Application of Learning Engineering Techniques Thinking Aloud Pair Problem Solving in Learning Mathematics Students Class VII SMPN 15 Padang

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Abstract. The students activity and responsible in studying mathematic is still lack. It gives an effect for the bad result in studying mathematic. There is one of learning technic to increase students activity in the classroom and the result of studying mathematic with applying a learning technic. It is “Thinking Aloud Pair Problem Solving (TAPPS)”. The purpose of this research is to recognize the developing of students activity in mathematic subject during applying that technic “TAPPS” in seven grade at SMPN 15 Padang and compare the students proportion in learning mathematic with TAPPS between learning process without it in seven grade at SMPN 15 Padang. Students activity for indicators 1, 2, 3, 4, 5, 6 at each meeting is likely to increase and students activity for indicator 7 at each meeting is likely to decrease. The finding of this research is $\chi^2 = 9.42$ and the value of $p$ is $0.0005 < p < 0.005$. Therefore $p < 0.05$ has means $H_0$ was rejected and $H_1$ was accepted. Thus, it was concluded that the activities and result in studying mathematic increased after applying learning technic the TAPPS.

1. Preliminary
Education plays an important role to improve the quality of human resources. Improving the quality of human resources at a given time is determined by relevant educational innovations. If education does not follow changes occurring at a certain time, then education will be out of date. Therefore, the government made various innovations in the teaching system including in mathematics learning such as: improving the quality of mathematics teachers by doing training / training, equipping educational facilities and infrastructure as well as perfecting the curriculum.

Based on the observations that researchers do in class VII.2, VII.3, and VII.5 at SMPN 15 Padang on November 28, 2014 up to December 2, 2014, it appears that students are less active in the learning process. When the teacher asks students to ask things that have not been understood no students are asking. However, when the teacher asks only one or two students are trying to answer and people tend to be the same. While the other students much silent and not motivated in studying the material. This can be seen when the teacher explains the material of some students chatting, annoying his friends, and scribbling his notebook.
Further problems in group discussions, student participation are uneven, there are students who want to fully take over the work of the group and vice versa most students ignore their responsibilities in group work and only rely on their friends. So not all members of the working group, most of the students chatting outside the topic of discussion with a group of friends, just waiting for an answer from a group of friends and do not want to try to complete the exercise. In addition, in group presentations dominated by smart students and other students simply copying the results of group discussions that are presentations on each note.

Based on the results of interviews that researchers conducted on December 2, 2014 with one of the teachers of mathematics in class VII SMPN 15 Padang, Ifawani mother obtained information that students rarely express opinions during the learning and students difficulty in understanding the example of the problems contained in the handbook. When given the form of the problem slightly different from the example problem, only some students who can do well even most of the students difficult in working on problem solving problems. In solving problems students are less motivated to think independently, students difficulty in understanding the purpose of the problem, choosing the right strategy used in problem solving and students difficulty in developing the strategy to solve the problem. This is because students have not understood the subject matter so that students can not analyze the problems contained in the problem.

Furthermore, the teacher also stated that the result of the students' mathematics learning in the middle of odd semester examination of class VII SMPN 15 Padang in the academic year 2014/2015 is still low that can be seen in Table 1.

| Class  | Number of Student | Completed Students | Total | Percentages |
|--------|-------------------|--------------------|-------|-------------|
| VII.1  | 36                | 25                 |       | 69.44       |
| VII.2  | 36                | 7                  |       | 19.44       |
| VII.3  | 36                | 6                  |       | 16.67       |
| VII.4  | 35                | 4                  |       | 11.43       |
| VII.5  | 33                | 5                  |       | 15.15       |
| Total  | 176               | 47                 |       | 26.70       |

Source: Math Teacher Class VII SMPN 15 Padang

Based on Table 1 it can be seen that there are still many students who have not fulfilled the Minimum Exhaustiveness Criteria (KKM) set at SMPN 15 Padang that is 75 except class VII.1 because the class belongs to the superior class.

In overcoming this problem, needed a learning technique that can improve activity and result of student learning that is Thinking Aloud Pair Problem Solving Technique (TAPPS). In this TAPPS learning technique, students are divided into pairs, one acts as a problem solver, and the other acts as a listener. For the next question there was a change of role. With TAPPS learning techniques each student has responsibility for the task given so that each student to take an active role in learning.

The purpose of this study is to determine the development of student activity in learning mathematics during applying TAPPS learning techniques and compare the proportion of students who achieve mastery learning mathematics by applying TAPPS learning techniques and the proportion of students who achieve mastery learning mathematics by applying regular learning in class VII SMPN 15 Padang.

Learning is the unity of the learning components that are related to each other. These components include: objectives, materials, methods and evaluation. In choosing and determining the media, methods, strategies, techniques and approaches that will be used in the teaching and learning process, the teacher should pay attention to these four components of learning.
This is in line with Hamalik's view (in Hosnan 2014: 18) which says that: "learning as a combination is composed of human elements, materials, facilities, equipment and procedures that influence each other to achieve learning goals".

In the learning of mathematics the active role of students is necessary. Gagne's learning theory cited by Suherman (2003: 33) states that:

In learning mathematics there are two objects that can be obtained by students that is direct object and indirect object. Indirect objects include the ability to investigate and solve problems, self-study, be positive about mathematics and know how to learn. While direct objects in the form of facts, skills, concepts, and rules.

Based on above learning theory, in learning mathematics students will get various facts, skills, concepts, and rules as well have the ability to investigate, solve problems, learn independently, be positive about mathematics, and know how to learn the right way.

Cooperative Learning is a learning that divides students into small groups to solve a problem. Suherman (2003: 260) states that:

Cooperative learning includes a small group of students who work as a team to solve a problem, complete a task, or do something to achieve another shared goal.

Based on the quotation, it can be concluded that cooperative learning emphasizes students to work together and be responsible to a team in solving a problem or task. So that high-ability students will try to help other members who have low ability to achieve group goals.

Cooperative learning is very concerned about heterogeneity. Students are divided into multiple pairs. The division of pairs in this study considers students' academic abilities for example, high-ability students are paired with low-ability students.

TAPPS learning techniques include one of the structures of cooperative learning methods. TAPPS is expressed by Lochhead and Whimbey (in Warsono and Hariyanto 2013: 92) "as a way of developing problem-solving skills by verbally declaring, reading aloud the problems to be solved". The word loud has enough understanding to hear her partner. In line with Kotsopolus's opinion in (Kani, 2015: 20) TAPPS aims to develop students' cognitive processes related to problem solving In TAPPS learning techniques students are divided into pairs, one of which acts as a problem solver, the other acts as a listener. The problem solver reads the written problem that the teacher asks loudly. Then the problem solver also verbally resolved the problem to the listener. The listener follows all the steps done by the problem solver, listens to what the problem is, how the solution proposed problem solver, advises the problem solver, and the listener must also understand the reasoning process behind the problem solving steps posed by the problem solver. This involves asking the problem solver if the expression is not clear. For the next question there was a change of role, problem solver becoming listener and vice versa. And so on until the question runs out or the time provided for the learning runs out. A. Whimbely and J. Lochhead (in Ilie, 2016 : 278) described this strategy that involves thinking and learning in pairs, by rotating roles. Students are more involved and become more active.

Articulating the problem-solving process yourself and listening carefully to solving other people's problems will help students practice what they have read or heard in their learning. In addition, Kotsopolus (in Kani, 2015 : 21) highlighted in her study on examining instances of talking aloud during peer collaborations in mathematics that it is important to teach the students both on how to express their thinking and their learning needs and how to attend to each other's thinking and learning needs in such settings.

The steps of TAPPS learning techniques (in Barkley 2012: 260) are:

1. Ask students to form partners and explain to them the roles of problem solvers and listeners. The problem solving role is to read the problem verbally and to articulate the reasoning process used in solving the problem. The role of the listener is to encourage problem solving to think verbally, and to illustrate the problem-solving steps. Listeners can also ask clarification questions and offer suggestions, but should refrain from solving problems.

2. Ask students to solve a number of problems, change roles for each new problem.
3. Activities be stopped if the student has successfully solved all the problems.

The steps of the application of TAPPS learning techniques that researchers apply are as follows: (1) The teacher explains the rules of the game and the time limit for each activity, (2) The teacher asks the students to sit in pairs based on the partner who has been determined, (3) The teacher explores the initial knowledge of the students by conducting question and answer on the material that has been submitted, (5) The teacher gives the question sheet and answer sheet to each pair, (6) For the first problem solver 1 read out the problem orally and use his skills in solving the problem, while explaining each step of completion to listener 1, (7) Listener 1 observed the process solving problems, responding if there is a wrong solution, advising if problem solver finds it difficult and asking if there is anything that is not understood, (8) The teacher walking around the classroom provides guidance and helps smooth the discussion. If a partner has difficulty in solving the problem, the teacher can help by becoming a listener, by asking questions that lead to problem solving, (9) Problem solver 1 and listener 1 exchanging roles and re-discussing such as steps 6 and 7 to complete question the other, (10) The group that has solved the problem faster than the specified time will get the bonus as an additional value, (11) After all the questions have been answered, the teacher selects a random pair to convey the problem-solving steps in front of the class (12) Students and teachers conclude the lesson of the day, (14) The teacher rewards the couple who can explain the problem-solving steps well in front of the class, (15) The teacher give homework to students.

Learning is a process by which students must be active. Teachers only present lesson materials, while processing and digesting are the students themselves according to their will and their respective abilities. Montessori (in Sardiman 2010: 96) asserted that "children have the power to develop on their own, forming themselves. Educators will act as mentors and observe how the development of their students ".

Based on the description Montessori can be explained that students who do more activities in the learning, while the teacher is only tasked to provide guidance and observe the development of students during the learning process takes place. Thus, it is clear that the subject students / students must be active in learning activities. So, in learning is necessary activity. Without activity, the learning process may not take place properly.

The types of activities in learning according to Paul B. Diedrich (in Sardiman 2010: 101) are:

a. Visual activities, which include, for example, reading, watching images of demonstrations, experiments, other people's work.

b. Oral activities, such as: stating, formulating, asking, advising, issuing opinions, conducting interviews, discussions, interruptions.

c. Listening activities, for example listening: descriptions, conversations, discussions, music, speeches.

d. Writing activities, such as writing stories, essays, reports, questionnaires, copying.

e. Drawing activities, for example: drawing, graphs, maps, diagrams.

f. Motor activities, which include: experimenting, constructing, refit modeling, playing, gardening, raising.

g. Mental activities, for example: responding, remembering, solving problems, analyzing, looking at relationships, making decisions.

h. Emotional activities, like for example, are interested, bored, excited, passionate, passionate, brave, calm, nervous.

Of the eight activities proposed by Diedrich, the researchers limit the activities to be observed in this study of oral activities, listening activities, writing activities and emotional activities. Indicator used to know the student activity during the learning process take place that is:

a. Oral activities

- Ask questions related to the material being studied
- The problem solving steps to their partner.
• Responding to the settlement of the partner.

b. Listening activities
• Listen well the explanation of the partner in solving the problem.
• Listen well the results of the answers presented by other couples.

c. Writing activities
• Recording or copying the material learned

d. Emotional activities
• Doing distorted behaviors, for example: talking outside topics, interrupting friends, making a fuss, doing other work and going out of the classroom.

2. Methodology
The type of this research is experimental research. According Sukardi (2007: 16) suggests that experimental research is a study that divides the object or subject studied into two groups, the treatment group or who get treatment and the control group who did not get treatment. This research is used to see the relationship and influence between one variable with other variables.

Based on the type of research above, this research is conducted on two classes, namely experimental class and control class. The experimental class is a class whose learning uses TAPPS learning techniques and control classes is a class whose learning uses ordinary learning.

The population is the whole of the sample under study. The population in this research is the students of class VII SMPN 15 Padang. The sample is part of the population, all the sample characteristics are the same as the population. In this study, the experimental class is class VII.2 and the control class is class VII.3.

Data collection tool in this research is observation sheet and test results of mathematics learning. From the observation sheet, the improvement and decrease of the students' learning activity during the application of TAPPS learning technique in the experimental class. The test of learning result is used to find out whether the result of learning mathematics of student by applying TAPPS learning technique better than result of learning of student mathematics by applying ordinary learning.

The data analysis techniques in this study are:

2.1 Student Learning Activity
To know the development of student learning activities during applying TAPPS learning techniques used observation sheet. Data on student learning activities were analyzed using the formula put forward by Sudjana (2013: 130) namely:

\[ P = \frac{F}{N} \times 100\% \]

Information:
\( P \) = Percentage of students performing activities
\( F \) = Number of students doing the activity
\( N \) = Number of students

2.2 Learning outcomes
Find out whether there are differences in learning outcomes from two independent sample classes, the experimental class applies the lesson using TAPPS learning technique and the learning control class using ordinary learning then hypothesis test. The hypothesis to be tested in this research is as follows:

\( H_0 \): The proportion of students who achieve mathematics learning completion by applying TAPPS learning techniques is similar to the proportion of students who achieve mathematical learning by applying ordinary learning.

\( H_1 \): The proportion of students who achieve the mastery of mathematics learning taught by applying TAPPS learning techniques is higher than the proportion of students who achieve mathematical learning by applying ordinary learning.
To test this hypothesis we used the test $\chi^2$ for two independent samples. The steps in using the test $\chi^2$ for two independent samples put forward by Siegel (1985: 136-137) as follows:

a. Enter observation frequencies in a $2 \times 2$ contingency table, as shown in Table 2.

**Table 2. Format Table Number of Students Experiment Class and Control Class According to KKM Achievement**

|                | Experiment Class | Control Class | $\Sigma$ |
|----------------|------------------|---------------|----------|
| Value $\geq$ KKM | A                | B             | A+B      |
| Value $<$ KKM   | C                | D             | C+D      |
| $\Sigma$       | A+C              | B+D           | N        |

Information:
A: Number of completed students in the experimental class
B: Number of students who complete the control class
C: Number of unfinished students in experiment class
D: Number of unfinished students in the control class
N: Total number of students in the experimental class and control class

b. Compute $\chi^2$ with the formula:

$$\chi^2 = \frac{N(AD-BC)^2}{(A+B)(C+D)(A+C)(B+D)}$$

with $db = 1$

c. Determine the significance of $\chi^2$ observation with reference table $\chi^2$. For a one-sided test, for two levels of designated significance. If the probability ($p$) given by Table $\chi^2$ is equal to or less than $\alpha$, then reject $H_0$ and accept $H_1$.

3. Results and Discussion
1. Student Learning Mathematics Activities

In learning is necessary activity. Without activity, the learning process may not take place properly. To know the development of student learning activity in experiment class is used observation sheet. At the time of the study, this observation sheet was filled at each meeting by two observers ie teachers of mathematics studies SMPN 15 Padang and colleagues.

The description of student activity obtained from the observations on each indicator observed during applying TAPPS learning technique is as follows:

1) Submit a Question Related to the Lesson being Learning

Activity is still relatively small. This is because students are still embarrassed to ask questions.

2) Stating the Problem Solving Steps to the Spouse

The percentage of students who do listening activities with good explanation of their partner in solving the problem has increased from the first meeting until the sixth meeting. This is because students have begun to understand what kind of responses will be given and students are getting used to writing their responses on the answer sheets provided specifically for students who act as listener.

3) Provide Response to the Settlement of the Spouse

The percentage of students performing activities responding to the settlement of their partner has improved from the first meeting until the sixth meeting. This is because students have begun to understand what kind of responses will be given and students are getting used to writing their responses on the answer sheets provided specifically for students who act as listener.

4) Listening Well Explanation of the Couple in Solving Problems

The percentage of students who do listening activities with both explanations from their partners in solving the problem increased from the first meeting until the sixth meeting. This is due to the
increasing number of students who serve as problem solver states the steps to solve the problem to his partner who acts as a listener and the less students do other activities that are not related to learning mathematics.

5) Listen Well the Results of Answers Presented by Other Couples
The percentage of students who do a good listening activity results of answers presented by other couples increased from the first meeting until the sixth meeting. This is due to good class control and motivation by researchers to students.

6) Recording or Copying Learning Materials
The second meeting there is a decline. This is due to the lack of students who recorded at this meeting. When the researcher gives the students time to take note of the material that has been described, there is a teacher picket who enters the class to ask the students for each student’s contribution and announce to the students that in the farewell event each class should have an entertainment show. As long as the teacher is in the class there are some students who are busy discussing with his friends about what appearances they will perform at the farewell show, some even just listening to the teacher speak. After the teacher came out of the class, the researcher directly gave the answer sheet and answer sheets and asked the students to do it with the TAPPS technique, this is done because the researchers remember the remaining time for only 40 minutes and this is why many students do not record at the second meeting.

7) Doing Distorted Behavior, For example: Speaking Outside Topics Discussion, Interfere Friend, Fussy, Working on Other Tasks and Entry Exit Class
The second meeting the percentage of students who do the deviant behavior increases which causes the same as the declining percentage of students who perform activities to record or copy the material that has been described previously. On third to sixth meetings, the percentage of students who behaved misbehaved continued to decline.

In the experimental class the researcher is assisted by two observers who monitor the students' activeness during the learning process takes place. The student activity is seen from the seven indicators contained in the observation sheet. In general at indicators 1, 2, 3, 4, 5, and 6 there is an increase in the percentage of students who perform activities for each meeting. Although, there are still activities that percentage up and down. In the 7th indicator of student activity performing deviant behavior, for example: talking outside topics, disturbing friends, fussing, doing other tasks and going in and out of class tends to decrease from first meeting till the sixth meeting. This happens because most students have performed activities on indicators 1, 2, 3, 4, 5, and 6 so that only a few students are still doing deviant behavior.

2. Student learning outcomes
To find out whether there are differences in learning outcomes between the experimental class and control class, data analysis is done by testing the hypothesis. To test this hypothesis test used \( \chi^2 \).

Before determining the value of \( \chi^2 \), first the number of experimental class and control class students according to the achievement of KKM as in Table 3.

| Table 3. Number of Students of Experiment Class and Control Class According to KKM Achievement After Final Test |
|---|---|---|
| | Experiment Class | Control Class | \( \Sigma \) |
| Value \( \geq \) KKM | 24 | 10 | 34 |
| Value < KKM | 12 | 26 | 38 |
| \( \Sigma \) | 36 | 36 | 72 |

Based on the above table, using the test \( \chi^2 \) for two independent samples is calculated and obtained values \( \chi^2 = 9.42 \) and \( 0.005 < p < 0.005 \). Therefore \( p < 0.05 \) means reject \( H_0 \) and accept \( H_1 \). Thus,
it is concluded that the proportion of students who achieve mathematics learning completion by applying TAPPS learning techniques is higher than the proportion of students who achieve mathematics learning completion by applying ordinary learning. This means that students 'mathematics learning outcomes by applying TAPPS learning techniques are better than the students' mathematics learning outcomes by applying ordinary learning.

During the application of TAPPS learning techniques in the experimental class, it appears that students are more active in learning. This is visible when the student given the opportunity to ask, asks people who are willing to ask questions. In the discussion of students who do not understand the material to ask his partner without shame because his partner is a peer. In addition, students also provide suggestions to their partners if there is a wrong solution so that a positive impact on mastery learning. Thus, by applying TAPPS learning techniques can give a good influence on the activity and mastery of mathematics learning outcomes.

The results of the TAPPS learning techniques will help students practice what they have read and hear in the learning so that students can get better learning outcomes. Percentage mastery of student learning outcomes by class in experiment class is 66.67% and control class is 27.78%. Although the percentage in the experimental class is higher but according to Depdikbud in Trianto (2010: 241) "A class is said to be complete learning (classical thoroughness) if there are ≥ 85% of students who have completed their study". This means the percentage of learning mastery in the experimental class has not been achieved well. Thus, students who have not completed completeness must make improvements (remedial) or be given additional tasks.

4. Conclusions
Based on the results of the discussion that has been done in the previous chapter it can be concluded:
1) Student learning activities in the classroom applying the TAPPS learning techniques from the first meeting to the sixth meeting on mathematics learning in grade VII SMPN 15 Padang tended to increase for indicators 1, 2, 3, 4, 5, and 6 and tended to decrease for indicator 7.
2) Students 'mathematics learning outcomes by applying TAPPS learning techniques are better than the students' mathematics learning outcomes that apply ordinary learning.

Reference
[1] Barkley, Elizabert. E., Cross, K.P., dan Major, C.H. 2012. Collaborative Learning Techniques. Jakarta: Nusa Media.
[2] Hosnan, M. 2014. Pendekatan Scientifik dan Kontekstual dalam Pembelajaran Abad 21. Bogor: Ghalia Indonesia.
[3] Ilie, Vali. 2016. How to Stimulate Future Teacher-Studens to Participate in Specific Instructive-Eduacational Activities.Romania : Journal Plus Education.
[4] Kani, Nekmahtul Hafizah Budi dan Masitah Shahrrill. 2015. Applying the Thinking Aloud Pair Problem Solving Strategy in Mathematics Lessons . Brunei Darussalam : Asian Journal of Management Sciences & Education
[5] Sardiman, A.M. 2010. Interaksi dan Motivasi Belajar Mengajar. Jakarta: Grafindo.
[6] Siegel, Sidney. 1985. Statistika Nonparametrik Untuk Ilmu-ilmu Sosial. Jakarta: PT Gramedia
[7] Sudjana, Nana. 2013. Penilaian Hasil Proses Belajar Mengajar. Bandung: PT. Remaja Rosdakarya.
[8] Suherman, Erman. 2003. Strategi Pembelajaran Matematika Kontemporer. Bandung : JICA
[9] Sukardi. 2007. Metodologi Penelitian Pendidikan. Jakarta: Bumi Aksara.
[10] Trianto. 2010. Mendesain Model Pembelajaran Inovatif-Progresif. Jakarta: Kencana Prenada Media Group.
[11] Warsono & Hariyanto. 2013. Pembelajaran Aktif Teori dan Asemen. Bandung: PT Remaja Rosdakarya.