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Influence of Learning Model and Initial Knowledge on the Ability of Mathematic Connection

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Abtract:- This study aims to find the effect of Problem Based Learning model and Conventional model as well as students 'early knowledge of students' mathematical connection ability. The research was conducted in class V SDN Rawamangun 05 Pagi East Jakarta. The method used is the experimental method with treatment design by level 2 x 2. The technique of analysis used is the analysis of two-lane variance (ANAVA). The results of this study suggest that (1) the ability of mathematical connections in groups of students who are given a problem based learning model is higher than that of the conventional modeled students, (2) there is an interaction effect between the learning model and the initial knowledge on the mathematical connection ability, the ability of mathematical connections in groups of students with high initial knowledge given the problem-based learning model is greater than the group of students given the conventional model; and (4) the students' mathematical connection ability in the group of students with low initial knowledge given the Problem Based Learning model is lower than the student group given the conventional model.

Keywords:- *Problem Based Learning, conventional, preliminary knowledge, mathematical connections.*

I. INTRODUCTION

Regulation of the Minister of National Education No. 23 of 2006 on Graduate Competency Standards for Elementary and Secondary School level explains that Mathematics Subjects need to be given to all students from elementary school to equip learners with logical, analytical, systematic, critical and creative thinking, and the ability to work together.[1] Mathematics is a form of human activity "(mathematics as a human activity)".[2] Mathematics as one of the subjects in school is considered to play a very rational, critical, careful, effective and efficient role. It is like Stacey says that "the ability of mathematical thinking has a contribution in developing problem-solving skills or problem-solving skills".[2][3]

Some experts say that mathematics is a way of finding answers to problems faced by humans, a way of using information, using knowledge of form and size, using knowledge of counting, and most importantly thinking in the person himself in seeing and using relationships.[4][5] The purpose of learning mathematics in elementary school is so that learners have the ability to understand the concepts of mathematics, explain the inter-linkage of concepts, apply concepts or logarithms flexibly, accurately, efficiently and appropriately in problem solving, patterns and traits, performing mathematical manipulations in making generalizations so that students are able to solve problems of designing mathematical models, explaining the models and interpreting the solutions obtained.[6]

Some of the main causes of low student literacy index in Indonesia are Leung's lack of curriculum in Indonesia, lack of trained Indonesian teachers, and lack of support from the environment and schools.[7] In addition, the problem of low mathematical connection ability of students occurs due to several factors that are born in teaching and learning activities. The root cause of mathematical connection problems can be sourced from the teacher, the learning process, the learning tool or media and the students, as can be interpreted as the causal factor that comes from the teacher is less optimal in using learning models, and the learning is still centered on the teacher, the learning process, the lack of variety of teachers in delivering the material in the learning process, as well as in delivering the ongoing lesson material.

Ruspiani states the ability of mathematical connections is the ability of individuals to connect mathematical concepts in mathematics or to relate other mathematical concepts to fields or disciplines. This capability is necessary because mathematics is a unity, which is another related concept.[8] In addition, the National Council of Teachers of Mathematics or NCTM 2000, states that there are five basic skills of mathematics which are the standard of problem-solving, reasoning and proof, communication, connections, (representation).[9] With reference to the five standards of NCTM capability, the objectives of mathematics instruction set out in the 2006 curriculum issued by consist essentially of: (1) understanding of mathematical concepts, explaining interconnectedness between concepts and applying concepts or algorithms, flexibly, accurately, efficiently, and (2) using reasoning in patterns and traits, performing mathematical manipulations in generalizing, compiling evidence, or explaining mathematical ideas and statements, (3) solving problems that include the ability to understand problems, designing mathematical models, solving models and (4) communicating ideas with symbols, tables, diagrams, or other media to clarify circumstances or problems, and (5) having an appreciative attitude to the usefulness of mathematics in life, that is, having curiosity, attention and interest in learn math, as well as a tenacious attitude and confidence in fix the problem.[6]

One of the important but under-mastered process skills of students is the ability of mathematical connections where students experience some silent difficulties solving related problems writing daily life problems into the form of mathematical models, connecting between objects and concepts in mathematics, and in determining what formulas will be used when faced with problems related to daily life problems. In addition, students also have difficulty in connecting concepts previously known to students with new concepts that students will learn because the basics of thinking have not been mastered properly.[7] Thus, the ability of mathematical connections is very important to have students so that students are able to make a meaningful relationship between mathematical concepts or between concepts with other fields or with the life or environment around the students.

In PISA 2015 there is a level or level of math ability that is tackled as follows: (1) Level 1. Students can identify and answer commonly known contextual questions and all relevant information is available with clear questions; (2) Level 2. Students can interpret and recognize situations in contexts that require direct inference and be able to sort the relevant information from a single source and use a single representation; (3) Level 3. Students can choose and apply simple problem-solving strategies and implement procedures well, including procedures requiring consecutive decisions; (4) Level 4. Students can work effectively with the model in concrete but complex situations and use their skills well and present reason and view flexibly according to context; (5) Level 5. Students can work with models for complex situations, know constraints, and make guesses; (6) Level 6. Students can think and reason math all and conceptualize and generalize using information based on a study in a complex situation.[10]

According to MoNE math connection is an important part that must get emphasis in every level of education that is: understanding the concept of mathematics, explaining the interconnection between concepts and apply the concept or algorithm in a flexible, accurate, efficient, and appropriate in solving the problem. [6] In the objective formulation, the ability of mathematical connections to be very important because it will help mastery understanding of meaningful concepts and help solve problem-solving tasks through the interrelationship between mathematical concepts and inter-concepts of mathematics with concepts in other disciplines.[11] Bell stated that not only is the ability of mathematical connection important but the awareness of the need for connection in learning mathematics is also important.[7] Sumarmo summarizes the activities involved in the task of mathematical connections as follows; 1) Understand the equivalent representation of a mathematical process, process or procedure; 2) Seeking relationships between various representations of concepts, processes, or mathematical procedures; 3) Understanding the relationship of between topics mathematics; 4) Applying mathematics to other fields or in everyday life; 5) Seeking the relationship of one procedure to another procedure in equivalent representation; and 6) Applying between topics relationships to mathematics and between mathematical topics and other disciplinary topics. Coxford points out that the ability of mathematical connections includes: (1) connecting conceptual and procedural knowledge, (2) using mathematics on other topics (3) using mathematics in life activities, (4) viewing mathematics as one (5) applying mathematical ability and modeling to solve problems in other subjects, such as music, arts, psychology, science, and business, (6) knowing connections between topics in mathematics, and (7) recognizing failed representations for the same concept.[12]

While the initial knowledge is a collection of individual knowledge and experience gained throughout the course of their lives and what is brought to a new learning experience.[13] Initial knowledge (according to Arends is a collection of individual knowledge and experience gained throughout the course of their life, and what it will bring to a new learning experience.) Importance of early knowledge is to help students build bridges between new knowledge and knowledge which has been owned.[14] In addition, according to Sardiman, the level of knowledge in terms of domain there are 6 levels: Know, Know (Comprehension), Application, Analysis, Synthesis, Evaluation).[15][16][17] Early knowledge has at least four qualities: (1) early knowledge is primarily based on the student's life experience, (2) the student's initial knowledge is sometimes different from the knowledge that scientists or teachers use , (3) resistant to change and strong persistence, although through formal learning, and (4) early knowledge will affect the learning process or the development of the conceptual.[14][18] Thus preliminary knowledge will affect the level of one's understanding of a passage because in the process of bringing together the knowledge already acquired or already possessed and the new knowledge gained.

Learning that can be done is to use an innovative learning model, but the selection of learning models must be tailored to the characteristics of students, materials and environmental conditions where the learning process is done. One of the learning models in question is Problem Based Learning. Problem Based Learning is able to identify problems, data collection, and use the data for problem-solving.[19][20][21] While Herman points out the characteristics of problem-based learning are as follows; 1) position the student as a self-directed problem solver through collaborative activities; 2) encourage students to be able to find problems and elaborate by proposing allegations and planning solutions; 3) facilitating students to explore alternative solutions and their implications, and collecting and distributing information, 4) train students to skillfully present findings, and 5) familiarize students to reflect on the effectiveness of their way of thinking in solving problems.[22] Hosnan explained the purpose of learning Problem Based Learning is to help students to gain experience and change student behavior, both in terms of quality and quantity.[23]

Another model that can be used in this lesson is the Conventional model. This conventional model is a model used by teachers so far, which is how the presentation of lessons by teachers with a direct explanation of students and learning starts from the presentation of information, giving illustrations and examples of questions, practice questions until the teacher finally feel what in teaching has been understood by the students.[24][25][26].

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Learning using the Problem Based Learning model offers the use of the concept of teacher learning to present the learning that begins by presenting the real problems. Furthermore, students are directed to find a solution to the problem in question in cooperation in a team. In this case, the teacher as a facilitator guides to describe the problem-solving plan into several stages of activity. In addition to the correct evaluation process, fast and efficient, early knowledge factors also play a role in supporting the success of student learning. Initial knowledge as the ability that has been owned by students from previous learning that will affect the next learning. Initial knowledge can be known by making observations or by providing a written test, which is part of the input evaluation (input evaluation). Through the introduction of students' initial knowledge, a teacher will be better prepared for the class and have solution choices when there are problems that occur in the classroom.

Teachers 'efforts to understand students' potentials are assumed to improve math knowledge so as to motivate better achievement. This is due to the learning style is the tendency of students in digging information to increase knowledge. This research will first be measured schemata (initial knowledge). Based on the above problems, the researcher is very interested to do research on "Influence of Early Learning Model and Knowledge to Mathematical Connection Ability." Thus this research can prove the truth of a theory and phenomenon.

A. Formulation of the problem

- Are there differences in the ability of students' mathematical connections taught by problem-based learning model and students taught with conventional models?
- Is there an interaction between the learning model and the initial knowledge of the mathematical connection capabilities?
- Are there differences in the ability of students' mathematical connections taught by using problem-based learning models and students taught using conventional models in groups of students with high initial knowledge?
- Are there differences in the ability of students' mathematical connections taught using problem-based learning models and students taught using conventional models in groups of students with low initial knowledge?

B. Research Hypothesis

- The ability of mathematical connections between students who are taught with a problem-based learning model is higher than students taught by conventional models.
- There is an interaction effect between the learning model and initial knowledge of mathematical connection ability.
- The ability of mathematical connections of students with a high initial knowledge was taught using a problem-based learning model higher than students taught using a conventional model.
- The ability of mathematical connections of students with low initial knowledge was taught using a problem-based learning model lower than using a conventional model.

II. METHODS

This study involves two independent variables of Problem Based Learning and conventional and the second initial knowledge and involves one dependent variable that is the ability of mathematical connections. So the study will compare two different learning models that are Problem Based Learning and conventional with early independent knowledge variables, to see students' mathematical connection ability. The design to be used is a 2x2 factorial design. The research design is simply described as follows:

Initial Knowledge (B)	Learning model (A)		
	Problem Based Learning (A_1)	Conventional (A_2)	Total
High (B_1)	12	12	24
Low (B_2)	12	12	24
Total	24	24	48

Table 1. Research Design Design Treatment Factorial 2x2

The sampling technique was done by the following process: (1) Randomly selecting SDN in Pulo Gadung sub-district and selected SDN Rawamangun 05, (2) afterward randomized again to determine the experimental class and control class, and (3) class VB experimental class and students of class VA control class.

III. RESULTS

A. Data Description

The following descriptions of data calculation results and research results:

Table 2. Description of research data Hypothesis test calculation

Data Description						
Learning model / Initial Knowledge	A_1		A_2		Total	
B_1	n_1 =	12	n_2 =	12	n_{b1} =	24
	SX_1 =	150	SX_2 =	124	SX_{b1} =	274
	SX_1^2 =	1894	SX_2^2 =	1298	SX_{b1}^2 =	3192
	x_1 =	12.50	x_2 =	10.33	x_{b1} =	11.42
	$(SX_1)^2$ =	22500	$(SX_1)^2$ =	15376	$(SX_{b1})^2$ =	37876
B_2	n_3 =	12	n_4 =	12	n_{b2} =	24
	SX_3 =	100	SX_4 =	79	SX_{b2} =	179
	SX_3^2 =	846	SX_4^2 =	537	SX_{b2}^2 =	1383
	x_3 =	8.33	x_4 =	6.58	x_{b2} =	7.46
	$(SX_3)^2$ =	10000	$(SX_4)^2$ =	6241	$(SX_{b2})^2$ =	16241
Total	n_{k1} =	24	n_{k2} =	24	n_t =	48
	SX_{k1} =	250	SX_{k2} =	203	SX_t =	453
	SX_{k1}^2 =	2740	SX_{k2}^2 =	1835	SX_t^2 =	4575
	x_{k1} =	10.417	x_{k2} =	8.46	x_t =	9.44
	$(SX_{k1})^2$ =	32500	$(SX_{k2})^2$ =	21617	$(SX_t)^2$ =	54117
		62500		41209		205209

B. Testing Requirements Analysis

Normality test

Table 3. Group Normality Test A1, A2, B1, B2, A1B1, A1B2, A2B1, A2B2

Sample Group	Number of Samples (N)	L_{hitung} (L_0)	L_{tabel} (L_t: α = 0,05)	Conclusion
A_1	24	0,153	0,162	Normal
A_2	24	0,161	0,162	Normal
B_1	24	0,137	0,162	Normal
B_2	24	0,111	0,162	Normal
A_1B_1	12	0,206	0,214	Normal
A_1B_2	12	0,205	0,214	Normal
A_2B_1	12	0,194	0,214	Normal
A_2B_2	12	0,181	0,214	Normal

Homogeneity Test

Table 4. Homogeneity Test Variant using Barlett Test

Sample Group	Variance S^2	VarianceCombined S^2	Value B	X^2hit	X^2tab	Information
A_1B_1	1,73	1,483	7,530	0,469	7,81	Homogeneity
A_1B_2	1,15					
A_2B_1	1,52					
A_2B_2	1,54					

Based on the above table obtained X2counted 0,511 while X2table with dk = 3 at the level of significance α = 0.05 obtained 7.81. This shows that X2count <X2table or 0.469 <7.81. If it is associated with the criterion of acceptance, then H0 is accepted. Thus the four groups of data are from a homogeneous population. Acceptance of normality and homogeneity test results above, it can be concluded that the test requirements for testing the hypothesis with a two-way analysis of variance (ANOVA) can be fulfilled and implemented.

C. Hypothesis testing

Hypothesis testing in this research is done by using two-way variants (ANOVA) analysis and continued with Tuckey test if there is interaction in the test. A two-lane variance analysis is used to examine the main effect and interaction effect between the learning model and the initial knowledge of mathematical connection capability. Using Anava obtained the following analysis results:

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Table 5. Two Line Path Variance Analysis Results

Source of Variance	Db	JK	RJK	F_{hitung}	F_{tabel}**
Between Columns	1	46,02	46,02	31,03	4,04
Between Rows	1	20,20	20,20	13,62	4,04
Interaction	1	22,08	22,08	14,89	4,04
In	44	65,25	1,48		
Total Reduced	47	299,81			

The test criterion used is rejected H0 if Fcount> Ftable. Based on the results of analysis of variance (ANOVA) two lines above, then hypothesis testing can be explained as follows:

1) The result of the analysis of two-lane variance between columns shows Fcount = 31.03 greater than Ftabel = 4.04 at significance level $\alpha = 0.05$. This means H0 ¬ is rejected and accepts H1. Once tested the difference significantly, then the next step to see which is better the ability of mathematical connections between the two treatments. Based on the result of the calculation, the average value of mathematical connection ability which got the Problem Based Learning (A1) learning model is 78,54 bigger than the mathematical connection ability which gets conventional learning model (A2) is 70,79.
2) Based on the analysis of two-lane variance between columns and rows shows Fcount = 14.89 is greater than Ftabel = 4.04 at significance level $\alpha = 0.05$. This means H0 ¬ is rejected and accepts H1. Thus the second hypothesis that there is an interaction between the learning model and the initial knowledge received significantly at the significance level $\alpha = 0.05$.
3) Based on the result of analysis of two line variance between rows shows Fcount = 13,62 bigger than Ftabel = 4,04 at significance level $\alpha = 0,05$. This means H0 ¬ is rejected and accepts H1. Thus this hypothesis states there are differences in the ability of a significant mathematical connection between students who have the high initial knowledge and low initial knowledge.

Tested significantly the interaction between the learning model and the initial knowledge of the ability of mathematical connections then the next step is to conduct further tests. Because the number of subjects in the same group, the further test used is the Tuckey test, stated that:

1) For groups A1B1 and A2B1, Qcount larger Qtabel or 6.16> 3.77 at $\alpha = 0.05$. This means H0 ¬ is rejected and accepts H1. Thus the third hypothesis which states that the mathematical connection ability of the group given the Problem Based Learning model of learning with high initial knowledge is greater than the group mathematical connection ability given the conventional model with high initial knowledge, received significantly at $\alpha = 0.05$.
2) For groups A1B2 and A2B2, Qcount larger Qtabel or 4.98> 3.77 at $\alpha = 0.05$. This means H1 is accepted and H0 is rejected. Thus the fourth hypothesis which states that the mathematical connection ability of the group given the Problem Based Learning model of learning with low initial knowledge is smaller than the group mathematical connection capability given the conventional model with low initial knowledge, received significantly at $\alpha = 0.05$. So that students who have low initial knowledge using conventional model is lower than students who have low initial knowledge with Problem Based Learning model.

The summary results of the calculation of each pair of groups with Tuckey Test can be seen as follows:

Table 6. Advanced Test Results with Tuckey Test

No	Hipotesis Statistik	Q_{Hitung}	Q_{Tabel} $\alpha = 0,05$
1	$\mu_{A1B1} > \mu_{A2B1}$	6,16*	3,77
2	$\mu_{A1B2} < \mu_{A2B2}$	4,98*	3,77

Based on the results of the Analysis of Variance and Tuckey's further test above, it can be stated that:

1) The third hypothesis which states that the mathematical connection capability given by the Problem Based Learning model with higher initial knowledge than the mathematical connection capability given by conventional learning model with low initial knowledge, received significantly at $\alpha = 0,05$.
2) The fourth hypothesis which states that the mathematical connection capability given by Problem Based Learning model with low initial knowledge is smaller than the ability of mathematical connection given by conventional learning model with low initial knowledge, accepted by significance at $\alpha = 0,05$.

IV. DISCUSSION

A. Differences in the ability of mathematical connections between students taught by problem-based learning model and students taught by conventional model.

The findings in this study revealed that there is a difference between students taught by Problem Based Learning model with students who teach conventional model. Daryanto revealed that problem-based learning is centered on the students.[27] The results show that the ability of mathematical connections in students who are given a model of Problem Based Learning is higher than students who taught conventional models. Based on this difference can be explained the model of learning Problem Based Learning is a learning model suitable for use in mathematics subjects because everything is problem-based, the problem is a real problem (contextual Learning) which concerns the events of everyday life. Unlike the conventional model is a learning model that focuses only on teaching methods of lectures. In this case, the teacher plays a major role in determining the content and sequence of steps in delivering the material to learners. While learners listen carefully and record the key points raised by the teacher so that in this learning activities of teaching and learning process is dominated by teachers. This resulted in the participants being passive because learners only accept what is delivered by the teacher, consequently, learners are easily saturated, less initiative, and dependent on the teacher.

Based on the findings obtained from the results of this study can be concluded that the ability of mathematical connections in the group of students who are given a model-based problem learning is higher than the group of students who were given a conventional model.

B. The influence of learning model interaction and preliminary knowledge on mathematical connection ability

Interaction implies that there is cooperation between two independent variables in influencing the dependent variable. The significance of this interaction will affect the form of interaction that occurs. This means that the interaction effect will have significance if tested at each treatment level. Based on the research findings stated that there is an interaction effect between the learning model and the initial knowledge of the proven mathematical connection ability, with the value of Fhitung = 14.89 greater than Ftabel = 4.04. Thus, the provision of learning should pay attention to the initial knowledge of students. In teaching activities, the more appropriate methods/approaches are used, the more effective and efficient the learning activities are undertaken between teachers and students will ultimately support and deliver the success of student learning and success teach made by the teacher. [28] Students with a high initial knowledge given the Problem Based Learning model demonstrated greater mathematical connection capability than students given conventional models. In contrast, students who had low initial knowledge given the Problem Based Learning model showed a smaller mathematical connection ability than students who were given a conventional model. This suggests that in providing a proper learning model should pay attention to the initial knowledge of the students.

C. Differences in mathematical connection ability of students taught by using the problem-based learning model and students taught by using the conventional model in groups of students who have high initial knowledge.

The findings in this study suggest that the ability of mathematical connections in groups of students with high initial knowledge given the problem-based learning model is greater than the group of students given the conventional model. According to Trianto, early knowledge is a collection of individual knowledge and experience gained throughout the course of their lives and what is brought about in a new learning experience. [13] This is evidenced by the Tuckey Test path obtained Q-counter Qtabel or 6.16> 3.77 at $\alpha = 0.05$. This means H0 ¬ is rejected and accepts H1. Thus, the third hypothesis which states that the mathematical connection ability of the group given the Problem Based Learning model of learning with high initial knowledge is greater than the group mathematical connection ability given the conventional model with high initial knowledge, received significantly at $\alpha = 0.05$. So that students who have high initial knowledge using Problem Based Learning model higher than students who have high initial knowledge with the conventional model.

D. Differences in mathematical connection ability of students taught by using the problem-based learning model and students taught by using conventional models in groups of students with the low initial knowledge.

The research hypothesis which states that the mathematical connection ability of students in the group of students who have low initial knowledge given the Problem Based Learning model is lower than the group of students given the conventional model. According to math connection is an important part that must get emphasis in every level of education that is by understanding the concept of mathematics. [6] This is evidenced by the test turkey obtained Qtabel Qtabel or 4.98> 3.77 at $\alpha = 0.05$. This means H1 is accepted and H0 is rejected. Thus the fourth hypothesis which states that the mathematical connection ability of the group given the Problem Based Learning model of learning with low initial knowledge is smaller than the group mathematical connection capability given the conventional model with low initial knowledge, received significantly at $\alpha = 0.05$. So that students who have low initial knowledge using Problem Based Learning model is lower than students who have low initial knowledge with the conventional model.

V. CONCLUDE

Based on the findings of this study, it can be concluded that the effect occurs among the research variables as follows:

- The ability of mathematical connections between students who are taught with a problem-based learning model is higher than the ability of mathematical connections between students who were taught with conventional models.
- There is an interaction effect between the learning model and initial knowledge of mathematical connection ability.
- Students who have the high initial knowledge, mathematical connection ability of students who are taught by using the problem-based learning model is higher than students taught by using conventional model.
- The ability of mathematical connections between students taught by Problem Based Learning with low initial knowledge is lower than that of students taught by conventional models with low initial knowledge.

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