Students’ characteristics, learning outcomes and needs of geometry media tools in junior high school at Padang

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Abstract. Many factor influence mathematics learning outcomes, such as students’ attitude, interest and motivation. The aim of this research was to describe students’ characteristics, learning outcomes and geometry media tools that was been used in Junior High School at Padang. Type of study was descriptive research with qualitative approach. Instruments were questionnaire, test, observation and interview. The result shows that students’ attitude, interest and motivation to learn are in well category.

1. Introduction
Geometry is important mathematics because it can develop students’ logical, analytical, systematical, innovative and creative thinking. Hence, geometry must be learned with meaningful learning to increase its learning outcomes. Mathematics learning outcomes in Indonesia curricula are based on Indonesia Education Ministry Regulation number 58 year 2014, that is concepts understanding, reasoning ability, problem solving, communication, attitude towards mathematics and using teaching aid or technology item in mathematics activity.

But in fact, geometry learning is not facilitated students optimally. Example in Nigeria, the learning environment and teachers’ geometry ability were bad [1]. In West Sumatera, Indonesia, it is found that geometry is pull to one side by teachers and students. The research toward 200 students junior high school in Padang city on April 2nd until 4th 2018 shows that only 39 % students were succeed to pass the passing grade in geometry subject. Many students in primary school, junior high school and senior high school say that geometry is difficult. Finally, geometry is been neglected by students, its learning was often canceled or left aside [2]. As result, there is been found misconception in geometry concept [3].

Geometry is abstract subject in mathematics. It is has been felt abstract because it has been learned as calculation subject not as application subject. Students just memorize the formula to solve mathematics problems without understand mathematics concepts [4]. To solve it, many experts suggest to using constructivism learning in mathematics to make it more meaningful for students. Constructivism learning in geometry needs relevant learning tools based on students’ characteristics and technology development. Now, students are close with technology media such as computer or gadget and it can be used in mathematics learning. Mathematics learning by using computer is had been proven can increase students achievement. The research toward 153 junior high school students in Pittsburgh, USA, shows that mathematics learning based on computer game can increase students’ achievement and it is effective towards students with low prior knowledge [5]. The same research is
also applied in Beijing, China, towards 64 students and the result shows that it can increase students’ achievement, self-efficacy and motivation in mathematics learning [6]. Mathematics learning by using media tools can increase students’ participation, strengthen their communication skills and correcting their misconception [7]. Integrating media tools based on technology is necessary in future education [8].

Remembering the benefit of using media tools in learning, Indonesia government made the regulation that is called Indonesia Education Ministry Regulation number 22 year 2016 about utilization of computer and information technology to increase the efficiency and effectiveness in learning. Teachers understand about that but the media that valid, practical and effective to increase students’ learning outcome are not available in school [9]. If they need it, they must develop it by themselves [10]. But, many teachers have lack ability to use multimedia [11].

From explanation above, it is needed to develop media tools to learn mathematics based on scientific approach and future demand. The developing process of media tools is started by doing preliminary research about students’ needs analysis, such as students’ characteristics, students’ achievement and geometry media tools that already available in school.

2. Method
Type of research was descriptive research with qualitative approach. This research described about students’ characteristics, geometry learning outcomes and the needs of media tools in geometry learning in junior high school. The analysis was done by three steps, namely: (a) identification toward students’ characteristics in mathematics learning (such as attitude, interest and motivation); (b) identification toward students’ geometry learning outcomes; (c) identification toward the needs of media tools in geometry learning at junior high school. Samples of research were mathematics teachers and students of three junior high school in Padang, West Sumatra, namely school A, school B and school C. The instruments were students’ characteristics questionnaire, geometry test, observation sheet and unstructured interview sheet.

3. Result and discussion
Based on observation and interview that were done at school A, school B and school C in Padang about implementation of geometry learning at school, it was found the data below.

3.1. Students’ characteristics
Analysis data from students’ questionnaire shows that many of them have positive attitude, interest and motivation towards mathematics. It is show in table below.

| No. | Students’ Attitude                          | Percentage |
|-----|--------------------------------------------|------------|
| 1   | Like mathematics subject                   | 73.68%     |
| 2   | Interesting to learn mathematics           | 78.57%     |
| 3   | Have good attention in mathematics learning | 82.46%     |
| 4   | Following mathematics learning             | 84.21%     |
| 5   | Try to be active in mathematics learning   | 92.98%     |

| Table 1. Students’ attitude toward mathematics learning |

| No. | Students’ Interest                          | Percentage |
|-----|--------------------------------------------|------------|
| 1   | Feeling grateful because can learn mathematics | 94.74%     |
| 2   | Capable to collaborate with friends in mathematics learning | 98.25%     |
| 3   | Try to consistent to use mathematics symbol and term | 73.68%     |
| 4   | Try to discipline in using mathematics rules and formula in problem solving | 94.74%     |
| 5   | Have confidence in mathematics problem solving | 54.39%     |

| Table 2. Students’ interest toward mathematics learning |
**Table 3. Students’ motivation toward mathematics learning**

| No. | Students’ Motivation                                           | Percentage |
|-----|----------------------------------------------------------------|------------|
| 1   | Always try to find the solution of mathematics problem         | 78.95%     |
| 2   | Always try to finish mathematics task correctly                | 91.23%     |
| 3   | Have strong will to learn mathematics                          | 82.46%     |
| 4   | Believe that mathematics can give good prospect in the future  | 91.23%     |
| 5   | Always create interesting action to learn mathematics          | 56.14%     |

Beside the data from Table 1, 2 and 3, there is also been found students that are not interest to learn mathematics. Based on observation in the classroom, it is found that many students do not pay attention to teachers’ explanation. Some of them are sleeping, walk around and go out from the class. They do that because they feel difficult to study geometry. They have trouble in imagining geometry visual because they only have geometry image on blackboard. As consequence, students lack of geometry concept understanding. As result of that, students do not have confidence in problem solving as be shown by Table 2 number 5.

Table 3 shows that students rarely create interesting action to learn mathematics because they lack of concepts understanding and as consequence, it makes students have low creative thinking. They just use mathematics formula to solve standard question as show in teachers’ examples but they cannot solve open ended problem or problem that teachers never show before.

### 3.2. Learning outcomes

The three students’ characteristics above are the basic to reach learning outcomes. The learning outcome can be reach with good attitude, interest and motivation toward mathematics. But, the fact is not the same. The average of geometry learning outcomes at excellent class of school C in Padang is 46.35 and at fair class is 9.74. Totally, the average score is 29.48. Students’ mistakes start with failing in concept understanding to problem solving. It also found that about 63% students cannot explain the definition of centre angle and are angle even after learning about circle. Many students have opinion that centre angle is an angle in a circle. It is caused by using whiteboard and its marker only in geometry learning. The information that students get is not clear. Teachers draw a circle without compass and draw an angle that form by intersection of two radius line in at centre point. Teachers do that without further explanation so students do not understand the definition of centre angle. It is only 37% students understand about it. It is also found that 69% students fail to draw apothem of circle and 39.66% students fail to shade in area of segment circle. As a consequence, there is no one can solve problem about circle.

All of that fact has close relation with students learning style. Based on theory, the oral explanation only can be understood by auditory students. Whereas, students in this research are mostly have visual and kinaesthetic style. Other research shows that students’ cognitive ability are complex so they must use varies learning to master the knowledge [12-13]. It means to solve the problem in geometry learning needs learning facilities that relevant to students’ learning style because it have been proven can increase students’ achievement and knowledge [14].

The explanation above shows the problems in geometry learning at samples school. Because students have good attitude, interest and motivation in learning mathematics, it can be said that the problem is not came from students but from others factors, such as curricula, learning tools and learning environment. Now, Indonesia implements 2013 curricula. Government makes regulation to optimize the implementation by releasing Ministry Education Regulation number 58 year 2014 that
say that learning at school must using information technology or teaching aids. In fact, junior high school in Padang cannot follow that regulation and curricula 2013.

3.3. Implementation of technology information media and teaching aid
Mostly mathematics learning in junior high school at Padang use students’ worksheet. Some of school use teaching aid and Power point presentation besides textbook.

3.3.1. Students’ Worksheet
Students usually use worksheet that is sold in market and it cannot build their knowledge. It only summarizes learning material and formula without give further explanation about steps and process to understanding the concepts. The image of students’ worksheet from market is shown below.

![Figure 1. Students’ worksheet from market](image)

Besides summary of learning material, it also has exercise in multiple choice and essay. It is shown in figure below.
Problems in students’ worksheet exercises are in abstract form so students cannot make relation between mathematics concepts with real life implementation. Figure 2 shows that there is no open ended problem so it cannot build students creative thinking and knowledge. Figure 1 also shows that students’ worksheet is presented uninteresting, no colour and no reasonable image. In image, AD = 10 cm but longer than BC=12 cm.

To increase students’ learning outcomes is by using students’ worksheet that is can build their knowledge or students’ worksheet that is based on constructivism learning. But, there is no students’ worksheet in market based on constructivism learning. So, it is needed to design students’ worksheet based on constructivism that can be used in mathematics learning.

3.3.2. Teaching aid and power point presentation

There is a few teaching aid in junior high school in Padang, such as frame of cube, beam, prism, pyramid and other media geometry to prove Phytagoras theorem. It is because no room to save the teaching aid and not practical to use teaching aid. Besides, the media geometry to prove Phytagoras theorem is in bad condition (the angle of triangle was not 90°). It makes students cannot observe the geometry media.

To solve it, some of junior high school in Padang use information technology, such as computer in lab, LCD, screen, smartphone and laptop. But, the implementation of computer in lab is only for examination only and LCD/screen in classroom also is rarely used by teachers because there is no presentation media based on scientific approach as said by 2013 curricula. Teachers say that they do not have ability to develop media based on scientific approach. Some teachers try to use Pustekom multimedia. Pustekom is one of institution that creates mathematics’ learning media tools. But, its media is not relevant with scientific approach. The figure of Pustekom presentation is shown below.
Figure 3 shows that presentation of learning material without scientific approach so it cannot facilitate students to build their knowledge. The presentation cannot facilitate the ability to observe, to make question and communication. Slide presentation consists of only text and no other visual (graphic, audio, animation and other). It makes students cannot pay attention to presentation because students usually use technology with more interesting presentation such as animation or video.

3.4. The needs of geometry learning tools
Based on data analysis of research instruments, it shows that teachers realise that:

- implementing teaching aid with textbook and students’ worksheet are not enough to facilitate students in geometry learning. One of teachers say “learning two-dimensional figure is needed creative media learning presentation that can visualize material so students can understanding the concepts”
- students feel bored in usual mathematics learning because it cannot facilitates students learning style
- teachers have perception that using media tools in mathematics learning only wasting time and it can cause the goal of competence in curricula cannot be reach. It is caused by teacher cannot make effective and efficient media learning
- students need media tools that can be used in anytime and anywhere, in school nor home, so they can learn material repeatedly. The trend is students close to technology, so it is needed media tools that can give interesting visual and animation. The research finds that using media visual tools in learning can stimulate students’ thinking ability and have positive relation with learning outcomes [15]
- mostly teachers do not have suffice ability to develop multimedia. But, they give positive response and hope there is development interactive multimedia that can visualize geometry material and can motivate students.

From explanation above, the problems in geometry learning at junior high school in Padang is not caused from students but others factors such as media tools and learning environment that cannot support implementation of 2013 curricula. It is needed media tools that based on scientific approach to build relevant environment learning based on 2013 curricula.
Based on students’ characteristics, geometry material, learning outcomes, learning facilities at school, and mathematics teachers competence at junior high school in Padang, so it is necessary increasing learning quality such as workshop to develop interactive multimedia and students’ worksheet that can be used by students or school that has computer lab, laptop or smartphone, with nor without students’ worksheet, depended the necessity. Students’ worksheet is must be developed based on scientific approach although it does not use computer, laptop or smartphone. Summary, developing interactive multimedia and students’ worksheet in geometry learning needs to fulfil aspects below:

- Media tools in geometry learning must facilitate students learning style, such as interactive multimedia, teaching aid and students’ worksheet.
- Media tools in geometry learning must be developed based on scientific approach so it can facilitated students to observe, to try, to reason and to communicate their thinking;
- Media tools in geometry learning must valid that based on strong theories (content validity) and every component in it must consistent and have relation one to another (construct validity);
- Media tools in geometry learning must practical that can help teachers and students to have meaningful learning, based on available learning time and interesting;
- Media tools in geometry learning must effective to increase students learning outcomes.

4. Conclusion
Based on research’s result and discussion, it can be concluded that junior high schools students’ characteristics in Padang toward geometry learning are positive, such as attitude, interest and motivation. But, students’ learning outcomes are not well and it is not caused from students, but others factors, such as media tools or environment learning. The usual media tools and environment learning is not relevant to students learning style. That is because paper and pen learning which happened in classroom at mathematics learning and that is not meaningful learning to students. This finding will be used to develop media tools that effective, efficient and can facilitate geometry learning in the classroom.

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