

**THE DIFFERENCE OF PROBLEM – BASED LEARNING MODEL AND COOPERATIVE
TYPE OF THINK – PAIR – SHARE TOWARD
STUDENTS' MATHEMATICS ACHIEVEMENT ON TOPIC
OF STATISTICS IN GRADE XI SMA NEGERI 2 BALIGE**

Syafari¹ and Yohannes¹

¹. Faculty of Mathematics and Natural Sciences, State University of Medan
email: *fari0929@gmail.com*

². Faculty of Mathematics and Natural Sciences, State University of Medan

Abstract

The research is aimed to find out if there is a difference between Problem – Based Learning (PBL) Model and Cooperative Type of Think – Pair – Share (TPS) Model toward students' mathematics achievement on topic statistics. The type of this research is Quasi Experiment Research which was conducted in SMA Negeri 2 Balige. The population of this research is all regular students at SMA Negeri 2 Balige. The sampling technique applied was cluster random sampling. The experiment class I that is chosen XI Science 6 consist of 32 students, meanwhile the experiment class II that is chosen XI Science 7 consist of 31 students. The instrument used to measure the students' mathematics achievement was a multiple choice test. The data analysis technique was t-test at the level of significance $\alpha = 5\%$. From the data analysis of each of experimental class were obtained that the average score of posttest in experiment class I is 16.03 and the average score of posttest in experiment class II is 14.06. Then the test of hypothesis by using t-test which is $t_{\text{calculate}} = 3.057$ and $t_{\text{table}} = 2.000$ so that $t_{\text{calculate}} > t_{\text{table}}$ ($3.057 > 2.000$). Consequently H_0 is rejected and accepted H_a . So, it can be concluded that there is a difference between Problem – Based Learning (PBL) Model and Cooperative Type of Think – Pair – Share (TPS) Model toward students' mathematics achievement.

Keywords: Mathematics Achievement, Problem – Based Learning, Think-Pair-Share.

A. INTRODUCTION

Mathematics is one of the subjects used scientific thinking. Mathematics is indispensable to develop the ability logically, systematically, and critically thinking in students' self for supporting learning success. If learning success can be achieved, then it will be affect to produce qualified human for progression of country as the role of school. As said by Santosa (in Hudojo, 2005: 25) says the success of the country can be seen from mathematics progression since mathematics is the way that can represent all of the science.

National Council Teacher of Mathematics (NCTM, 2000: 4) explains that the need to understand and be able to use mathematics in everyday life and in the workplace has been greater and will continue to increase.

Mathematics and learning are close related each other. Learning is a process and an activity that is very crucial in levels of education. It means that the success and failure of educational goals achievement depends on the process experienced by students, both while students are in school, civil environment, and also in family. Learning is an effort to obtain a new experience through the change of behavior in the interaction with the environment.

The definition of learning completely stated by Slavin (2000: 141) that define learning is usually defined as a change in an individual caused by experience. Changes caused by development (such as growing taller) are not instances of learning. Neither are characteristics of individuals that are present at birth (such as reflexes and respons to hunger or pain). However, humans do so much learning from the day of their birth (and some say earlier) that learning and development are inseparably linked.

Based on the description above then can be concluded that learning is a continuous process of thinking and gaining knowledge and skill which is caused by experiences and make some changes in an individual.

According to Sudjana (2009: 22), learning achievement are the abilities of the students after he received his learning experience. Horward Kingsley divide three kinds of learning achievement, namely (a) the skills and habits, (b) knowledge and understanding, (c) attitudes and ideals. In this study, learning achievement are defined as the knowledge, skills and competences that people have acquired as a result of learning and can demonstrate if needed in a recognition process. However, not all outcomes can necessarily be measured, codified or assessed for recognition purposes.

According to Bloom, the learning achievement including cognitive, affective and psychomotor aspect. Cognitive domain are knowledge, comprehension, application, analysis, synthesis and evaluation. Affective domain are receiving, responding, valuing, organizing, and characterization. Psychomotor domain are initiatory, pre-routine, and routinized.

Mathematics achievement is the abilities of students after they received the mathematics learning experience. Mathematics learning achievement is the behavioral change in students, who observed and measured in terms of changes in knowledge, behavior, attitudes and skills after learning of mathematics. The changes are interpreted as the improvement and development to a better way than ever.

In this study, the researcher focused on the cognitive domain. Thus the cognitive domain is close related to Bloom's Taxonomy. Cognitive domain was developed by group of college educators and researchers, heads by Benjamin Bloom and published in 1956.

The taxonomy is designed to be a classification of the student behaviours which represent the intended outcomes of the educational process.

In fact, the students' mathematics achievement is still low. It can be shown from some condition. Beaton (1996: 22) shows the Comparison of Mathematics Achievement at Year 8 among Countries Participating in the TIMSS, the position of Indonesia among other countries participating in the TIMSS. It is seen that Indonesia is ranked number 39 out of 42 countries. Similar with TIMSS, LIPI (2008: 135) shows based on an annual survey conducted three PISA (Programme for International Student Assessment) in 2003, Indonesia ranks 40 from the 40 countries in terms of mathematics, science and reading. In the PISA survey for 2006 which has increased the number of countries to 57 countries surveyed, Indonesia ranked for math fell from rank 38 (of 40 countries in 2003) became the order of 52 of the 57 countries.

Mathematics is still a subject that is considered difficult and boring to many students. According to Woodard (in Zakaria et al., 2013: 1), weaker students feel anxiety toward mathematics, and this anxiety affects their performance in mathematics. Students who lack mastery in mathematics are less successful, despite being in secondary schools for a long period of time. Furthermore, low proficiency students in mathematics performed below average on the national tests in Indonesia.

Based on observations of high school mathematics students, the information shows that students are not actively involved in developing knowledge; they receive information passively and are less motivated. This passivity has caused much concern among educators because knowledge of mathematics plays a significant role in enhancing the country's social economic development.

The fact is also shown when the researcher doing Integrated Field Experience Program (PPLT) in SMA Negeri 2 Balige. The low of students' mathematics learning achievement is close relates with the learning process which has done by the teachers where the students in passive condition. The low of mathematics learning achievement in SMA Negeri 2 Balige is also shown from the mid test score of grade XI. From the data of mid test score of XI Science 4, 5, 6 and 7 (regular class), there are 50.39% of students who have not been reach the minimum standard criteria (KKM) that is 75

Based on the preliminary observation, it can be concluded that students' mathematics learning achievement is still low and unsatisfactory. The lack of students' mathematical ability of SMA Negeri 2 Balige is close related to the learning process which has done by the teachers where the teachers do not design learning scenario that more involve student's activity. The learning process is dominated by teacher while students are

made passive. It appropriates with the interview of mathematics teacher in SMA Negeri 2 Balige, Sir Marudut Simangunsong, S.Pd. He argued that although there are so many learning model can be used, but most of teachers still use the conventional learning because a lot of material should be taught and the limit of time make them to teach rapidly.

Therefore, to enhance the understanding and also the learning achievement of mathematics, students must be more active in the classroom and must creatively acquire knowledge, especially in understanding and solving mathematical problems through the use of Problem Based Learning model. The purpose of PBL is to encourage student development of critical thinking skills, a high professional competency, problem-solving abilities, knowledge acquisition, the ability to work productively as a team member and make decisions in unfamiliar situations, and the acquisition of skills that support self-directed life-long learning, self-evaluation, and adaptation to change.

PBL is the most significant innovation in education. Students are given the opportunity to find knowledge for themselves and to deliberate with others. Students in PBL acquire many important skills that are essential in life. PBL encourages students to take an inquisitive and detailed look at all issues, concepts, and problems within the given problem. It also enables students to develop skills, such as literature retrieval, critical appraisal of available information, and ability to seek information from peers and experts. Through self-directed learning, peer learning, team teaching and presentation activities, the cognitive processes are thus enriched.

PBL requires students to become responsible for their own learning. The PBL teacher is a facilitator of student learning, and his/her interventions diminish as students progressively take on responsibility for their own learning process. According to Azer (2008: 15), the main educational objectives of PBL as follows: use of problems to acquire a knowledge base that is easy to retain; development of the clinical reasoning and problem-solving skills characteristics of the expert clinician; development of self-directed learning skills; development of a professional attitude and non-cognitive skill such as empathy, communication and interpersonal skills; provision of a student-centered learning approach; and encouragement of independent critical thinking skill.

In other view, Zakaria and Iksan (in Zakaria et al, 2013: 1) told that the students should be given the opportunities to develop, to interact, and to share with friends through cooperative learning activity. Thus, the cognitive and affective development of students in mathematics can be improved. An alternative method for the delivery of material is cooperative learning. They agree that in cooperative learning students work face to face to

complete a given task collectively. Cooperative learning encourages students to be active participants in the construction of their own knowledge.

Cooperative learning also encourages students to interact and to communicate with peers in harmony. A study by Zakaria, Chin, and Daud (2010) found that cooperative learning improves students' achievement in mathematics. Think-Pair-Share (TPS) is one of the cooperative learning model that require student works together and cooperative so that the problem can be solved well. TPS is also suitable when applied to solve the mathematical problem.

Gregory (2007: 120) proposed that TPS is a great technique to facilitate wait time. Asking students to think by themselves, pair with other students, and share their ideas naturally gives students time to think, access information, and formulate better answers. This also decreases the chance of overstressing the student and increases the chances of the student actually thinking about and attending to the question that has been posed. It encourages all students to share thinking, not just the person called on to answer. Studies show that greater retention and student achievement will result when students are given more wait time for thinking. As the teacher comes to know the learners better and to recognize their levels of readiness, questions can be differentiated by level of complexity. This challenges learners at or just beyond their levels of comprehension or experience.

TPS learning model gives students more time to think, respond, and help each other. There are three reasons of using TPS. First, TPS helps students to think individually about a topic or answer to a question. Second, TPS teaches students to share ideas with classmates and builds oral communication skills. Third, TPS help focus attention and engage students in comprehending the reading material.

According Trianto (2009), problem – based learning model and Cooperative type of think – pair – share are two models which use the same foundation that is constructivist theory. Both of these models have in common in terms of problem – solving activities, and also in the syntax model of learning which begins with giving problems to the students so that they can train students' thinking skills, organize learners to think, present the results of the discussion then the teacher to evaluate the problems that have discussed, but PBL model and TPS learning model have a difference in the technical implementation of the solution of the problem. In PBL model, the technical implementation of solving the problem occurs in small groups of 4 – 5 people who jointly solve the problem, while in TPS learning model, the technical implementation of solving the problem of learners consists of 2 people are paired together to solve problems by the teacher.

Based on the previous research conducted by Laili (2010), she found in her hypothesis test that H_0 is accepted. It means that not enough reason to say that the learning achievement of students who are taught by cooperative learning model different with the learning achievement of students who are taught by problem – based learning model. While Ulfah (2014) in her research found that there was a significant differences on the student’s learning achievement of chemistry learning between the class which implemented problem – based learning model and the class which implemented think – pair – share model.

According to these two previous research, it is known that both the learning model has a similarity and also the different characteristics, but equally can improve students’ mathematics achievement. Then, the issue now is the researcher want to make sure that whether there is a significant difference in learning achievement between students who taught by problem – based learning model with students who taught by think – pair – share learning model.

Based on the explanation of background above, then researcher has interest-ed to do research entitled: “The Difference of Problem – Based Learning Model and Cooperative Type of Think – Pair – Share toward Students’ Mathematics Achievement on Topic of Statistics in Grade XI SMA Negeri 2 Balige.”

B. RESEARCH METHODOLOGY

The type of study which is used in this study is quasi – experiment study because the conditions of students cannot be controlled as a whole. The design of this study is *Quasi Experimental* with type of *Non – Equivalent Group Pretest – Posttest Design* that is experiments identified two groups, both of which are given experimental treatment. This study is conducted in two classes that are chosen randomly. These two classes are given the different action, those are experiment class I and experiment class II. In this case, the experiment class I is taught by using problem – based learning (PBL) model and experiment class II is taught by using cooperative learning model type of think – pair – share (TPS).

The design of this study can be seen from this following table:

Table 1. The Research Planning

Class	Pre – test	Treatment	Post – test
Experiment I	T_1	X_1	T_2
Experiment II	T_1	X_2	T_2

Explanation:

X_1 : Problem – based learning (PBL) model

X_2 : Cooperative learning model type of think – pair – share (TPS)

T_1 : Pre – test

T_2 : Post – test

The population of this study is all regular students at SMA Negeri 2 Balige for academic year 2014/2015. The sample of this study is taken by using cluster random sampling technique. In this case, the researcher chosen students in class XI MIA 6 which consist of 32 students as Experimental Class I taught by problem – based learning and XI MIA 7 which consist of 31 students as Experimental Class II taught by cooperative learning model type think – pair – share.

The variable of this study are independent variable which is problem – based learning model as model that used in experimental class I and cooperative type of think – pair – share model as model that used in experimental class II. The dependent variable used is students' mathematics achievement of cognitive aspect in the topic of statistics.

The instrument used is multiple choice test that is pre – test and post – test. Before the instrument used, researcher has done the validity test, reliability test, difficulty level index, and discrimination power of test. The calculation is helped by using Microsoft excel 2013. After the whole test were done, the instrument is ready to use in determine the student's mathematics achievement in both experimental class.

Based on the test of instrument, for pre – test there are 18 questions valid from 25 questions and for post – test there are 20 questions valid from 25 questions. The reliability of the instrument are high reliability. The difficulty level index of instrument are easy and medium. The discrimination power of test of instrument are strongly good, good, and some questions need revised.

Instrument pre – test and post – test are proportional. It means there is no difference of level between pre – test and post – test. After the pre – test given then the results will be used to determine the initial ability of students. It will used to dividing the students become groups according to the model used. Meanwhile the post – test were obtained after the treatment has been done were used to test the hypothesis, that is to see if there is a significant difference of learning model PBL (Problem – Based Learning) and TPS (Think – Pair – Share) learning model toward students' mathematics achievement in SMA Negeri 2 Balige.

The data were analysed by using Normality test, Homogeneity test, and t-test which is use the Independent Sample t-test.

C. RESULT AND DISCUSSION

The result of this research showed that there is no difference between problem – based learning model and cooperative learning model type of think – pair – share toward students' mathematics achievement at SMA Negeri 2 Balige.

The summary statistic descriptive for every treatment group are shown in the Table 2 below:

Table 2. Summary of Descriptive Statistic

Statistic	Pre-Test (Initial Test)		Post-Test	
	X ₁	X ₂	X ₁	X ₂
Mean	11.97	11.32	16.03	14.06
Median	12	11	15.5	15
Mode	12	11	17	15
Standard Deviation	2.51	2.55	2.52	2.59
Sample Variance	6.29	6.49	6.35	6.73
Range	10	10	9	14
Minimum	8	7	11	9
Maximum	18	17	20	20
Sum	383	351	513	436
Count	32	31	32	31

Notes:

X₁: Group of students by Problem – Based Learning (PBL) Model

X₂: Group of students by Think – Pair – Share (TPS) Model

Based on table above, the mean score of pre – test both of experimental class in not much different while on post – test the mean score of both experimental class are significantly difference. The mean score of PBL class is higher than mean score of TPS class. Thus, to determine whether there is difference between both model toward students' mathematics achievement will be used t-test.

Before analysing the data by using t-test, firstly done prerequisite test, which are normality and homogeneity test. Normality test is calculated by using Liliefors' test. Based on the result of normality test of pre – test, students' mathematics achievement taught by Problem – Based Learning (PBL) Model gives $L_{\text{calculate}}(0.152) < L_{\text{table}}(0.157)$ then the data has normal distribution. While for the students' mathematics achievement taught by Think

– Pair – Share (TPS) Model gives $L_{\text{calculate}}(0.158) < L_{\text{table}}(0.159)$ then the data has normal distribution.

While the result of normality test of post – test, for students' mathematics achievement taught by Problem – Based Learning (PBL) Model gives $L_{\text{calculate}}(0.121) < L_{\text{table}}(0.157)$ then the data has normal distribution. While for the students' mathematics achievement taught by Think – Pair – Share (TPS) Model gives $L_{\text{calculate}}(0.157) < L_{\text{table}}(0.159)$ then the data has normal distribution.

Next, the homogeneity test is calculated by using Fisher Test by comparing the both of variance in experimental class. The result of homogeneity of pre – test showed that $F_{\text{calculate}} (1.032) < F_{\text{table}} (1.835)$ that means the data came from the homogenous population. While the homogeneity test of post – test showed that $F_{\text{calculate}} (1.060) < F_{\text{table}} (1.835)$ that also means the data came from the homogenous population.

The data that has been analysed show that it is normally distributed and it came from the homogeneous population. Then the data analysis is continue by using t-test. The kind of t-test used is independent sample t-test. Testing is done on each variable, which is problem – based learning and cooperative learning type of Think-Pair-Share as independent variable and student's mathematics achievement as dependent variable. In this test, there are two hypothesis, they are:

$H_0: \mu_1 = \mu_2$ There is no difference between problem – based learning model and cooperative learning model type of think – pair – share toward students' mathematics achievement.

$H_1: \mu_1 \neq \mu_2$ There is a difference between problem – based learning model and cooperative learning model type of think – pair – share toward students' mathematics achievement.

Based on the t-test of pre – test is obtained $t_{\text{calculate}}(1.02) < t_{\text{table}} (2.00)$ and it means H_0 is accepted at significant level $\alpha = 0.05$. This means that learning models namely Problem – Based Learning (PBL) Model has no difference impact to the students' mathematics achievement compare with cooperative model type of Think – Pair – Share (TPS).

Because the hypothesis test of pre – test conduct a result that there is no difference between problem – based learning model and cooperative learning model type of think – pair – share toward students' mathematics achievement. It mean both two experimental class have the same initial ability. It will be continue to hypothesis test of

post – test to determine whether there is a difference between problem – based learning model and cooperative learning model type of think – pair – share toward students' mathematics achievement after the treatment is given.

Then the result of t-test of post – test is obtained $t_{\text{calculate}}(3.057) > t_{\text{table}}(2.000)$ and H_0 is rejected at significant level $\alpha = 0.05$. This means that learning models namely Problem – Based Learning (PBL) Model has a difference impact to the students' mathematics achievement compare with Think – Pair – Share (TPS) Model.

The study result above support the relevant study of Kusumah (2009) that states there is a difference between the students' electrical achievement taught by Problem – Based Learning Model and Think – Pair – Share Model and also relevant to the study of Ulfah (2014) also states that there is a difference between the students' chemistry achievement taught by Problem – Based Learning Model and Think – Pair – Share Model.

It can be accepted since by using Problem – Based Learning (PBL), students were placed as learning subject and try to gain or find the knowledge by themselves through the problems given. The students have a meaningful learning since the materials given by teacher is connected to the problem around the daily life. Student works as a team actively to solve the problem given. While in Think – Pair – Share (TPS) Model, although the students were placed as learning subject but the problem given to the students is not really as the problem faced by the students. Pairing makes the development of solution to be bounded. The students need more attention from teacher to help them solve the problem.

This study was done as perfect as possible by using the scientific procedural study, but it can't close the possibility of many limitations. The limitations are *first*, there were some student's error or difficulties to both of these two models. It could be shown in student's worksheet. The student's error was in interpreting and understanding to the problem given that made the students to be difficult in answering and solving the problems. These error was caused by some students who didn't involve, participate, and active to their discussion in their own group.

Second, the amount of group especially for TPS is influenced the learning process occurred. It also relates to the bad of time effectiveness management in group discussion. Some students looked not work well and participated to the discussion in their team. The weakness will disturbed the learning outcomes of students as a learning objective. Because of these weakness, for other researcher must pay attention when did the same research or involved the both PBL and TPS Model.

Third, this study only done in two treatment classes by using PBL and TPS Model, so that this study can't generalized into wider context, except that the characteristics of students and the material or learning topic are similar to the characteristics of this study.

From the explanation above can be concluded that the students' mathematics achievement taught by PBL Model different with students' mathematics achievement taught by TPS Model and PBL Model gives more effect than TPS Model to the achievement. It means the students' mathematics achievement taught by PBL Model is higher than mathematics achievement taught by TPS Model.

Based on the result above, Problem – Based Learning (PBL) Model or Think – Pair – Share (TPS) Model can be alternative learning model to improve the students' mathematics achievement. These model can produce the higher mathematics achievement rather than use conventional learning which not involved student actively.

D. CONCLUSION

Based on the result of research from data analysis and test of hypothesis then it can be conclude that: There is difference between problem – based learning model and cooperative learning model type of think – pair – share toward students' mathematics achievement at SMA Negeri 2 Balige. The students' mathematics achievement taught by Problem – Based Learning (PBL) Model is higher than students' mathematics achievement taught by Think – Pair – Share (TPS) Model.

REFERENCES

- Azer, Samy., (2008), *Navigating Problem – Based Learning*, Elsevier Australia, Australia.
- Beaton, A.E., et al., (1996), *Science Achievement in the Middle School Years*, TIMSS International Study Center Boston College, USA.
- Gregory, Gayle H. and Carolyn Chapman., (2007), *Differentiated Instructional Strategies: One Size Doesn't Fit All Second Edition*, Sage Publications Company, California.
- Hudojo, H., (2005), *Pengembangan Kurikulum dan Pembelajaran Matematika*, Universitas Negeri Malang (UM Press), Malang.
- Kusumah, Cipta Jayakarta., (2009), *Perbandingan Model Pembelajaran Problem Based Learning Dengan Model Pembelajaran Kooperatif Tipe Think Pair Share Terhadap Hasil Belajar Siswa Pada Program Diklat Mengoperasikan Peralatan Pengalih Daya Tegangan Rendah (MP2DTR) Di BPTP Bandung*, S1 Thesis, Universitas Pendidikan Indonesia.

- Laili, BintiNur., (2010), *PerbedaanHasilBelajarSiswa yang Diajardengan Model PembelajaranKooperatifdan yang Diajardengan Model PembelajaranBerdasarkanMasalahpadaMateriPokokBangunRuangSisiLengkungdi kelas IX SMP Giki 3 Surabaya, EngD thesis, UIN SunanAmpel, Surabaya.*
- LIPI., (2008), *Masyarakat Indonesia: MajalahIlmu-IlmuSosial Indonesia*, YayasanObor Indonesia, Jakarta.
- National Council of Teachers of Mathematics (NCTM)., (2000), *Principles and Standards for School Mathematics*, Reston, NCTM.
- Slavin, Robert., (2000), *Cooperate Learning: Theory, Research and Practice*, Allymand Bacon, London.
- Sudjana., (2009), *MetodaStatistika*, Tarsito, Bandung.
- Trianto., (2009), *Mendesain Model PembelajaranInovatif – Progresif*, Prenada Media Group, Jakarta.
- Ulfah, MeiriaMentari., (2014), *StudiPerbandinganHasilbelajar Kimia SiswaMenggunakan Model Pembelajaran PBL (Problem Based Learning) dan Model Pembelajaran TPS (Think Pair Share)*, Skripsi, UB, Bengkulu.
- Zakaria, Effandi, et al., (2013), *Journal: Effect of Cooperative Learning on Secondary School Students' Mathematics AchievementVol 4, No.2, 98-100*, Creative Education, Malaysia, Published Online February 2013 in SciRes (<http://www.scirp.org/journal/ce>).
- _____. (2010). *The effects of cooperative learning on students' mathematics achievement and attitude towards mathematics*. *Journal of Social Science*, 6, 272-275.