Discover the pythagorean theorem using interactive multimedia learning

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Abstract. In learning process students are required to play an active role in learning. They do not just accept the concept directly from teachers, but also build their own knowledge so that the learning process becomes more meaningful. Based on the observation, when learning Pythagorean theorem, students got difficulty on determining hypotenuse. One of the solution to solve this problem is using an interactive multimedia learning. This article aims to discuss the interactive multimedia as learning media for students. This was a Research and Development (R&D) by using ADDIE model of development. The results obtained was multimedia which was developed proper for students as learning media. Besides, on Phytagorian theorem learning activity we also compare Discovery Learning (DL) model with interactive multimedia and DL without interactive multimedia, and obtained that DL with interactive gave positive effect better than DL without interactive multimedia. It was also obtained that interactive multimedia can attract and increase the interest of the students on learning math. Therefore, the use of interactive multimedia on DL proceeds can improve student learning achievement.

1. Introduction
Students’ mathematic achievement can be seen in the report of Program for International Student Assessment (PISA). Based on the results of PISA in 2015, Indonesia was ranked to 62 from 70 countries [1, 3]. Apart from the results of the PISA mathematics learning achievements can also be seen from the results of the Trends in International Mathematics and Science Study (TIMMS) [2, 3], Indonesia was scored 386 in average and ranked 38 of 42 countries. This indicated that the mathematics achievement of Indonesian students was still low in international level. While at the national level, the achievements of learning mathematics can also be seen on the results of the National Examination (UN). In the 2015/2016 academic year, students’ achievement of geometry and measurement material was in the lowest level compared to other material [4].

The difficulty of students in learning the Pythagorean theorem was in determining the hypotenuse, specifically in the algebra operation, and stated an idea [5]. Based on the previous statements, obtained several problem to solve: (1) in mathematics there are many abstract elements of algebra, especially for Junior High School students is hard to understand abstract things. According to Piaget’s learning theory that students in junior level (ages 12-15) had not yet fully able to understand the abstract material [6]. (2)
the student's got difficulties in determining the hypotenuse because of the media applied in classroom was less effective. (3) students' also got difficulty in conveying an idea or opinion. This was also caused of students accepted direct material without engaging in learning. The selection of the appropriate learning model is important in the learning process. (4) Students tend to be lazy and not interested in learning mathematics. So students achievements did not show the good results. This is in line with the opinion of House, that students who have serious or interested in learning mathematics has a higher learning achievement of students who are bored or not interested in learning mathematics [7].

Based on these problems, some suggestions are likely to be running well is: first, the selection of the model of Discovery Learning (DL). DL is a learning model that focuses on the discovery process of a concept or principle, so learning will be more meaningful and can last longer stored in memory [8, 9, 10, 11]. The learning model DL has advantages in training the students to be active in the learning process, improve students' curiosity, and train the skills of students in solving their own problems with how to collect, process, and analyze data by themselves [8, 9]. The application of DL was appropriate to discover the Pythagorean theorem included in the geometry. It is because most students learn geometry based on his memory [11]. Based on the results of research and Oyebayin Martins [12], indicates that DL is better than traditional learning. The steps of DL is as follows: 1) Giving Stimulus, 2) Identifying Problems, 3) Collecting Data, 4) Processing Data, 5) Verifying, and 6) Making Conclusion [13, 14].

The second suggestion is the use of media of instruction, i.e. interactive multimedia. Interactive multimedia is merging/blend two or more media such as text, images, animations, graphics, sounds, video, and audio which is used for the presentation of which the target can control their own media [15, 16, 17, 18, 19, 20]. In addition to the realization of the principle of Mathematic Curriculum, interactive multimedia can also help in attracting and facilitate students in learning process. This is in accordance with the results of the study [21, 22], "Multimedia lessons certainly make learning easier, especially in the fields which are more abstract and which would be better understood with the help of pictures and animations".

Based on both the suggestions of the previous problems, obtained one solution that is using interactive multimedia in application of DL to learn the Pythagorean theorem. For that we developed interactive multimedia with DL on the Pythagorean theorem material to improve learning achievement.

2. Methods
This research was research development (R&D) which focuses on product development. Development of the research method is research in generating new products, and further test the effectiveness of such products [23]. This research aims to produce mathematics multimedia learning on the Pythagorean theorem material by using DL in curriculum 2013 and packaged in the form of CD-assisted learning software Adobe Flash Pro CS6.

The development model used in this study is a model of ADDIE (Analysis, Design, Development, Implementation, and Evaluation). ADDIE model of development was selected because it is one of the most widely used models to develop effective products [24, 25]. Through the stages the ADDIE gained a decent media used in learning. The media is said to be valid if it fulfill the criteria of feasible, practical, and effective [26]. Valid criteria obtained from the results of the assessment by media experts, practical criteria obtained from the assessment of the media by the students, and criteria for effective analysis of data obtained from a test-t. If the test result indicates that the null hypothesis is rejected, then the DL with interactive multimedia learning proved to be more effective than learning DL without using interactive multimedia [23, 27].

The population in this research is the student of MTs Al Furqon in academic year 2017/2018 and obtained students of two class as chosen sample by using random sampling techniques. Each class is used as an experimental class and the class of the control. Experimental class would be applied to DL learning
model with interactive multimedia while the class control applied DL that doesn't use interactive multimedia. Research instrument used are interviews, observation, and test.

3. Result and Discussion
The following below are the results of the research development by following the flow of the ADDIE model of development:

3.1. Analysis
On the stage there is a field of study with Analysis do observations conducted at MTs Al Furqon. Results found less computer lab is underutilized. Activities conducted in the laboratory of computer learning, practice only computer course. Based on the results of the interviews one of the teachers that students less interested by mathematics, and tend to get bored when lessons take place.

The current curriculum is a curriculum of 2013. The material was selected as research materials is the Pythagorean theorem with a low absorbance [4]. The model of learning tailored to the needs of students, namely model DL. Based on the study of the literature of the difficulty students in learning the Pythagorean theorem, then needed an interactive multimedia learning DL model on the material of the Pythagorean theorem to solve problems that have been discussed before.

Interactive multimedia will be presented in the form of a learning CD. Minimal specification your computer in order to run interactive multimedia are: (1) computer with Windows XP/7/8/10 or Linux, (2) with Computer-equipped flash Player, (3) Intel Pentium IV or higher, (4) CD-ROM (Compact Disc Read-Only 52x dive speed memory), (6) of RAM (Random Access Memory) minimum of 512 megabytes, VGA (Video Grapics Array) 32 megabytes, and (7) active or there is Headphone Speaker.

3.2. Design
The design phase is carried out after the stage of analysis. In such activities is obtained early in the framework of creating interactive multimedia such as Flowchart.
This interactive multimedia in learning-centered "activities" which contained student learning materials model DL. In addition there is an "evaluation" that are embedded in interactive multimedia this as material students after learning exercise done.

3.3. Development
In this stage of development, there is the process of making media, after it's done the validation by an expert (expert media and expert material). Experts assess media now by completing the assessment of the media. If in the judgment of the media by experts there is input, then the corresponding revised media expert input.
Figure 2 shows one of the display of student learning activities in finding Pythagorean theorem based on DL model stage. In that stage students will discover the concept of Pythagorean theorem by themselves, so learning will be stored long in memory.

### Table 1. Summary of Development Stage Result

| Stage      | Test Subject         | Average Score | Percentage | Classification | Information |
|------------|----------------------|---------------|------------|----------------|-------------|
| Validation | Media Expert         | 4.2           | 83.00      | Very high      | Valid       |
|            | Materi Expert        | 4.0           | 80.67      | Very high      |             |
| Alpha test | Students of MTs      | 4.3           | 86.00      | Very high      | Practical   |
|            | Al-furqon            |               |            |                |             |

Based on table 1 in the validation stage, it was found that the average score of media assessment from media experts was 4.2 with percentage of 83.00%, and it was found that the average score of media valuation from the material expert was 4.0 with the percentage of 80.67% obtained very classification high. It can be concluded that interactive multimedia has been valid based on the assessment of media experts and material experts.

Prior to the implementation phase, the first phase of trials conducted in small classes (alpha test), in which there are 10 students. Students are asked to use multimedia and then given the now assessment of media for users (students). If there are entries from students, then the media will be revised again before testing in the larger class (beta test).

Based on table 1 in the alpha test stage that interactive multimedia is considered practical with the average score of 4.3 and the percentage of 86.00%, so multimedia is ready to be implemented to a larger class.

### 3.4. Implementation

The implementation was done in experiments class which in there are 23 students. Students were asked to use the multimedia learning. After the study is completed students prompted the now assessment of media.

### Table 2. Summary of the results of the assessment by media students

| Aspect | Indicator   | Average | Average | Total |
|--------|-------------|---------|---------|-------|


Based on table 2 is obtained that for the aspect of conformity in a study on indicators of interest in learning the Pythagorean theorem with an average score of 4.1 with very high criteria. This means that 82% of 23 students feel interactive multimedia learning interest adds to their Pythagorean theorem. Moreover, in the interest of learning indicators in other mathematical material has an average score of 4.4 that includes high criteria. This means that 87% of the 23 students want to learn using interactive multimedia on mathematical material to another. In line with the opinion that multimedia can enhance Arsya’s interest student learning [28].

Interactive multimedia that is developed also provide learning aid for students. As shown in table 1 with an average score of 3.7 which means it belongs to the category. So obtained 74% of students find it helpful in learning the Pythagorean theorem with the interactive multimedia. In line with the opinions and research results Milovanovic and Hardiyanto that multimedia helps the learning process easier especially abstract elements are more easily understood by the existence of images and animation [21, 27].

Other results obtained is the percentage of students scoring against interactive multimedia model DL developed amounted to 82%, this includes very high. So, interactive multimedia model DL assessed practical use by users (students).

### 3.5. Evaluation

At this stage of the evaluation of the students do a written test in order to obtain data on student learning achievement. Proven data obtained with Gaussian test and Lilliefors test proven to be homogeneous by Bartlett. After all the prerequisites are met that test done testing hypotheses with t-test.

| Table 3. Summary of t-test Achievement of Math Learning |
|-----------------------------|----------------|----------------|------------|
| Class          | N  | Average | $t_{obs}$ | $t_{cr}$ | Decision |
| Experiment     | 23 | 81,65   | 2,66       | 1,68       | $H_0$ is rejected |
| Control        | 24 | 77,0    |            |           |            |

Based on table 3 looks that $t_{obs}=2,66>t_{c}=1,68$ so that $H_0$ is rejected. The conclusion is a model learning DL by using interactive multimedia better than on learning model DL without using interactive multimedia. It contents in line with the results of the study [27] Hardiyanto and Adrian [29] that learning with interactive multimedia gives better results than without use of interactive multimedia learning.
Interactive multimedia that is developed more effective because in the interactive multimedia embedded learning model DL so that students learning more meaningful and long-stored in memory [8, 9, 10, 11]. In addition, the interactive multimedia enhances the interest of students who have been described previously in the implementation phase outcome that good may increase interest in the achievements of learning math. The last was developed interactive multimedia can help instructional criteria either. In accordance with the opinion of the [21, 22], "Multimedia lessons certainly make learning easier, especially in the fields which are more abstract and which are better understood with the help of pictures and animations".

4. Conclusion and Suggestion

Based on the result and discussion can be inferred that the interactive multimedia developed viable for use in learning the Pythagorean theorem. This is because the interactive multimedia has met the criteria of a valid, practical, and effective.

Interactive multimedia judged can raise the interest of students in learning mathematics and help learning model DL. If student learning increased interest, then it can spur student learning achievement because the increasing of interest is one of the deciding factor whether or not learning achievements. It is therefore Expected to develop interactive multimedia content on other particularly in learning mathematics.

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