to revise the prototype.
- d. Small group  
At this step the revised prototype tested in small groups, consisting of four Junior High School eighth grade students.
- e. Revision  
Once the prototype is tested, students were asked to provide feedback on the prototype. Based on the results of student responses and researcher observations during the learning process, prototype is re-revised. The revised prototype is expected to produce a valid teaching materials and practical.
- f. Field Test  
The revised prototype tested to research subjects. In the field test will be known the practicality and effectiveness of the final prototype. It can be seen from the process of learning, student activities and student capabilities that include cognitive learning the tangents to two circles by using multimedia instructional materials with PMRI approaches.

### Data Collection and Analysis Techniques

Based on the methods and procedures of research, data collection and analysis techniques used in this study are as follows:

#### a. Document

The document used are a junior high school mathematics curriculum, expert validation sheets, walkthrough results, comment sheets from students, as well as the results of LKS at stage one to one, small group and field test. LKS answer results in the field test stage was analyzed based on the scores that have been established by researchers. Then, the score is converted to a value in the range 1-100 with the formula:

$$\text{Value} = \frac{\text{the scores obtained}}{\text{the maximum scores}} \times 100$$

#### b. Walk through

At this stage, walk-through conducted by experts. Then experts give suggestions and comments in validation sheet based on the following:

1. Format, include: clarity direction.
2. Contents, include:
  - a. Suitability of Material
  - b. Suitability of teaching materials with the students' ability
  - c. The role of instructional materials to encourage students to construct their own concepts learned
  - d. Teaching materials are describing contextual material
3. Languages, include:
  - a. Standard language
  - b. Ease of students in understanding the language used
  - c. Simplicity / clarity of sentence structure
  - d. Sentence contains no ambiguity
  - e. Systematic organization

#### c. Observation

Observations carried out to look at the practicality of teaching materials. In this study, researchers assisted by two observers in charge of observing the activity with the students during the learning process with PMRI approach. Data collection was done by giving the score in the column corresponding to the visible indicator on the observation sheet.

#### d. Test

The test is used to look the effectiveness of the use of instructional materials that have been developed for students' understanding of concepts. The steps undertaken to analyze the data from the test / assignment of students is as follows:

- 1) Create an answer key test items / tasks and scores on each answer
- 2) Check the students' answers and give the value according with a predetermined criterion score.
- 3) The value obtained by students then converted into qualitative data to determine students' understanding of the concept
- 4) Documentation

Documentation serves as the data in the form of physical audio and visual form. The learning process is documented in the form of photographs and video recording.

## RESULTS AND DISCUSSION

### Instructional Materials Development Results

The study produced instructional materials in the form of worksheets and multimedia PowerPoint which are valid, practical and have a potential effects on students' understanding of internal and external tangents concept. Where the development process instructional materials through two stages: preliminary, and formative evaluation.

At the preliminary stage performed analysis of junior high school mathematics curriculum. Analysis results are obtained:

Competency Standards : Determine the element, part of a circle and its size

Basic Competence : Calculate the length of tangents to two circles

This research focuses on understanding of internal and external tangents concept based on four indicators:

1. Painting internal tangents two circles
2. Calculate the length of internal tangent two circles
3. Painting external tangent two circles
4. Calculate the length of external tangent two circles

Next step is designing a prototype that is based on 3 principles and 5 characteristics PMRI, namely: guided reinvention and didactical phenomenology, progressive mathematization, self-developed models, using contextual problems, using a model or a bridge with a vertical instrument, using the contributions of students, Interactivity, integrated with other learning topics (Zulkardi, 2002).

The second stage was a formative evaluation. This stage is carried out through self evaluation, expert review, one to one, small group, and a field test. At the expert review stages is obtained comments and suggestions from experts and note that the prototype still needs a lot of revision, especially in terms of content. Expert validation sheets is used to revise the prototype. Furthermore, parallel with expert review, also conducted one to one. In one to one, two students were asked to work on worksheets, then each of them give comments and suggestions about prototype. The observation of the trial it was found that students' difficulty in understanding about the purpose and difficulty in performing activities of drawing tangents. Comments and difficulties students one to one benchmark to revise the prototype.

The revised prototype tested on a small group of 4 persons eighth grade students of senior high. After the test, students were asked to provide comments and suggestions of the prototype. At this stage it is known that the students are very excited to work on the problems, they can understand the intent of the questions with ease, yet still having enough trouble in drawing, it is because they are not used to draw using the term and need guidance in every step of the drawing. Current observations and comments of students used trial researchers to revise the prototype.

The next stage is field test. This stage is done for 3 days in class VIII.2 of senior high school 6 Kayuagung. At the meeting of 1 and 2 performed the learning process by using materials that have been developed, and then on the third meeting held tests.

## Potential Effects of Instructional Materials

### ➤ Description of Student Activity Observation Data Analysis

At the first meeting, students were not accustomed to using worksheets with PMRI approach. In beginning they much asking the teacher about how to answer activity on worksheet. They need guide from teacher especially in drawing external tangent of two circles. But the interesting thing during the learning process is the students seemed enthusiastic about working together with their group. They also dared to express their answers worksheets in class. They look very happy during the study. The student activity can be seen in Figure 2 and 3.



Figure 2. Students answer worksheets after being given a direction by the teacher



Figure 3. Students work with a friend in answering worksheets

In the second meeting, students are more enthusiastic. They are working on worksheet easily because they have known the way how to do it from the first meeting, especially on drawing internal tangents activity. Students more expressive on describe their answered when other group present their worksheet.

The learning process with PMRI approach is looked from the context used by students that drawing sewing machines wheel and pulley. Students draw it well because they have good known about the context. They described the function and working principle of the context. After they drawn it, they describe the intertwining of the context with the material that they will study. But for this section, just some students are able answer correctly.

### ➤ Description of Data Analysis Document

Overall, the students can work on worksheets. They only had enough trouble in drawing tangents. This difficulty is because the students do not understand the steps to draw so that the pictures were not right and also the students are not familiar with



using compass so that in the first meeting it's spend a lot of time for drawing. From the results of students' answers on the activity 2, it is seen that students are not too much argue when requested explanation.

At the second meeting, the value of increased student worksheets that were previously in the previous encounter no value to the students who achieve excellent category, this time there is one group that fall into that category. Then, there are 14 groups worksheets answers his entry into either category, it is different from the previous meeting that there are only 11 groups. This increase occurs because the second meeting of students has been accustomed in doing worksheets. Here are described the results of worksheet answer:

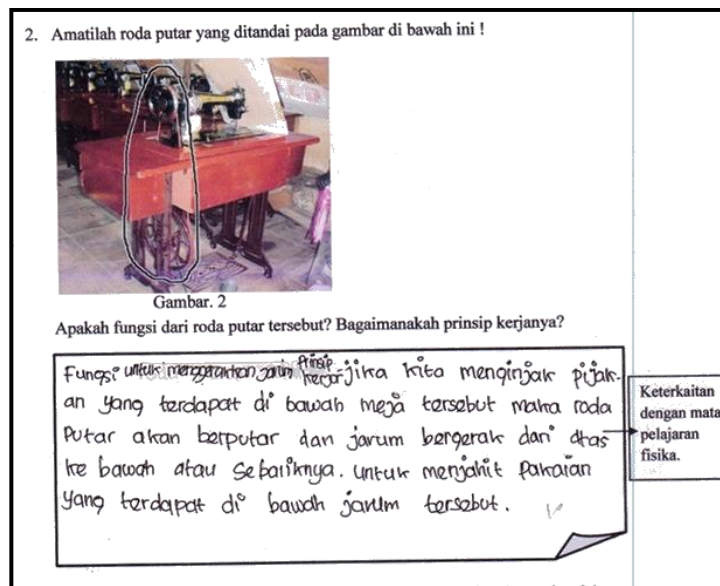


Figure 4. Students' answers on question number 2, first activity

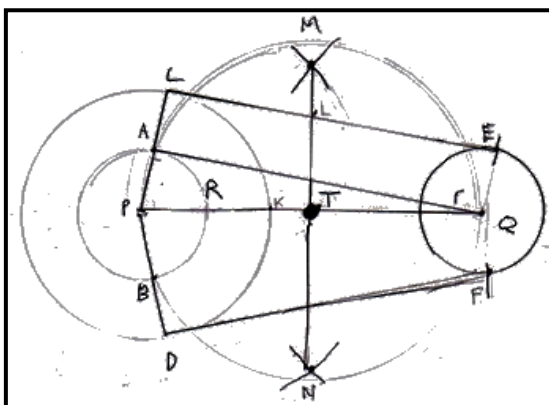


Figure 5. Result of student's drawing external tangent two circles

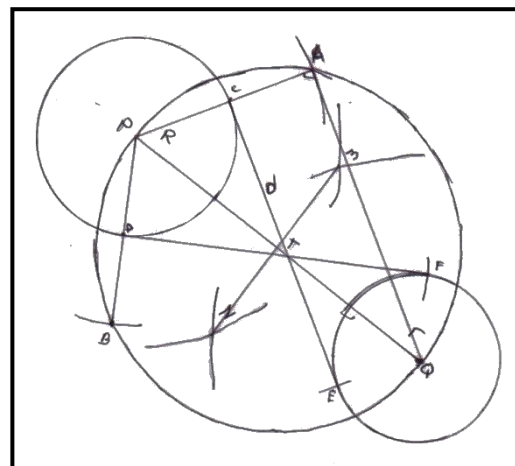


Figure 6. Result of student's drawing internal tangent two circles

There are various kinds of students' answers on question number 2 first activity, one seen in Figure 4. Students responded in accordance with the ideas / knowledge

respectively. In figure 5 and 6, looked the result of student's drawing of tangent two circles, they can do it correctly.

#### ➤ **Description Data Test Analysis**

In the first and second meeting, students are given the task to measure the student's understanding of concept base on two indicators, which presents the concepts in a variety forms of mathematical representation and apply the concept or problem-solving algorithms. Later, at third meeting conducted tests to measure students' understanding of concepts based on six indicators.

In task 1, there are 13 students get the value 66-75, which is enough categories. In this task there are 2 question, which at the first question many students can't solve it correctly. Most of students are not correctly drawing tangents, they just draw it for some steps corectly. In other hand, at the second question, many of them are able solve it because they just need use the algorithms base on formula they have known. Meanwhile, for the task 2, most of students are getting good value. It means the result are better than before. At the last, students are given test which consist of 5 question. Each question measure six indicators of concept understanding.

Base on the test result, most of students have good concept understanding of internal and external tangents to two circles. There are 16 students are getting 78-85. Most of them are able to restate a concept and classify objects according to certain properties (in accordance with the concept). Three students get less value because they didn't use algorithm correctly in solving problem and not right in drawing tangents.

From the task and test results can be seen that students' understanding of the concept is good categorized. It can be concluded that the teaching materials using the circle tangent PMRI multimedia approach has a good potential effect on students' understanding of the concept of communion tangents outside and inside the two circles.

## **CONCLUSION**

This research resulted in a product that is student worksheet and simple multimedia-based instructional media developed by PMRI approach and has been tested on students of class VIII.2 in Senior High School 6 Kayugung. Based on the results of research and discussion, the conclusion is:

1. Instructional materials of tangents to two circles which has been developed are valid and practical. Validity of instructional materials based on expert assessment that covers several aspects : the format, content and language, as well as views of the extent to which instructional materials can be understood by students one to one based on the analysis of worksheet. Practical instructional materials categorized as could be used easily by students, it is seen at the small group. From the results of the students' answers worksheet shows that instructional materials can be applied and used in the field with only a bit revision.
2. The study produced teaching materials that have a potential effect on students' understanding of the internal and external tangents concept. It based on the analysis of tasks and tests students on field test which is most of studenst are getting good value. Then, also obtained by the observation analysis of students' activity with PMRI approach which are students actively discuss, use the real context and enthusiastic of learning. Thus it can be said that that isntructional



materials has been developed by researchers has good potential effect on students' understanding of the internal and external tangents concept.

## SUGGESTION

Based on the research results and conclusions, researchers gave suggestions to:

1. Teacher as a controller in the learning process should make innovations in learning, one of which is with PMRI. Researchers hope instructional materials that have been developed can be used by teachers in the classroom.
2. For students, are expected to work independently with their peers and get used to issue an opinion in response to the questions contained in the worksheet.
3. For other researchers are expected to develop instructional materials tangents to two circles using more interactive multimedia with PMRI approach, and using context of tangents two circles are more real and familiar to students.

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