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Increasing of Students' Achievement in Polynomial by Using Jigsaw Method

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Abstract

The aims of this study are to know the increasing of students' achievement and to improve students' achievement on polynomial by using cooperative learning type Jigsaw in Indonesia. The type of this research was a Classroom Action Research**.** The research was conducted in the second grade, State Senior High School of Kisaran, Indonesia which consist of 32 students and objects in this study was increasing of students' achievement in polynomial by using the jigsaw method. The data was taken from the test of students' achievement and observation. The form of Achievement test was essay test and it conducted in the end of cycle. The goals of observation to see the ability of researchers in the learning management in the learning process.

The results of observation showed that there was increasing of students' achievement. The average of student's achievement in initial formative was 55.78 where there are 21 students who can not achieve the mastery learning or approximately 65.63% of the 32 students. On achievement test I, there was increasing in average student's achievement to be 67.56 where there are 9 people who can not achieve the mastery learning or approximately 58.12% of the 32 students. On achievement test II, there was increasing average of student's achievement to be 80.09 where there are 4 students who did not complete. This means that there are 87.5% of students who achieved mastery learning. Then we can conclude that the increasing of students' achievement is enough significant. Based on the observation of each meeting, the ability of researchers are quite good at classroom management by implementing cooperative learning model jigsaw. Because of that, it suggests to mathematics teacher in order to use cooperative learning type Jigsaw in learning process as an alternative learning to improve students' achievement.

Keywords: Students' achievement, Jigsaw method, Classroom action research

1. Introduction

Education is the key to all progress and development of a country. Education can maximize the potential of human being both as individuals and citizens. This is in accordance with Law No. 20 Year 2003 on National Education System that said that the national education serves to develop skills and form the character and civilization of a dignified nation in the context of the intellectual life of the nation. The aims of education are to develop the potential of students to become a human being faithful and pious to God, noble, healthy, skilled, creative, independent, and democratic citizenship, and responsible. In order to realize this potential its need the increasing of ability through education that is implemented in the learning process.

Mathematics can provide the ability to think logically in solving problems, giving high skills in critical thinking, systematic, and creatively to solve problems. But ironically, now mathematics is considered as a difficult subject and avoided by the students. Heward (Mundia, 2012: 349) said that some students seem to be negatively influenced by the stereotype beliefs held by many people that mathematics is a difficult subject. This is consistent with the opinions were expressed by Abdurrahman (2010: 252) that said from the various subject taught in the school, mathematics is a subject that considered the most difficult for students.

The Difficulties in learning mathematics affected the lower of student's achievement. Lack of students' achievement reflect that students have difficulties in understanding the concept, implementation and completion of a problem in mathematics. There are several factors that affect the learning activities, such as teacher, student, infrastructure, tools, media, and environmental factors. (Sanjaya, 2010: 52). One of the factors that affect the learning process is the teacher's factor. The submission by the teachers is a factor that causes mathematics are considered as difficult subject. The teaching method by the teacher must be variety and involve students actively; it is not make students to be passive. As expressed Trianto (2010: 5) that said empirically based on analytical results for the low learning outcomes of students caused the dominance of conventional learning. So, in this learning the classroom tends to teacher centered.

A teacher needs an ability to design and implement a variety of learning methods are considered to match the interests and talents and in accordance with the level of development of the students. If the teaching method by the teacher is not appropriate with the condition of the students, it will affect the learning of students who are not good anyway. This of course will have an impact on improving student learning outcomes.

To overcome difficulties in learning, teachers should be able to find appropriate learning strategies to be used so that students can easily understand the concepts and the subject matter presented. Teachers should select and use a variety of learning models according to the material will be taught, so that will increase students' interest in learning mathematics. In the selection of instructional strategies teachers are bound by a number of factors. Not justified for teachers to select learning strategies that will be used because of the habit and have been mastered. But it must also consider the objectives to be achieved, the material to be taught, as well as environmental conditions, and the students them selves. Surely none of the most appropriate learning strategies in the application of a concept, but the teacher is obliged to seek the most suitable learning strategy and according to the situation of the class.

Jigsaw learning model can liven the classroom, empowering students or focuses students that on the productive class. Unlike the conventional learning that teachers use this time where students are not active and passive. In the jigsaw learning model students learn in small groups. Each member worked together to understand the material. After that, each member of the group will return to the initial group to deliver and combine the results of discussion to the other group members. In the jigsaw learning model, the learning that has been teacher-centered converted into learning student-centered. So that students are given the opportunity to discover and develop mathematical knowledge that will be his own.

From the observations were done in the second grade, State Senior High School of Kisaran, found that students are less active in the learning process, even students tend to be passive. This of course affected the lower student learning outcomes. It proved from the results of students' math test where the students generally do not achieve the minimum standards of mastery learning students.

From the preliminary observations of the polynomial in the third grade, the students were given several questions about the polynomial. Such as:

1. Determine the degree of polynomial below:
   a. $P(x) = 5x^6 + 2x^2 + 3x + 4$
   b. $P(x) = (x^2 – 1) (2x^2 - 7x + 3)$
2. Determine the value of polynomial $P(x) = x^5 – 2x^4 + 3x^3 + 4x^2 – 10x +3$ for x= 1 and x=2
3. Determine the result and remainder of division polynomial $P(x) = 2x^3 + 4x^2+5x+7$ by (x-2)

After the observation, there are some mistakes made by the students. On the first question, students were asked to determine the degree of the given problem. Here is a picture of the answer of the students.

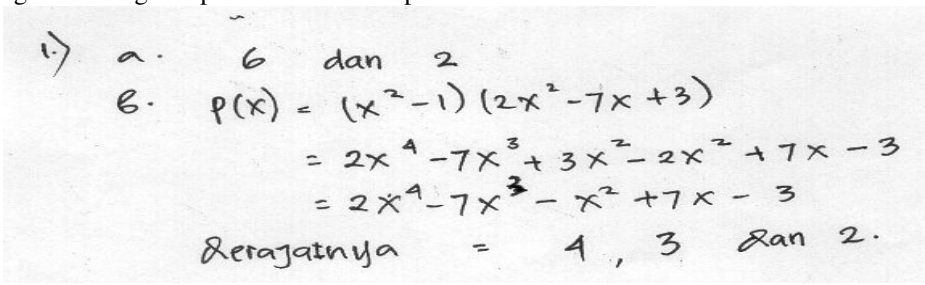

Figure 1. Students' Answer for the First Problem

From the picture of figure 1. Students' answer showed that the student is still confused in determining the degree of the polynomial. Students can not tell which is called exponent of variables, and which is called the degree of polynomial. Some students answer for question 1a the degree is 6 and 2. While the answer for question 1b is 4, 3 and 2. Student answer was not showing the degree of polynomial, but some of the exponent of variable x. The degree polynomial is the highest power of the variable x in the polynomial equation. So the correct answer to question 1a, the degree of the polynomial is 6. While the correct answer from question 1b after the algebra simplified then the degree of the polynomial is 4. For the second question, all students can answer that question properly.

Here are some students' answers about the third problem which students are asked to determine the result and remainder of polynomial division.

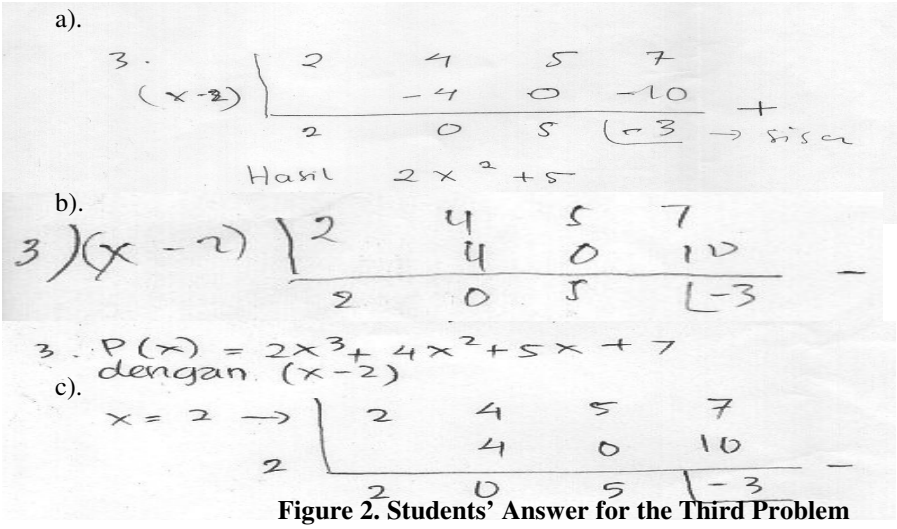

Figure 2. Students' Answer for the Third Problem

From the picture of figure 2. the students' answer above, founded some errors in answering the questions. In a picture, it seems that the students are still confused in making the division of polynomials by Horner or synthetic division. The mistakes made by the student are used additional operation in the division polynomial by using synthetic division. On the divisor, the student is using a form of (x - 2) then the corresponding operation is subtraction. While the operation used by the students was additional operation. Of course, this led to the results of the students' answers. If the used of the operation in division of polynomial is wrong, then the result and the remainder of division will be wrong anyway.

In figure 2b showed that students using the form (x - 2). The operations that used are in accordance with the form persisted. However, students' responses are errors in the process of multiplication and division between third line and the divisor. The students multiplied the third row with a value of 2, not -2. The error of multiplication by the students will impact on the result of division. From the answer seen that students are still confused in the use of appropriate operation in the division by Horner or synthetic division. Although the use of the operation is in accordance with the form of the divider, but the process is still wrong in multiplication.

While the picture 2c, it appears that students are already using a form zero function in divisor of polynomial. But the fallacy of the student is the use of operation in the division by Horner. The students use the subtraction operation. The students using zero function in the divisor and then the corresponding operation on division by Horner is the addition operation. This mistake affected in the results and the remainder of the division. The results and the remainder of the division was wrong because the use of wrong operation on the division by Horner way.

From the students' answers, give the fact that the students are still confused in determining the degree of polynomial. Some students can not distinguish the degree of polynomial and exponent of the variable in the polynomial equation. Students assume that the degree of the polynomial is the exponent of variable x.

Based on above explanation, so the problems will be uncovered and the solution are "is there any increasing of students' achievement in polynomial by using jigsaw method? and how the increasing of students' achievement in polynomial by using jigsaw method?

2. Literature Revieu

Learning is essentially a process that is characterized by a change in a person. Changes as a result of the learning process can be indicated in various forms such as changing the knowledge, understanding, attitudes and behaviors, skills, abilities, and changes in other aspects that exist in individual learning. (Trianto, 2010: 9)

Someone called learn mathematics when occurs an activity which results in a change in behavior related to mathematics. Learning mathematics is a mental activity to understand the concepts in mathematics which is then applied to other situations. So, learning mathematics is also a process of deliberate activity to gain a new knowledge linking symbols and connecting structures to gain an understanding and application of concepts in real situations. Learning mathematics is also an active process intended to acquire new knowledge, resulting a change in a person that is related to behavior changes towards a better mathematician.

There are some definitions about achievement suggested by some experts, including: according to Abdurrahman (2010: 37), the student's achievement is an ability gain by the students after learning activities. Learning is a process of a person who seeks to obtain a form of behavioral change that is relatively sedentary. In this learning

activity is called programmed and controlled learning activities or instructional activities, learning objectives set in advance by the teacher. The students who succeed in learning are successfully achieving learning goals or instructional purposes.

In order to support the learning of mathematics in school should be developed a mathematics curriculum concepts that are used in a clear and focused so that the process of learning mathematics can run as expected. And, more importantly, learning math can be used to equip students with critical thinking skills, logical, and systematic. Learning mathematics has become a necessity for an individual's full development in today's complex society (Ignacio,et al, 2006:16).

Cooperative learning is a learning approach that focuses on the student learning activities in small groups to maximize the learning conditions to achieve specific goals. Sanjaya (2010: 242) defines the cooperative learning is an instructional model using a system of grouping / small team, which is between four to six people who have the academic background, gender, race, or ethnicity is different (heterogeneous).

The activities in cooperative learning conducted in group learning activities, so that the participants can inter learning through the exchange of ideas, experiences and ideas. Each member of the group is working hard to learn, encourage and motivate other members to mastering the subject matter, so they can achieve the group's objectives. According to Steen (Bergeson, 2000: 53), learning mathematics in cooperative groups is effective, especially for younger students. When the students reach high school, the research evidence is less clear, as these students exhibit stronger individual motivations, interact socially in more complex ways, and often are defensive or embarrassed about their knowledge and learning in mathematics.

Jigsaw was developed and tested by Elliot Aronson and his colleagues at the University of Texas and then adapted by Slavin and his colleagues. (Arends, 1998: 317)

Essentially, in this model the teacher divides the unit of information into smaller components. The teacher divides the students into cooperative learning groups that consist of four students so that each member is responsible for the control of each component/sub-topics assigned to the best. Students from each group are responsible for the same subtopic forming more groups consisting of two or three people.

These students work together to complete the cooperative task in: (a) learn to become an expert in the subtopic part, (b) planning how to teach subtopics to other members of the initial group. After that, these students return to their groups as "experts" in his sub-topic and teach the important information of subtopic to his friend. The experts in others subtopic also do the same one, so that all students are responsible for demonstrating his capability of all materials are assigned by the teacher. Thus, each student in the group must master the subject as a whole. (Komalasari, 2010: 65).

The steps of jigsaw type's cooperative learning by Hanafiah and Suhana (2010: 44) are as follows:

1. Students are grouped into teams of 4 members
2. Everyone in the team is given a different part of the material.
3. Everyone in the team is given a piece of assigned material
4. The different members of the team have been studying part/section of the same meeting the new group (expert group) to discuss their section.
5. After completed the discussion as a team, each member returned to the home team and take turns teaching their teammates about their section and listen to every other member.
6. Each team of experts presented the results of the discussion
7. Teachers provide evaluation
8. Closing

3. Research Method

The type of this research is a classroom action research to improve the quality of learning in the classroom. The main purpose of action research is to solve the problems associated with learning problems in the classroom. Through action research learning issues can be studied thoroughly so that the process of innovative learning and achievement of learning goals can be actualized as systematically. Research was conducted in the second grade, State Senior High School of Kisaran, Indonesia.

4. Result and Discussion

4.1 Cycle 1

Before doing the learning on the subject of research, firstly researchers did the observation to the last formative achievement of students; the aim was to form groups for discussion. The data of last formative achievement can be seen at table 1.

Table 1. The Level of Student Mastery In Previous Formative

Percentage of Completeness	Level of Mastery	Amount	Percentage of Students
< 65	Did Not Complete	21	65,63%
≥ 65	Completed	11	34,37 %
Total		32	100%

From the table 1. we can see that only 11 students or approximately 34.37% of students can achieve the level or completeness the mastery learning from all students in the second grade. Of course the percentage of completeness is far from standard classical mastery learning that 85% of students who can achieve the percentage of mastery learning outcomes ≥ 65%. So it can be concluded that student learning outcomes were still low.

The implementation of action I by conducting the learning process that appropriate with lesson plan, where the researcher acted as the teacher in classroom. The Learning process conducted in the second grade at 2 meetings with time allocation 4 hours of lesson (4 x 45 minutes). The meeting in cycle I conducted on March 30th 2013 and April 6th 2013 with the subject of polynomial

Tests conducted at the end of the meeting in cycle I to know improving student learning outcomes after aplying cooperative learning type jigsaw. After the data obtained then assessed and processed so it can be determined the minimum, maximum, and the average value of student listed at table 2.

Table 2. Minimum, Maximum and Average Value of Student Based on Achievement Test I

Minimum value	35
Maximum value	90
Average	67,56

Based on the results of students achievement test using cooperative learning jigsaw on the material type polynomial as follows (Tabel 3):

Table 3. Level of Student Mastery Learning Cycle I

Percentage of Completeness	Level of Mastery	Amount	Percentage of Students
< 65	Did Not Complete	9	28.12%
≥ 65	Completed	23	71.88 %
Total		32	100%
Mean of Students Achievement			67.56

Based on the table 3. above it can be concluded that there are 23 students (71.88%) can achieve the level of mastery learning and 9 students (28.12%) can not achieve the level of mastery learning. From the result of students achievement test cycle I after conducted cooperative learning type jigsaw, the class can achieve 71.88% of mastery learning. This is not in accordance with the criteria of 85% classical mastery learning so it still does not meet the set targets. Therefore it is necessary to improvement learning in cycle II which is expected to enhance students' mastery learning.

From previous formative test scores and results of achievement test cycle I, obtained an increasing about 37.51%. From 34.37% to 71.88% at previous formative to achievement test cycle I. The achievement test I used as a reference in giving action on the cycle II and to overcome the learning difficulties of students in solving problems of polynomial.

4.2 Cycle II

Based on the analysis of the action in the cycle I, learning activities continued in the second cycle. At this stage the researcher makes the alternative solutions continue to use cooperative learning type jigsaw. But in the cycle II is performed some action to avoid some errors like in the first cycle such as do not combine students who are less active in the same group, both in home teams and expert. It aims to increase the activity of students in a discussion to reduce the dominance in group discussions. In addition, teachers should also give more direction and monitor the discussion so that students are more active in the discussions of expert teams and home teams. The steps were taken in the action plan II are a lesson plan that will be implemented in the cycle II.

Giving action in cycle II to implement the learning in accordance with the plan that had been developed, the researcher acted as a teacher in the classroom. Learning is done in the second grade by 2 meeting with the allocation of time of 4 hours of lessons (4 x 45 minutes). The Meeting in the first cycle was held on April 13th 2013 and April 20th 2013. Subject matter presented is an advanced material polynomial.

At the end of the meeting in cycle II did achievement test II to determine the increasing of student achievement after improved the cooperative learning type jigsaw. After the data obtained is then assessed and processed so it can be determined the minimum, maximum, and the average value of students as listed in the table 4.

Table 4. Minimum, Maximum and Average Value of Students Based on Achievement Test II

Minimum Value	50
Maximum Value	92
Average Value	80.09

Based on the achievement test results of students using cooperative learning type jigsaw on polynomial is as follows (table 5)

Table 5. Level Students Mastery Learning Cycle II

Percentage of Completeness	Level of Mastery	Amount	Percentage of Students
< 65	Did Not Complete	4	12.5%
≥ 65	Completed	28	87.5 %
Total			100%
Mean of Students Achievement			80.09

From the table 5 above we can see that 4 people (12.5%) of students not achieve mastery learning. From the table we can also see that students achieve mastery learning as 28 students (87.5%) who can achieve mastery learning. This means that the percentage of students achieved mastery learning which exceeds the classical criteria of mastery learning by 85%. So, based on mastery learning criteria can be concluded that the class has been thoroughly studied on the subject of polynomial. Thus it can be said that the jigsaw cooperative learning can improve student learning outcomes on the subject of polynomial.

4.3 Discussion

The study was conducted in the second grade, State Senior High School of Kisaran, Indonesia by applying the Jigsaw cooperative learning model on the subject of polynomial. To know the increasing of student achievement can be seen in the following graph (figure 3).

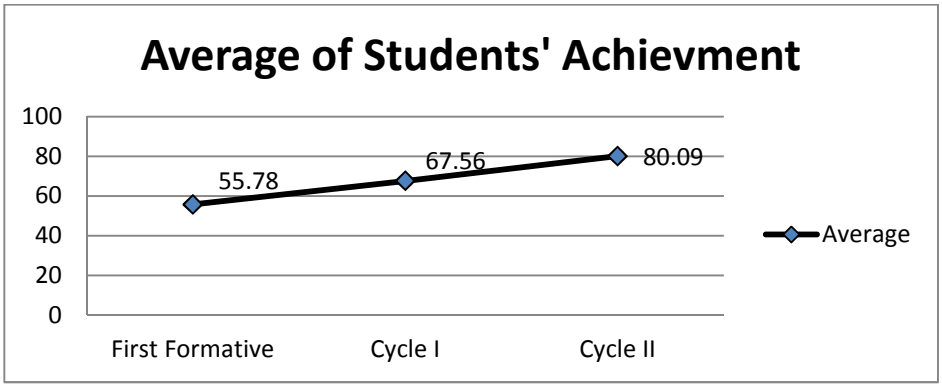

Figure 3. Average of Students' Achievement

From the chart above (figure3) we can see that there is an increasing in students' achievement from the previous formative where the average values 55.78 increases about 11.78 to 67.56 in the cycle I after doing cooperative learning model type jigsaw. Then after the implementation of the achievement test cycle II occurred an increasing the average of student achievement around 12.52 to 80.09. This is show that the model of cooperative learning type jigsaw can improve students' achievement. Then to know the increasing of classical mastery learning can be seen in the following graph (figure 4).

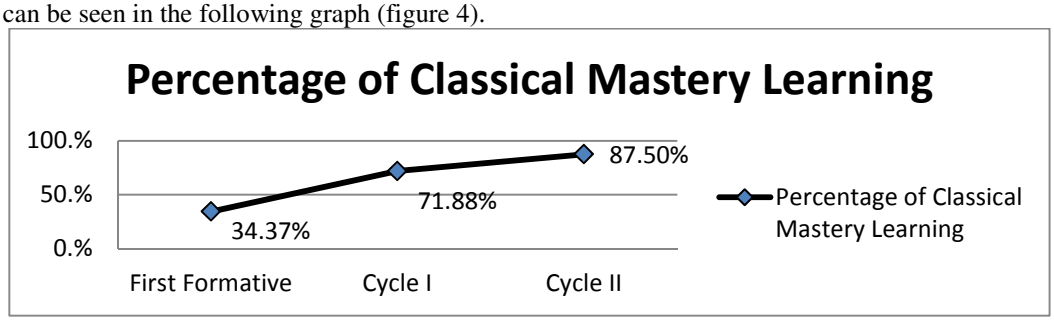

Figure 4. Percentage of Classical Mastery Learning

From the chart above (figure 4) we can see there is an increasing in the percentage of classical mastery learning after conducted model cooperative learning type jigsaw. In the previous formative the percentage of student classical mastery learning increase from 34.47% to 71.88% in the cycle II. This means that there is an increase of percentage about 37.51% at the percentage of classical mastery learning after cooperative learning type jigsaw. There were 21 students that can not achieve the level of mastery learning in previous formative, while after conducted cooperative learning type jigsaw and achievement test I reduced to 9 students. There was increasing of student's classical mastery learning after conducted cooperative learning type jigsaw and achievement test cycle II about 15.62% to 87.50% in the cycle II. This means that the class has achieved classical mastery learning 85% so that it can be stated that the class has completed the study polynomial. While students who can not achieve the mastery learning was 4 students or approximately 12.5%.

From the discussion of the results of this study can be concluded that there was increasing of students' achievement and classical mastery learning in the second grade, State Senior High School of Kisaran, Indonesia after conducted cooperative learning type jigsaw.

5. Conclusion

It has been proven that the implementation of cooperative learning type jigsaw increase of students' achievement in polynomial. The improvement is also shown from increasing students' learning process. The increasing of student s' achievement in polynomial was significant.

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