Scaffolding in geometry based on self regulated learning

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Abstract. This research aim to know the influence of problem based learning model by scaffolding technique on junior high school student’s learning achievement. This research took location on the junior high school in Banyumas. The research data obtained through mathematic learning achievement test and self-regulated learning (SRL) questioner. Then, the data analysis used two ways ANOVA. The results showed that scaffolding has positive effect to the mathematic learning achievement. The mathematic learning achievement use PBL-Scaffolding model is better than use PBL. The high SRL category student has better mathematic learning achievement than middle and low SRL categories, and then the middle SRL category has better than low SRL category. So, there are interactions between learning model with self-regulated learning in increasing mathematic learning achievement.

1. Introduction
Mathematics is one of the most important and influential lessons for someone’s future. According to National Council of Teachers of Mathematics (NCTM), in this fluctuate era, someone who can understand and master Mathematics, has wider opportunity to determine his future [1]. This is because by mastering mathematical competencies, someone can develop themselves in several of life optimally, otherwise someone who does not master mathematical competence, their future will be limited. According to survey held by Programme for International Student Assessment (PISA) at 2015 in collaboration with 72 countries, showed that Indonesia has increased to previous year, from 375 point in 2012 become 386 in 2015. However, this achievement is still low compared to the average of Organization for Economic Cooperation and Development (OECD)’s amount 490; and Indonesia’s position is ranked sixth from the last. Mathematics is a branch of abstract science; means that the learning process requires understanding and problem-solving that are not real [2]. One of abstract branch is geometry. A branch concerned with point, straight line, plane figures, space, spatial figure and the relations between them was called geometry [3]. Geometry is a part of mathematics which related to student’s life, because almost all of the objects around them are geometry [4]. The study of geometry helped students develop the skills of visualization, critical thinking, intuition, problem-solving, deductive reasoning, logical argument and proof [5]. So, one of the important branch of mathematics was geometry.

Based on observation and interview to junior high school teacher said that for students, geometry is one of difficult lesson. Moreover, most of the mathematics learning process is still teacher-center; teacher is the only one source. The teacher is dominant and the students do not required be
independent and active during the learning process. Generally, the application of mathematics learning process gain from teacher, it will be makes the students passive [6]. The learning process in Indonesia is still dominated by conventional learning or direct, so it approved that this is a serious problem whence most of the students did not understand what they learned because they were passive during the learning process so their achievement very unlikely to develop [7].

In this case, the teacher is required to revise learning strategies, technique and media that support the success of learning process. The learning process focuses on solving problem then teachers are recommended to use problem-based learning. The key components of the problem-based learning is the act of reflection where students are asked to apply what they have learned in other situations which refers to transfer knowledge. There are five components in the learning process in the classroom which include students, teachers, content, methods and the environment. Williams [8] Stated that teachers must understand the context of mathematics in order to apply the suitable technique. One of technique that can be applied in learning process is scaffolding [9]. Scaffolding is one of technique teacher can choose to help students who face difficulties [10]. Difficulties in learning must be experienced by students especially when faced new materials or information. Scaffolding can be applied to every teacher, adults, or experts in their daily life. However, in order to process scaffolding properly and effectively they need to get enough training and experience.

Furthermore, the combination of Problem Based Learning and scaffolding technique will benefit the students in formulating and organizing students’ mathematical learning. Scaffolding is success combined with PBL on student learning [11]. The exact and appropriate technique is feasible to influence students in mathematic learning. Based on those reasons, technique scaffolding is used for Problem Based Learning model expected to increase the mathematic learning achievement. Much of the students thought that mathematics is difficult and boring. It has impact to student’s mental in doing something that is depending on other people. The complex problem of mathematics is actually from the students’ mind itself. That cognitive problem influenced their academic achievement [12].

Academic achievement have role into some life aspects such as anxiety, self-esteem, and optimism [13]. The student with high academic achievement tended to have a strong competitive motivation than whose with low academic achievement [14]. One of cognitive aspect which influenced achievement is self-regulated learning. Thus, learning process nowadays considered that one of its aims is to free the students from their need of teacher, so they can learn independently in their whole [12,15,16]; and to learn independently the students should be a self-regulated learner [17]. Self-regulated learning that used in this research are autonomy, creative and initiative, responsible, and able to refrain [18]. The aim of this research is to know whether PBL-Scaffolding can achieve better result of study than PBL without Scaffolding and direct learning. Beside that to know the student’s achievement with self-regulated learning in high category, achievement with self-regulated learning in middle category, achievement with self-regulated learning in low category, and also to know the interaction between learning model and self-regulated learning to the student’s learning achievement.

2. Method
This research was a quasi-experimental research, because the researcher cannot control all the relevant variables. The research design is 2X3 factorial that aims to know the influence of two variables independent to dependent. The independent variable for this research is PBL model with scaffolding technique for experimental class and PBL model to class control. Next, for other independent variable is self-regulated learning which rated to high, middle, and low categories. Population for this research is all of the students at SMP 2 Sokaraja VII grade class 2016/2017. The sample was class VII B (experimental class) 36 students and class VII F (control class) 36 students. The mathematic learning achievement obtained by using multiple choice test with geometry material, whereas SRL obtained by using questioner data based on the indicator made by SRL aspect.
3. Results and discussion

Mathematic test for students was 25 multiple choice given to experimental class and control class. Based on the result, the average learning mathematic achievement for experimental class 1 was 36, and control class was 36. Before the ANOVA two ways test, normality test held on the data. The mathematic learning achievement normality test is held by using SPSS software with 5% level of significance. The result of normality test of student’s mathematics learning shows that in the experimental class the sig value is 0.395 > 0.05 and control class the sig value is 0.199 > 0.05. Therefore from the statement above can be take conclusion that the sample of achievement tests comes from a normally distributed population.

The homogeneity test of student achievement test shows that the value of sig. = 0.521 > 0.05. Therefore, the conclusion can take from the population has the same or homogenous variance. In this study, data analysis used two-way ANOVA shown in table 1 with the following results.

Table 1. The result of hypothesis test

| Source          | Type III Sum of Squares | df | Mean Square | F       | Sig. |
|-----------------|-------------------------|----|-------------|---------|------|
| Corrected Model | 6210.098a               | 5  | 122.020     | 17.410  | .000 |
| Intercept       | 315708.574              | 1  | 315708.574  | 4.425E3 | .000 |
| Model           | 385.301                 | 1  | 385.301     | 5.401   | .023 |
| SE              | 4974.635                | 2  | 2487.317    | 34.865  | .000 |
| Model*SE        | 542.667                 | 2  | 271.333     | 3.803   | .027 |
| Error           | 4708.513                | 66 | 71.341      |         |      |
| Total           | 390820.000              | 72 |             |         |      |
| Corrected Total | 10918.611               | 71 |             |         |      |

Table 2. The result of post hoc tests anava

| (I) SE  | (J) SE  | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval |
|---------|---------|-----------------------|------------|------|------------------------|
|         |         |                       |            |      | Lower Bound | Upper Bound |
| High    | middle  | 13.26*                 | 2.486      | .000 | 7.30        | 19.22       |
| low     |         | 24.17*                 | 2.820      | .000 | 17.41       | 30.93       |
| Middle  | high    | -13.26*                | 2.486      | .000 | -19.22      | -7.30       |
| low     |         | 10.92*                 | 2.395      | .000 | 5.17        | 16.66       |
| Low     | high    | -24.17*                | 2.820      | .000 | -30.93      | -17.41      |
| middle  |         | -10.92*                | 2.395      | .000 | -16.66      | -5.17       |

Table 3. Homogeneous subsets result

| SE     | N  | Subset |
|--------|----|--------|
|        |    | 1      | 2     | 3     |
| Low    | 19 | 61.47  |       |       |
| Middle | 36 | 72.39  |       |       |
| High   | 17 | 85.65  |       |       |
| Sig.   |    | 1.000  | 1.000 | 1.000 |

Based on the calculation Table 1, can be seen that the influence of Problem Based Learning model with scaffolding technique toward mathematics learning achievement has the value of F arithmetic = 5.401 with sig = 0.023 < 0.05, so H0 rejected and Ha accepted. It can take the conclusion that there are differences between the students’ mathematics learning achievement in the experimental class used
Problem Based Learning model with scaffolding technique with the control class used PBL. Whereas, based on the average of the students’ mathematic learning achievement, so the group of students used scaffolding technique in PBL bigger than the students with PBL non technique scaffolding.

This is because during the process of learning mathematics using scaffolding students become more understand the material. When the discussion process takes place, the problem will be solved by the students. The provision of assistance usually provided by teachers in the PBL process is minimal so that students are not fully understood. The scaffolding was provide by teachers to students due to the learning process can develop a conceptual in children and help the learning process [19]. Teachers only provided scaffolding with sufficient so that students will not feel disturbed and feel neglected. Hence, the mathematics learning outcome of students can be improved.

The influence of self-regulated learning towards the mathematic learning achievement has a value of F arithmetic of 34.865 and sig = 0.000 <0.05, so can take the conclusion that there is a difference between categories in self-regulated learning. Based on table 2 it can be seen that there is a difference between self-regulated learning of high category students toward middle and low category. While based on table 3 it shows that the self-regulated learning of the high category is better than the middle and low category self-regulated learning, and then the self-regulated learning of the middle category is better than the low self-regulated learning category. Based on Table 1, On column Class*BRL obtained sig. = 0.027 <0.05, so can take the conclusion that there is interaction between Problem Based Learning model with scaffolding technique and self-regulated learning (independence learn) student to student's mathematics learning achievement.

The use of learning model aims to overcome the problems in teaching and learning process so the material can be delivered maximally. Most of the students in learning the geometry material based on the understanding, thus, when given the problem students do not understand it. A lack understanding of concepts can lead to poor mathematical achievement. One of causes students lack of understanding because teacher uses a less precise learning model. Learning model that enables for learners to solve daily problems and depth understand the concept is the learning model in which learners faced with a problem and seek solutions. Giving problems in everyday life is very important for students’ thinking, so the use of PBL models is the right solution to use in learning. PBL is a promising approach not only to build mathematics understanding but also to test students’ conceptual knowledge [20]. PBL uses problems to improve student achievement, so it can stimulate students to build the right solution for the given problem [21]. Based on the results of this research indicate that the model of learning and self-regulated learning affect mathematics learning achievement. The use of learning strategies helps students learn activities and apply what they already know to be effective in learning [22]. The effectiveness of PBL in mathematics learning can improve creative thinking and provide great opportunities for students to actively participate in the learning process [23].

One of the benefits that can be obtained from PBL is the emergence of students’ attitude, objective and curiosity in solving the problem. Student curiosity causes students to become eager to learn and know their knowledge. Student curiosity provides motivation for students to seek answers of questions or problems that arise and deal with them. The presentation of geometry problems in a way that stimulates curiosity and encourages exploration, can improve their learning and attitudes toward mathematics [24]. Learning with scaffolding techniques helps students in solving the problem. The use of scaffolding is a support given to the student when the teacher gave a problem and the student cannot solve the problem [25].

In this research, it can be seen that when students are given scaffolding technique in mathematics learning process, it makes students become easier in understanding and confidence about the result obtained to solve the problem. Unlike a class which without using scaffolding techniques, to solve problems the students are unsure with the result. If students understand the material that obtained, then when students find the same problem will be able to solve it well. In the process of learning mathematics using PBL many students are lazy to do, because teachers guide them only in general and demands them to solve the problems based on existing sources. Unlike the case with PBL which is using scaffolding techniques, students who ask to the teacher was guided by giving instructions to
solve the problem. Assistance is not only given at the beginning of problem solving, but help or support can be given in the middle or at the end of the problem solving. Any help will be reduced and given opportunities to learners along with the ability to complete a job independently.

Scaffolding in learning is a teaching technique that consists of teaching a new skill by inviting students together to accomplish tasks that are too difficult if the student solve their own, and help the student in building an understanding of knowledge and new processes [26-29]. It shows that providing support to learners at the right time will create a better learning process of mathematics, otherwise if does not right, then it will interference. Scaffolding should be provided sufficiently and timely so that learners can be responsible and independent of the learning they are doing [19].

When the learning model combined with scaffolding techniques will establish student's confidence in solving a problem, so they can find the right solution to overcome the existing shortcomings. Through confidence, it will make them express opinions and independent in learning so that they can understand easily and able to solve the problems. In this case the effective scaffolding technique is used in problem based learning process (PBL). Providing appropriate scaffolding techniques in the learning of mathematics can improve the intellectual development of learners in achieving the goals of mathematics learning.

4. Conclusion
Based on the results of research above, the conclusion that can be taken is the difference of student achievement between students using PBL model with scaffolding technique and PBL. The achievement of learning mathematics using PBL with scaffolding technique gives better result than the achievement of learning mathematics without scaffolding. There is a difference in learning achievement between high, middle and low category students. However, the high SRL category student has better mathematical learning achievement than middle and low SRL categories, and then the middle SRL category has better than low SRL category. Based on the research discussion, the results showed that the influence of Scaffolding can increase the achievement of higher learning achievement of mathematics in PBL than the achievement of learning achievement not using scaffolding.

5. Acknowledgments
The authors thank to the Department of Magister Mathematics Education, Faculty of Teacher Training and Education, Universitas Sebelas Maret.

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