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A Comparative Study between the Use of Problem Based Learning Method and Expository Learning Method in SPLDV Material on Students' Mathematical Concept Understanding

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Abstract

Perbedaan Kemampuan Memahami Konsep Matematika Siswa Menggunakan Metode Pembelajaran Problem Based Learning (PBL) Dengan Metode Pembelajaran Ekspositori. Pada Materi Sistem Persamaan Linier Dua Variabel di Kelas VIII SMP Negeri 8 Pematangsiantar. Penelitian ini bertujuan untuk mengetahui perbedaan kemampuan memahami konsep matematika siswa yang menggunakan metode pembelajaran Problem Based Learning (PBL) dengan metode pembelajaran ekspositori pada materi sistem persamaan linier dua variabel. Populasi dalam penelitian ini adalah seluruh siswa kelas VIII SMP Negeri 8 Pematangsiantar. sampling, maka diperoleh sampel penelitian kelas eksperimen sebanyak 32 siswa. Instrumen yang digunakan adalah tes hasil belajar berupa soal uraian yang telah dilaksanakan di SMP Negeri 8 Pematangsiantar. Dari hasil belajar rata-rata hasil *pretest* = 30,29 dan rata-rata hasil *posttest* = 34,9. Kemudian homogenitas data diuji dengan menggunakan uji homogenitas varians F_{hit} = 1,77 < F (0,05; 29:30 = 1,89 dengan tingkat kepercayaan = 0,05 artinya sampel homogen karena F_{hit} tidak berada pada daerah kritis Dari hasil perhitungan harga t_{hit} = 1,86 untuk = 0,05 dan v = 59 dan tabel = 1,67 ternyata t hit berada pada daerah titik k, karena 1,86 > 1,67. Jadi dapat disimpulkan bahwa belajar siswa Hasil Belajar Menggunakan Metode Problem Based Learning Dengan Metode Ekspositori pada Materi Sistem Persamaan Linier Dua Variabel (SPLDV) di Kelas VIII SMP Negeri 8 Pematangsiantar.

Kata kunci: kemampuan pemahaman konsep, metode pembelajaran PBL, metode pembelajaran ekspositori, matematika

Abstract

Differences in Students' Mathematical Concept Understanding Ability Using Problem Based Learning (PBL) Learning Methods With Expository Learning Methods. On the Material System of Linear Equations of Two Variables in Class VIII SMP Negeri 8 Pematangsiantar. This study aims to determine the difference in the ability to understand mathematical concepts of students using the Problem Based Learning (PBL) learning method with the expository learning method on the material of a two-variable linear equation system. The population in this study were all eighth-grade students of SMP Negeri 8 Pematangsiantar. sampling, the experimental class research sample was obtained by as many as 32 students. The instrument used was a learning outcome test in the form of description questions that had been carried out at SMP Negeri 8 Pematangsiantar. From the results of the study, the average pretest result was 30.29, and the average post-test result = 34.9. Then the homogeneity of the data was tested by using the homogeneity test of variance Fhit = 1.77 < F(0.05; 29:30 = 1.89 with a confidence level of = 0.05 meaning the sample is homogeneous because Fhit is not in the critical area. the results of the calculation of the price t-hit = 1, 86 for = 0.05 and v = 59 and t table = 1.67 it turns out that t-hit is in the k-point area, because 1.86> 1.67. So it can be concluded that student learning outcomes are good Using Problem Based Learning Method with Expository Method on Two-Variable Linear Equation System Material (SPLDV) in Class VIII SMP Negeri 8 Pematangsiantar.

Keywords: *the ability to understand concepts, PBL learning methods, expository learning methods, mathematics*

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INTRODUCTION

Education is an effort to provide knowledge, insight, and expertise to individuals. This is stated in Law No. 20 of 2003 article 1 paragraph 1 concerning the national education system, that education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious-spiritual strength, self-control, personality, intelligence, noble character, and skills needed by him, society, nation, and state; Rohim, (2021); Mudanta, Astawan, & Jayanta, (2020). One of the fields of education that has an important role in improving the quality of education is mathematics education (Suryana, 2020). Mathematics as one of the subjects in school is considered to have played an important role, both in terms of mindset in shaping students to become qualified and in its application in everyday life (Fadila et al., 2020). Therefore mathematics is very important to be mastered as early as possible.

In the 2006 KTSP which was refined in the 2013 Use curriculum, (2016); Istiqomah, (2017), lists the objectives of learning mathematics as follows:

> (1) Understanding mathematical concepts, explaining the interrelationships between concepts, and applying concepts or algorithms, flexibly, accurately, efficiently, and precisely, in problem-solving; (2) Using reasoning on patterns and traits, performing mathematical manipulations in making generalizations, compiling evidence, or explaining mathematical ideas and statements; (3) Solving problems which include the ability to understand problems, design mathematical models, complete models and interpret the solutions obtained; (4) Communicating ideas with symbols, tables, diagrams, or other media to clarify situations or problems, and (5) Having an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention, and interest in learning mathematics, as well as a tenacious attitude and confidence in problem-solving.

Related to learning, the teacher's role is not only to provide information but also to position themselves according to the student's condition, and to understand what is going on in the students' minds which then facilitates student learning and develops student abilities. As *the National Council of Teachers of Mathematics* (NCTM) Sheppard & Wieman, (2020); Edelen & Bush, (2020), set standards for mathematical abilities such as concept understanding, problem-solving, reasoning and proof, communication and connection, and representation, which should be owned by students.

Based on the five main competency standards, the focus of this research is concept understanding ability. The ability to understand mathematical concepts is an important mathematical ability and needs to be mastered by students who study mathematics a. Diana et al. (2020) stated that understanding mathematical concepts includes low-level understanding and high-level understanding.

Mathematical understanding is a basic competency in learning mathematics which includes: the ability to absorb the material, remember mathematical formulas and concepts and apply them in simple cases or similar cases, estimate the truth of a question, and apply formulas and theorems in problem-solving.

According to Mawaddah & Maryanti (2016), the indicators of concept understanding ability are as follows:

1. Restate the definition of a concept.
2. Identify the relationship between the concepts studied.
3. Select, use, and utilize procedures or operations that are appropriate for the given problem.
4. Solve problems based on the properties of an object being studied.

Based on this explanation, the ability to understand concepts is a very basic and very important part. However, in reality, many students in Indonesia still have difficulty understanding mathematical concepts, this can be seen in Kompas (2019), the results of the *Program for International Student Assessment* Wu, Gao, &

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Shen, (2020) which shows the ability to understand basic concepts of Indonesian students aged 15 years in science, reading and math are still low. Indonesian students' ability in science 403, reading 397, and mathematics 386; below the average of countries that are members of the Organization for Economic Cooperation and Development (OECD), namely 493.493 and 490. Among ASEAN countries, Indonesia's rank is below Thailand and Vietnam.

Based on initial observations made by researchers in the form of diagnostic tests related to the ability to understand concepts in the Two-variable Linear Equation System in class VIII SMP Negeri 8 Pematangsiantar odd semester 2018/2019 academic year, there were errors and difficulties made by some students in making mathematical models from story questions about the ability to understand SPLDV concepts, which also shown from the results of students working on the following questions:

Andi bought 6 pencils and 3 drawing books for Rp. 24,000. at the same shop, Dani bought 8 pencils and 2 drawing books for Rp. 20,000. how much do 1 pencil and 4 drawing books cost?

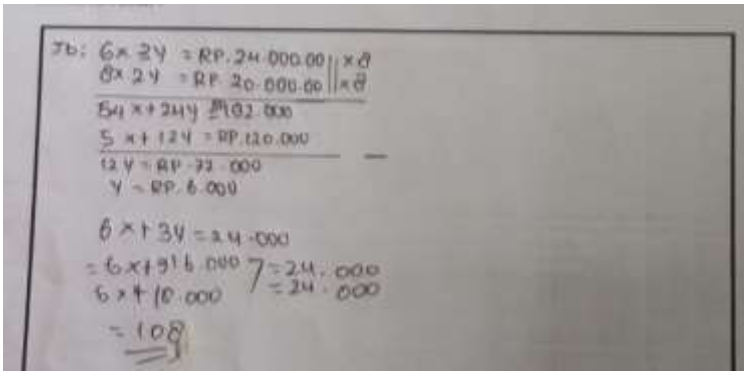

Figure 1. Student Worksheet

The researcher concludes that the students' work errors regarding understanding the concept of a two-variable linear equation system, namely students do not understand the concept of questions that are known and asked and students are still wrong in calculating. Therefore, the understanding of the concept of a two-variable system of linear equations at SMP Negeri 8 Pematangsiantar is still very low.

The low ability to understand students' mathematical concepts is shown by several factors, namely conditions where students are less involved in learning, lack of teacher motivation, students are still weak in understanding mathematical concepts, and difficult to express mathematical ideas contained in story problems to symbols or mathematical models, and the learning methods used are less varied. One of the learning methods that make students' ability to understand mathematical concepts low is the use of expository learning methods. According to Hamzah, A & Muslisrarini (2018: 272) that "The expository method is an integrated method consisting of the information method, demonstration method, question and answer method, practice method and at the end the lesson is given an assignment"

Based on this, an alternative that can create student activity and independence in learning is to use the *Problem Based Learning method.* According to Tri Pudji Astuti, (2019) that " *Problem Based Learning* (PBL) is a learning method that is presented by giving problems to students, the problems presented are problems that have a context with the real world, the closer to the real world, the better the effect on improving student skills. According to ASTUTI, (2019); Fatchurrohmah et al., (2017) learning using the *Problem Based Learning* (PBL) method begins with (1) First of all students are presented with a problem (2) Students discuss the problems in the PBL tutorial in small groups. (3) Students engage in independent study to solve problems outside of the teacher's guidance. this can include: libraries, *databases, websites,* communities, and observations (4) Students return to the PBL tutorial, then share information, through *peer teaching* and *cooperative learning* on certain problems (5) Students present solutions to problems (6) Students review what they have learned during the

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process so far. Based on the background above, the researcher wants to examine "The Difference in Students' Mathematical Concept Understanding Ability Using *Problem Based Learning Learning* Methods With Expository Learning Methods on Two-Variable Linear Equation Systems Materials in Class VIII SMP Negeri 8 Pematangsiantar FY 2019/2020.

METHOD

This type of research is experimental research by Riyanto & Hatmawan, (2020), which is to see the differences in students' mathematics learning outcomes using the *Problem Based Learning* (PBL) method with students' mathematics learning outcomes using the expository method. The two small groups of students who were the research subjects were given different lessons on the same material. The learning in question is learning that uses the *Problem Based Learning* (PBL) method compared to learning that uses the Expository learning method on System material. Two-Variable Linear Equation (SPLDV). The design of this research is a *posttest-only control design*, namely placing the research subjects into two groups (classes) which are divided into an experimental class (the group that is given treatment) and a control class (the group that is not given treatment) Krishnan, (2021); Purba et al., (2021).

Table 1
Research Design

Group	*Treatment*	*Posttest*
Experiment	X	O_1
Control	Y	O2 _

Description:
X = Treatment (Treatment)
O_1 = *Posttest* in the experimental class
O2 = Posttest in the *control* class

In this study, there are 2 (two) variables l that must be defined operationally, namely, The independent variable in this study is the learning method which consists of the *Problem Based Learning* (PBL) and method expository (Suardana, 2019). The Problem *Based Learning* (PBL) method is a type of learning cooperative that places the students in group heterogeneous consisting of four to five people to emphasize activity and interactive para students, each other motivate and help in understanding something Theory learning. The expository method is a method of teacher-centered learning, with a verbal delivery process from the teacher to students with the aim that students master the subject matter optimally.

The dependent variable in the study is learning outcomes. The learning outcomes in question are the scores achieved by students after being given a test at the end of the study.

The instrument used by researchers to obtain data is a test. The test used is in the form of a description. The test given is 4 questions. Each question has four alternative answers. Able to answer mathematical problems as a whole and correctly given a score of 3, being able to answer some mathematical problems given a score of 2, being able to answer mathematical problems but not leading to the correct answer given a score of 1, not solving the same mathematical problem once given a score of 0. The time given in solving the problem is 60 minutes.

Table 2
Grid of Students' Mathematical Concept Understanding Test

Indicators of Understanding Mathematical Concepts	Learning Indicators	Question Item Number
Redefining a concept	Students can understand and re-explain the SPLDV.	1,2,3,4

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Identifying the relationship between the concepts being studied.	Students can identify the relationship between concepts and SPLDV.	1, 2,3,4
Select, Use, and Utilize procedures or operations that are appropriate for the given problem.	Students can select, use, and utilize procedures or operations that conform to the SPLDV	1,2 , 3,4
Solve problems based on the properties of an object being studied.	Students can solve problems based on the properties of an SPLDV object.	1,2,3, 4

RESULTS AND DISCUSSION

Test Result Data Analysis

Before the research instrument was given to the research sample, a research test trial was first conducted on September 9, 2019, at SMP Negeri 4 Pematangsiantar (appendix 8). The trial was carried out to determine the quality of the test items which included the validity of the test items, the reliability of the test, the level of difficulty of the test items, and the distinguishing power of the test items.

Item Validity

By using Pearson's product-moment correlation formula, the coefficient of validity of each test item is obtained. The test item validity coefficients are presented in Table 3.

Table 3
Validity of Test Items

No Item	Validity Coefficient	Information
1	0.657559052	Tall
2	0.641153991	Tall
3	0.618674295	Tall
4	0.603795963	Tall

From table 3 it can be seen that each item has a high validity coefficient, so it can be concluded that all items are valid.

Test Reliability

Based on the data in Appendix 10 using the Alpha formula, the test reliability coefficient is 0.375631. The test reliability coefficient is compared with the r_{tabel} the critical value of the product-moment for $\alpha = 0{,}05$ and $N = 31$ namely, $r_{tabel} = 0{,}335$, it turns out $r_{11} = 0{,}375631 > r_{tabel} = 0{,}335$that it can be concluded that the test is reliable.

Item Difficulty Level

By using the formula for the level of difficulty of each test, the level of difficulty of the test items is presented in Table 4.

Table 4
Test Item Difficulty Level

No Item	Difficulty Level	Information
1	0.629032	Currently
2	0.612903	Currently
3	0.612903	Currently
4	0.612903	Currently

From Table 4 it can be seen that all test items have a moderate level of difficulty so all items are considered good.

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Distinguishing Power of Items

By using the formula for distinguishing the power of each item, the discriminating power of test items is presented in Table 5.

Table 5
Distinguishing Power of Test Items

No Item	Distinguishing Power	Information
1	0.3125	Enough
2	0.225	Enough
3	0.225	Enough
4	0,201944	Enough

From Table 5 it can be seen that all test items meet the criteria, namely enough. From the results of the calculation of the test item validity coefficient, test reliability, item difficulty level, and test item discriminatory power, it can be concluded that the test meets the requirements and is feasible to use for data collection in research.

Research Result Data Analysis

The research was conducted at SMP Negeri 8 Pematangsiantar from September 2, 2019, to September 12, 2019, with class VIII-7 as the experimental class and class VIII-5 as the control class.

Data Statistics

Statistics from the two research classes, namely the class whose learning uses the *Problem Based Learning* method and the expository method are presented in table 6 as follows:

Table 6
Statistics of the Data of the Two Samples

Statistics Type	Experiment Class (*Student teams achievement division* method)	Control Class (Expository Method)
N(Lots of data)	31	32
Average	6,8709677419	5,34375
variance	9,78125	7,5827956989
Standard deviation	3,122699153	2,753687654
Highest score	12	12
Lowest score	3	0

From the statistics in the table above, it appears that the average score of the experimental class is 6,87, while the average score of the control class is 5,34. So it can be concluded that the average ability to understand mathematical concepts of students in the *Problem Based Learning group* is higher than the average ability to understand mathematical concepts of students in the expository group.

In this case, to see the success of the results of students' mathematical concept understanding ability is presented in the table below:

Table 7
Students' mathematical concept understanding

Indicator	Learning methods PBL			Average (%)	Expository Learning Method			Average (%)
	Question Number	Total score	%		Question Number	Total score	%	
1. Restate the definition of a concept.	1	73	77.4%	77.4%	1	61	62.4%	62.4%

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2. Identify the relationship between the concepts studied.	2	44	45.2%	45.2%	2	25	23.7%	23.7%
3. Select, use, and utilize procedures or operations that are appropriate for the given problem.	3	69	71%	71%	3	63	64.5%	64.5%
4. Solve problems based on the properties of an object being studied.	4	37	35.3%	35.5%	4	22	20.4%	60.4%

Sample Normality Test

1. Experimental Group (*Numbered Head Together Method* with LAS)

Based on the research data, the results of the calculation of the price of L $_0$ = 0.0061 with n = 31 and the level of significance are obtained $\propto= 0{,}05$. From the list of tables in can $L = \frac{0{,}886}{\sqrt{31}} = 0{,}1591$. Then L $_0$ < L, so H $_{0\ is}$ accepted. The conclusion is that the sample comes from a normally distributed population. (appendix 18)

2. Control Group (Expository Method)

Based on the research data, the results of the calculation of the price Lo = 0.0078 with n = 32 and the level of significance $\alpha = 0{,}05$. From the list of tables in can $L = \frac{0{,}886}{\sqrt{32}} = 0{,}156624152$. Then L $_0$ < L, so H $_{0\ is}$ accepted. The conclusion is that the sample comes from a normally distributed population. (appendix 18)

Variance Homogeneity Test

Based on the calculation results (attachment 19) obtained a value $F_{hitung} = 0{,}7752378989$ when compared with $F_{tabel}$for $\alpha = 0{,}05$and $v_1 = 30$ and $v_2 = 31$by using the one-sided test obtained critical points $F_{0{,}05(30;31)} = 1{,}8409$where the critical area is $F_{hitung} < F_{tabel}$found to be $0.7752378989 < 1{,}8409$, it can be concluded that the two variances are homogeneous.

Research Hypothesis Testing

The hypothesis of this research is related to differences in students' ability to understand mathematical concepts. To test the hypothesis, the difference between two averages is used, namely by using the t-test (Appendix 20), where:

$H_0 : \mu_1 = \mu_2$, the average learning outcomes of the *Problem Based Learning* group sample group with the expository method were not significantly different.

$H_a : \mu_1 \neq \mu_2$, the average learning outcomes of the *Problem Based Learning* group sample group with the expository method were significantly different.

From the results of the calculation of the price $t_{hit} = 1{,}96$for $\alpha = 0{,}05$and v = 61 the critical point is $t_{hit} < -t_{tabel}$ atau $t_{hit} > t_{tabel} = 1{,}67$ that it $t_{hit}$is in the critical area, where $t_{hit} > t_{tabel}$ $(1{,}96 > 1{,}67)$. So that it is H_0rejected and $H_a$accepted (the average mathematical concept understanding ability of the two samples is significantly different).

Thus it is concluded that the mean of the two samples is significantly different . Because the average that uses the Cooperative learning method of *Problem Based Learning* (PBL) is higher than the average of the expository method, it can be said that learning with the Cooperative learning method of *Problem Based Learning* (PBL) is better used than the Expository Method on Linear Equation System material. Two Variables (SPLDV) in Class VIII SMP Negeri 8 Pematangsiantar FY 2019/2020.

Discussion

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This research is entitled "The Differences in Students' Mathematical Concept Understanding Ability Using *Problem Based Learning* Methods with Expository Learning Methods on the Material of a Linear Equation System of Two Variables in Class VIII SMP Negeri 8 Pematangsiantar FY 2019/2020".

The problem formulations discussed in this study are: (1) How is the ability to understand students' mathematical concepts using the *Problem Based Learning learning method* in the material for the Two-variable Linear Equation System in Class VIII SMP Negeri 8 Pematangsiantar FY 2019/2020? (2) How is the ability to understand mathematical concepts of students using the Expository learning method on the material for the Two-variable Linear Equation System in Class VIII of SMP Negeri 8 Pematangsiantar FY 2019/2020? (3) What are the differences in the ability to understand mathematical concepts of students who use the *Problem Based Learning* learning method with the expository learning method on the material for the Two-variable Linear Equation System in class VIII of SMP Negeri 8 Pematangsiantar FY 2019/2020?

The aims of this study are: (1) to find out how the ability to understand mathematical concepts of students using the *Problem Based Learning learning method is* on the material for the Two-variable Linear Equation System in Class VIII SMP Negeri 8 Pematangsiantar FY 2019/2020, (2) to find out how the ability to understand mathematical concepts of students using the Expository learning method on the material of the Two-Variable Linear Equation System in Class VIII SMP Negeri 8 Pematangsiantar FY 2019/2020, (3) to find out how the differences in students' mathematical concept understanding abilities using learning methods *Problem Based Learning* with expository learning methods on the material of the Two-variable Linear Equation System in class VIII of SMP Negeri 8 Pematangsiantar FY 2019/2020.

The population in this study was class VIII SMP Negeri 8 Pematangsiantar, namely 63 people, and the sample in this study was two classes, namely class VIII $_7$ (the group that used the *Problem Based Learning method*) as many as 31 students and class VIII $_5$ (the group that used the expository method) as many as 32 students. The research instrument given to the sample was tested first and it was stated that the quality of the research instrument was significant, because by using the product moment formula, the lowest validity coefficient was 0.603795963 (High validity) and the highest validity coefficient was 0.657559052 (High validity). The test items are valid, by using the alpha formula for the test, the results of the test reliability coefficient calculation are 0.375631 and when compared with the r value of the critical price r product-moment $_{table}$ for a significant level $\alpha = 0{,}05$and n = 4, it $r_{tabel} = 0{,}355$turns out $r_{hitung} > r_{tabel}$ that the instrument is reliable.

Research conducted on a sample of 63 students, obtained student learning outcomes using the *Numbered Head Together method* with an average score of $6{,}8709677419$ and standard deviation, $2{,}753687654$ while student learning outcomes using the expository method with an average score $5{,}34375$ and standard deviation $3{,}122699153$. By using the Liliefors test to test the normality of the data on student learning outcomes, it turns out that for the *Numbered Head Together method group, it* is obtained $L_0 = 0.0061$ for n = 31, and a significant level of 0.05, namely $L_{table} = 0.1591$ turns $L_0 < L_{table}$, and the expository method group $L_0 = 0.0078$ when compared with the $L_{table\ value}$ for n = 32, and the significant level is 0.05, namely $L_{table} = 0{,}156624152$ then the data on the learning outcomes of the two classes are normally distributed. Because the data is normally distributed, the homogeneity test of the sample was carried out.

Based on the score of student learning outcomes, the results of the homogeneity test of the sample using the F test are obtained, $F_{arithmetic} = 0{,}7752378989$ and when compared with the price F distribution $_{table}$ F for a significant level $\alpha = 0{,}05$and $v_1 = 30$, $v_2 = 31$ i.e. $F_{tabel} = F_{\alpha;(n_1-1);(n_2-1)} = F_{0{,}05(30;31)} = 1.8409$ it turns out $F_{hitung} < F_{tabel}$ that the two classes of samples are homogeneous or come from populations with the same variance. Therefore, the research hypothesis testing was carried out by testing the difference between the two

means and it was obtained $t_{hit} = 1{,}9641495256$ and when compared with the t value of the statistical $_{\text{table}}$ of the t distribution curve for a significant level $\alpha = 0.05$ v $_1 = 30$ v $_2 = 31$ i.e. $t_{tabel} = t_{1-\frac{1}{2}\alpha;n_1+n_2-2} = 1.67$, it turned out $t_{hitung} > t_{tabel}$ that there was a difference. There is a significant difference between students' mathematical problem solving abilities using the *Numbered Head Together* method and the expository method.

CONCLUSION

Based on the results of data analysis and hypothesis testing, the researchers put forward conclusions and suggestions in accordance with this study. The ability to understand mathematical concepts of students who use the Cooperative Method of *Problem Based Learning (PBL) in the Two Variable Linear Equation System* (SPLDV) material in class VIII of SMP Negeri 8 Pematangsiantar FY 2019/2020 has an average 6,87and variance of 9.78. The ability to understand mathematical concepts of students who use the Expository Method on Two Variable Linear Equation Systems (SPLDV) material in class VIII of SMP Negeri 8 Pematangsiantar FY 2019/2020 has an average 5,34 and variance of 7.58. There is a significant difference between the ability to understand mathematical concepts of students who use the Cooperative Method of *Problem Based Learning* (PBL) with the Expository Method on the material for the Two Variable Linear Equation System (SPLDV) in class VIII SMP Negeri 8 Pematangsiantar FY 2019/2020, as evidenced by the test. Hypothesis where t $_{\text{hit}} = 1.96$ > t $_{\text{table}} = 1.67$ with a difference of 0.29 so that H $_0$ is rejected and vice versa Ha is accepted. It was concluded that the ability to understand mathematical concepts of students who used the cooperative method of *Problem Based Learning* (PBL) was better than the ability to understand mathematical concepts of students who used the expository method.

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