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Development of pythagoras puzzle media to enhance understanding pythagoras theorem concept

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Abstract
The purpose of this study is to produce a valid and practical learning media in learning mathematics, especially in the material of Pythagoras theorem, to evaluate the product of the development result to be revised and test the product of the development result to know its practicality in the learning. The type of this research is Research and Development with the model used consist of several stages: initial research, development stage, and assessment phase. The result obtained is the value of validity or media feasibility obtained by analyzing the media validation sheet of 2 validators. The value of the feasibility of the Pythagoras puzzle media is 3 which means Pythagorean puzzle media is valid and feasible to use. The value of media practicability is obtained by analyzing student questionnaire. The value of practical obtained is 2.6 which means Pythagorean puzzle media is quite practical and need some revisions.

Keywords: learning media, pythagorean puzzle, Pythagorean Theorem, initial research, development stage, assessment phase

1. Introduction

Mathematics is a very important subject in education systems around the world. Various forms of symbols, formulas, theorems, propositions, statutes, and concepts are used to assist calculations, measurements, judgments, forecasts and so on. Thus, it is not surprising that human beings are changing rapidly because they are supported by the participation of mathematics that always follows the changes and the development of the times (Sadiman, *et al*., 2006) [4]. Starting from kindergarten, elementary, junior high to high school mathematics has a very important role, but some students still think that mathematics is difficult, not least of them avoid mathematics lessons, whereas mathematics is an important science in everyday life. Even to be able to proceed to a higher level of mathematical value becomes one of the main prerequisites. Long enough, school math generally tend to put mathematics as a ready-made tool and ignore mathematics as a human activity, so it is possible for students to simply memorize without understanding, but should be able to memorize only after they understand, consequently the students find it difficult to understand math even though they already know since in kindergarten or elementary school.

Learning media is considered to have a strategic role in the effort to boost the success of the learning process. Learning media is something that can be used to stimulate the mind, attention and ability or skills of learners so as to encourage the learning process that will improve the achievement of learning competencies (Sadiman, *et al*., 2006) [4]. Learning models have been developed intensively through various studies as a way of enhancing academic cooperation between educators and learners (Ningsih, 2009). Conventional methods of delivery of lectures will be more interesting if balanced with learning media such as props. This can support the interest of learners to want to learn math materials with a happy feeling.

The process of learning mathematics is a communication process. A definite communication process involves three main components, namely the sender of the message (teacher), the component of the message recipient (student) and the component of the message itself. In the communication process sometimes there is a communication failure. This means that messages or subject matter that will be delivered cannot be received well by the recipient of the message and the more severe the recipient of the message is wrong in understanding the message delivered. In Indonesia today the process of learning in the classroom at the value of less encourage students to develop thinking skills. Students are only given information and required to memorize. In other words, they lack or do not even understand the meaning of the information received. Meanings are created by students from what they see, hear, feel and experience. With the existence of mathematics tools, students will be more focused on paying attention to teachers who are explaining the material. Boredom and saturation for students in learning can be avoided and a sense of fun for learning can be developed. In learning mathematics, teaching aids are one of the strong appeals to motivate students in learning mathematics.

By using props strived to understand students can be more in-depth about the material being studied. Understanding is a translation of the term understanding which is defined as the absorption of the meaning of a material being studied. Understanding according to (Uno, 2010) [6] is the ability of a person in interpreting, or express something in his own way about the knowledge he has ever received. An example is a student can explain in his own words about the Pythagoras

theorem. From this understanding, there are three aspects of understanding, namely the ability to recognize, the ability to explain, and the ability to interpret or draw conclusions.

Effectiveness can be expressed as a success rate in achieving its goals and suggestions. (Sutikno, 2005) [5] Argued that effective learning is a learning that allows students to learn easily, fun, and can achieve learning objectives as expected. Thus, learning is said to be effective when the purpose of learning is achieved. Furthermore, (Hamalik, 2001) [2] states that effective learning is a learning that provides the opportunity to learn alone or do the widest activity to students to learn. The provision of self-learning opportunities and activities as widely as possible is expected to assist students in understanding the concepts being studied.

Focusing on research that aims to: 1) produce valid and practical learning media in mathematics learning to enhance conceptual understanding of Pythagoras theorem material; 2) assessing the product of development result for subsequent revision; 3) test the product of the development result to know its practicality in the learning process in class. According to (Gay, 1981) [1] states that the main purpose of research and development is not trying to formulate a test or theory but developing effective products for school use. One such product is learning media. Learning media can be software or hardware. In this research, we will create props to help students understand the concepts of Pythagoras theorem, in which the props developed based on analogical reasoning. The use of props is intended to make students more interested and facilitate students in understanding the concepts of Pythagoras theorem, especially the formula of Pythagoras theorem.

Based on these descriptions, the authors felt compelled to create a learning medium in the form of Puzzle on the subject outlining the proof of the Pythagoras theorem. Pythagoras theorem is a subject matter taught in class VIII. Given this material is abstract to facilitate students in understanding the problem of authentication and its application then the authors raised this topic as a study of learning media mining with the title "Development of Pythagoras Puzzle Media to Enhance Understanding Concept Pythagoras Theorem" by using this learning media students are expected to be easier in understanding math lessons especially in the discussion of the Pythagoras theorem.

2. Materials and methods

This research type is Research and Development. In this study, the model used is a model introduced by (Van de & Plomp, 2010) [7] that consists of several steps is preliminary study, development, and assessment. Activities included in this preliminary study is a literature study, then from the data collected is then implemented drafting the product, followed by presenting the draft in front of expert lecturers. The next stage is the development stage which aims to develop the learning media Puzzle Pythagoras. From the design that has been set in the previous stage then the media "Puzzle Pythagoras" made. Once the product is produced, the next stage is the assessment stage by conducting a limited trial and a wider trial. In this study, trials conducted only limited trials. This limited trial is conducted through Peer Teaching with witnessed by expert lecturers. Student Questionnaires were given to students who participated in Peer Teaching, while at the same time validation sheet was given to 2 validators namely Lecturer and one of the students who became observers of learning activities.

The research instruments in this research are Media Validation, Student Response Questionnaire, Expenditure Execution Plan and Group Exercise. In this research and development, data were collected and obtained using the instrument of media validation sheet and student response questionnaire after the learning activity was conducted. The data collected in this research is qualitative and quantitative data. The data obtained from the assessment of media validation and student response questionnaire after learning using media "Puzzle Pythagoras". Data obtained from the validation instrument will be analyzed to determine the feasibility level. Data analysis of validation results using average analysis technique.

3. Results & Discussion

The development of this learning medium begins with a preliminary study. It is done by examining some problems in learning, especially learning of math. Progress and rapid development of technology in the modern era as it has now presented various ways for a teacher to teach his students, not least the learning of mathematics itself. In this regard, the literature study, which is part of a preliminary study, found that in learning activities the more students involved, the students' understanding of the concepts being taught, the better. The number of senses involved is also influenced by the many activities involved in the learning. From the preliminary study also, the computer media which is a learning medium that developed very rapidly in this modern era, capable and should be utilized to assist the learning process in understanding students will a mathematical concept.

As a mathematical concept, the Pythagoras theorem needs to be taught by using props. This is done to give students many activities in the learning process that will have a good impact in understanding the concept itself. In the literature study, it was found that a good Pythagoras theorem study should be able to elicit reasoning, one of which is analogy reasoning. Moving from literature studies conducted by researchers, researchers then create a design of instructional media that is arranged in such a way as to elicit students' analogy-shaped props with the title "puzzle Pythagoras". With this media, students are also expected to be motivated and have a passion for learning.

From the data collected through this literature study, researchers constructed a draft to make props about the Pythagoras theorem. Researchers designed props that were named "Puzzle Pythagoras" by using materials that are easily obtained by exposing in front of expert lecturers and postgraduate students of mathematics education. In the exposure, obtained inputs that make a sheet of group activities made in the form of stories, props made more interesting, props are made including props that fit the concept of theorems Pythagoras and not fit the concept of Pythagoras theorem with the aim that students can practice and see directly differences resulting from the props. In addition, also added that the materials used should be Styrofoam more easily taken anywhere.

After the draft report for the media "Puzzle Pythagoras" was approved then the next step is to develop the media. The first step is to collect the learning materials which become the prerequisite material of the Pythagoras theorem, which is the square area. After collecting these materials, the researcher purchased the materials needed for the manufacture of the props. Once the entire material is available, the third step is to create a learning medium. First of all, researchers prepare tools and materials used in the process of making props such as scissors, candle glue, pencil, cardboard, flannel, clear plaster and plastic board. Then cut the carton to the specified size as well as the flannel. The plastic board used is made of a hard material that is not easily broken and easily formed in accordance with the props to be made. The colors used are red, green, white, and yellow to make the resulting look more interesting. For flannel fabrics, the colors used are red. In making these props are also given name information so that students more easily mention the name of the props. Please note that the purpose of this tool is to clarify the presentation of the material so that not only is verbal, students can be active in finding solutions of the media used, students' attention to the material in high learning, students get concrete experience, encourage students to learn independent or group, and results learned or obtained by students are hard to forget. To be more clear the props that researchers make can be seen the following picture.

Fig 1: The props with right triangle

Fig 2: The prop with any triangle

After the media is finished and ready to be used then the next step is the assessment stage. Assessment stage in this research with validation data and student response questionnaire when conducted a limited trial. Limited trials were conducted by peer teaching. The researcher performs all the activities in the pre-made RPP starting from opening lessons, dividing the students into 2 groups, dividing the group worksheet that had been prepared to give the problem. The next learning step is to divide the media and explain the rules of the media used, as well as invite students to conclude their work-related problems given. At the end of the lesson, the researcher evaluates the conclusions of each group and closes the learning.

After a limited trial was conducted, the researcher gave a response questionnaire to the students to see the students' opinions about the media used. From the results of an analysis conducted by researchers, obtained data for the first indicator with an average of 3.3 which explains that the media used in accordance with the material being taught. For the second indicator, the average obtained 2.3 explains that the media used is less helpful for students to understand the concept of proof of the Pythagoras theorem. Furthermore, the third indicator with an average of 2.2 describing the media used still creates multiple interpretations for students. The fourth indicator with an average of 2.4 explains that the student is still poorly understood how the media is used. The fifth indicator with an average of 2.5 explains that the media is easy to use. The sixth indicator with an average of 2.7 explains that the media display is attractive to students. Final, the seventh indicator with an average of 2.6 explains that the media is enough to motivate students in learning the theoretical material of Pythagoras.

The details of the validity value of the "Pythagorean puzzle" media for each indicator can be seen in the table below.

Table 1: The average value of students' response validity of each Indicator

Indicator	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Avarage value	3.3	2.3	2.2	2.4	2.5	2.7	2.6

From the table, the average value of the validity can be concluded all indicators stated that the use of media in the category is quite valid. The average value of the validity of the use of learning media developed is 2.6 where the numbers indicate that the media developed is quite valid and some need to be revised.

The students' suggestions on the "Pythagoras puzzle" media made among others for square pieces made on the props are too thin, so it is necessary to look for thicker material and the right triangle on the props needs to be given a different flannel cloth to the color base for the right triangle in question is more clear. Other students also argue that because there are two different visual aids, each group should be given the opportunity to try both props directly. In addition, the demonstrated props less represent the concepts to be explained.

While the students fill out response questionnaires, the researcher also gives validation instrument to 2 validators. As a result, both validators state that the "Pythagorean puzzle" media is worthy of use. Some data obtained is the first indicator obtained an average of 3 which explains that the

media used in accordance with the subject matter. For the second indicator, there is an average of 3 which means that the media used in accordance with the learning objectives. Furthermore, the third indicator obtained an average of 3.5 which explains that the media used can provide an illustration in accordance with the actual situation. The fourth indicator obtained an average of 2.5 which explains that the media can facilitate students in understanding the concept. The fifth indicator until the indicator of call earned an average of 3 each explains that the appearance attract student attention, proportional media display, media usage can reduce student dependence on a teacher, and media usage can minimize the mistake of concept comprehension in a student.

The details of the average validation values for Pythagorean puzzles on each indicator can be seen in the table below.

Table 2: The average value of expert validation of each Indicator

Indicator	1	2	3	4	5	6	7	8
Avarage value	3	3	3.5	2.5	3	3	3	3

From the table, the average value of the validity in table 2 can be concluded that the third indicator has a validity level "valid", while the other indicator has a valid and validity level, and all indicators on the student validation sheet need not be revised. Thus the total mean value of all indicators is 3 which indicates the Pythagoras puzzle medium has a valid and validity level and does not need to be revised.

As for the suggestion of the validator, it would be better if the square on the media is cut into several square units so that the number 1 and 2 questions in the Group Activity Task can be easily answered by the students. In addition, by cutting the square into several square units, the concept of Pythagoras theorem to be built can be connected with the concept of the area of the square. Furthermore, the Group Activity Task that is made less fit, need to be more matched to the media including those that are not right-angled triangles yet in the Group Activity Task.

4. Conclusions

From the results of discussions that have been described previously, can be drawn some conclusions that development of Pythagorean puzzle media has several steps, namely the initial research phase, development stage, and testing phase, validity value or media feasibility is obtained by analyzing the media validation instrument of 2 validators. The feasibility value of the Operation Count medium is 3 which means Pythagorean puzzle media is valid and feasible to use and the value of media practicability is obtained by analyzing student's questionnaire. The practical value obtained is 2.6 which means Pythagorean puzzle media is quite practical and need some revision.

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