The Effect of The Problem-Based Learning Model on The Interest and Learning Outcomes of Mathematics of Elementary School Students

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Abstract

This research aims to: 1) know the difference in interest in learning mathematics between students who follow the problem-based learning model with students who follow conventional learning models, 2) know the difference in mathematics learning outcomes between students who follow the problem-based learning model and students who follow conventional learning models, 3) simultaneously know the differences in learning interests and learning outcomes of mathematics between students who follow the problem-based learning model and students who follow conventional learning models. This study is a quasi-experiment with randomized post-test only control group design. The population of this study is all students in grade V elementary school, cluster XV, Buleleng district. There were 182 students, while the study sample comprised 60 students, comprising 30 students as a control group and 30 students in an experimental group. The research instrument uses questionnaires to measure interest and tests to measure students learning outcomes, which are further analyzed using one-way manova. the results showed: 1) there was a significant difference in the learning interests of students who followed the problem-based learning model with conventional learning, 2) there are significant differences in math learning outcomes that follow problem-based learning models compared to conventional learning, 3) there are differences in learning interests and math learning outcomes of students who follow problem-based learning models and conventional learning. The results of data analysis show that the application of problem-based learning models has a significant influence on students nterests and learning outcomes.

Keywords: Problem-Based Learning Model; Conventional Learning; Learning Interest; And Learning Outcomes

Abstrak

Penelitian ini bertujuan untuk: 1) mengetahui perbedaan minat belajar matematika antara siswa yang mengikuti model pembelajaran berbasis masalah dengan siswa yang mengikuti model pembelajaran konvensional, 2) mengetahui perbedaan hasil belajar matematika antara siswa yang mengikuti model pembelajaran berbasis masalah dengan siswa yang mengikuti model pembelajaran konvensional, 3) mengetahui secara simultan perbedaan minat belajar dan hasil belajar matematika antara siswa yang mengikuti model pembelajaran berbasis masalah dengan siswa yang mengikuti model pembelajaran konvensional. Penelitian ini merupakan quasi eksperimen dengan rancangan randomized post–test only control group design. Populasi penelitian ini seluruh siswa kelas V sekolah dasar di gugus XV Kecamatan Buleleng. berjumlah 182 siswa, sedangkan sampel penelitian ini adalan 60 siswa yang terdiri dari 30 siswa sebagaia kelompok kontrol dan 30 siswa sebagai kelompok eksperimen. Isntrumen penelitian menggunakan kuisioner untuk mengukur minat serta tes untuk mengukur hasil belajar siswa yang selanjutnya dianalisis mengunakan one-way manova. Hasil penelitian *menunjukkan: 1) terdapat perbedaan yang signifikan dari minat belajar siswa yang mengikuti model pembelajaran berbasis masalah dengan pembelajaran konvensional, 2) terdapat perbedaan yang signifikan hasil belajar matematika yang mengikuti model pembelajaran berbasis masalah dibandingkan dengan pembelajaran konvensional, 3) terdapat perbedaan minat belajar dan hasil belajar matematika siswa yang mengikuti model pembelajaran berbasis masalah dan pembelajaran konvensional. Dari hasil analisis data menunjukkann bahwa penerapan model pembelajaran berbasis masalah mempunyai pengaruh yang signifikan terhadap minat dan hasil belajar matematika siswa.*

Kata Kunci: Model Pembelajaran Berbasis Masalah; Pembelajaran Konvensional; Minat Belajar; Dan Hasil Belajar

Introduction

Learning is an activation process that results in a change in a person (Trianto, 2009). According to Bower and Hilgard (in Susanto, 2013) learning will focus on changes in the individual's potential or behaviour to produce changes as a result of an experience that is not caused by instincts, habits or maturity of the individual. According to Gagne (in Susanto, 2012) learning can be interpreted as a process that causes living things to change behaviour as a result of an experience. This shows that learning is interpreted as a process to obtain or increase motivation in aspects of knowledge, skills, habits, and behaviour. Based on the views above, it can be formulated that learning is an activity that is planned by someone in a conscious state to get a new concept, description or knowledge so that it causes a person to form a good attitude in thinking, feeling, or acting.

Students will acknowledge their learning outcomes if the material taught is in accordance with their level of ability and can be directly implemented to their everyday life. Learning ability is related to the development of children, especially at the elementary school level, which is still in the concrete operational stage, therefore teachers must design learning which activate students motivation to learn (Suparya, 2020). This means that students need to be actively involved in the teaching and learning process. Mathematics is one of the subjects taught at the elementary school level.

Learning mathematics is an educational process to provide learning experiences to students through a series of planned activities so that students gain competence about the materials being studied (Suci, DW, & Taufina, T, 2020) In mathematics, learning emphasizes the need for meaning, especially on the subject matter, focusing students on the concept of understanding, Avianty, D., & amp; Cipta, D. A. S. (2018). Mathematics seeks to equip students with various skills about recognition methods and doing methods that can help students mastering numeracy in depth. Based on this thought, mathematics emphasizes on students active learning and learning by doing.

In the process of learning mathematics, both teachers and students jointly carry out the process to achieve educational goals. General goal of education is to achieve each learning objectives optimally. Thus, it is known that the process of learning mathematics is not only transferring knowledge from teachers to students but rather a process that establishes interactions between teachers to students, student to student, and also between students to their environment. Not only that, learning mathematics is not just a transfer of knowledge, which means students are objects of learning, but students should be the subjects of learning.

Learning mathematics is designed to create fun learning by designing meaningful learning for students so that students are interested in learning mathematics. Align with the aim of learning mathematics in schools, to the general goal of learning mathematics in elementary schools is to prepare students to be able to experience changing circumstances in everyday life and in a world that is continuously growing, through mathematics practice they will be able to stimulate their logic, rational, critical, thorough, honest and efficient thinking (Sumantri, 2016; Kharisma & Asman, 2018). In the mathematics learning process carried out by teachers nowadays, it has been quite good with the use of interesting methods in their learning that is supported by creative media. However, there are still students who lack interest in learning mathematics because they are not happy with the methods used by their teachers in the learning process. This is because the methods used in each learning process are relatively the same and without the umbrella of an appropriate learning model. This is a problem that must be solved by the teacher because the lack of students interest in learning can affect the student learning outcomes.

Class management and the learning process in schools mostly are teacher-centred. The teacher holds the full authority and become the centre of information in classroom management and in the learning process. This statement is supported by the results of observations and interviews with several mathematics subject teachers which revealed that they still predominantly use conventional classroom management models. This fact can be said that the teacher seems to be the only source of learning for students. This is contrary to the constructivist view where knowledge must be built by the students themselves. Apart from the teacher, it was also obtained information that in the process of learning mathematics some students were lacked of interest in learning.

Nurhasanah, & Sobandi (2016) stated that interest is an impulse within a person or an aspect that raises interest and attention selectively, which causes the choice of an object or activity that is profitable, exciting, and over time produces satisfaction in him. So the teacher must be able to increase interest in learning with good management of the learning process so that students have a high interest in the learning process. The interest that a student has in learning activities can be seen in their attitude and behaviour. When students are happy in the process of learning, it can be interpreted that children are very interested in participating in the learning. So, in general, someone who is interested in the learning process tends to have good learning outcomes.

Learning outcomes can be interpreted as learning achievements obtained by students when following the teaching and learning process with the emergence of changes and one's behaviour. According to Fimansyah (2015), learning outcomes are changes that occur in a person's individual which causes that person to change in his attitude and behaviour. Learning outcomes can also be interpreted as abilities or competencies possessed by students after they receive learning experiences through the learning process. From thus description above, the students mathematics learning outcomes are influenced by many factors. Teachers must have skills in choosing learning models according to learning conditions and understand the level of student development, and understand the characteristics of students. Based on several factors that cause problems in learning mathematics, we need an application of learning that makes students happy to learn. If students are happy in learning, it will make students achieve optimal learning outcomes and will be useful for students in the future. In connection with these problems, the author tries to apply an innovative learning model as an alternative to increase students learning interest and learning outcomes, namely the problem-based learning model.

Problem Based Learning is a learning model that involves students solving a problem through the stages of the scientific method so that students can learn knowledge related to the problem and at the same time have the skills to solve problems. In this activity, efforts are made to solve the problems given by the teacher based on the information they have. Before the learning process in class, students are assigned to observe the problem first, so that the learning process can stimulate students to give a meaning to their learning. It means, by doing this activity students know their learning goals. Lidinillah, (2013) provides a formulation of the steps that will be passed by students in the problem-based learning process, these are (1) finding problems, (2) defining problems, (3) collecting facts, (4) making hypotheses, (5) research, (6) rephrasing the problem, (7) presenting alternatives, and (8) proposing solutions. Based on the description above, problem-based learning has different characteristics from conventional learning. These differences in characteristics will have consequences on the process and learning outcomes of students, and this is thought to affect students learning interests and learning outcomes.

Based on the results of research conducted by Fauzia, (2018); Lestari, K. S., & Dantes, N. (2018); Maryati, I. (2018), has conducted research at the elementary school and secondary education level stating that the problem-based learning model has been able to improve students mathematics learning outcomes. In line with the results of the study, it can be assumed that the problem-based learning model can increase student learning interest and learning outcomes. Starting from the background above, the objectives of this study are 1) to describe the differences in interest in learning mathematics between students who follow the problem-based learning model and students who follow the conventional learning model, 2) to describe the differences in mathematics learning outcomes between students who follow the learning model. problem-based with students who follow the conventional learning model, 3) simultaneously describe the differences in interest in learning and learning outcomes in mathematics between students who follow the problem-based learning model and students who follow the conventional learning model.

Method

This study uses a quasi-experimental approach, quasi-experimental research does not fully control the research group involved (limited control). (Sugiyono, 2017) there are two groups involved in this study, namely the control group and the experimental group. The formation of the experimental group and the control group did not randomize the research subjects. All grade V elementary school in cluster XV, Buleleng district which total 182 students were used as the population in the study, 60 students from the population were determined as the research sample consisting of 30 students as the control group and 30 students as the experimental group using pretest - posttest non-equivalent control group design factorial 2 x 2 (Dantes, 2017). The reason for choosing this design is because the researcher did not change the class, in other words, using an existing class as the research sample, the full design can be seen in table 1.

Table 1. Experimental Design

Group	**Pre Tes**	**Treatment**	**Post Test**
Experiment	O1	X	O3
Control	O2	-	O4

Information

X: application of problem-based learning
O1: *pre-test* experimental group
O2: *pre-test* control group
O3: *post test* experimental group
O4: *post test* control group

There are two independent variables and two dependent variables involved in this study, the independent variables are problem-based learning models and conventional learning models while the dependent variables are interest and learning outcomes, designed as table 2.

Table 2. Analysis Design Matrix

A_1		**A_2**	
Y_1	Y_2	Y_1	Y_2

Information:

A1: problem-based learning
A2: conventional learning
Y1: interest in learning
Y_2: student learning outcomes

Hypothesis testing is carried out from the acquisition of a normalized gain score (N-gain) for each student can be calculated using the following formula (Dantes, 2017).

$$N\_Gain = \left[\frac{(Spost - Spre}{Smax - Spre} \right]$$

Information:

N-Gain: normalized gain
S_{post} : *post-test* score
S_{pre} : *pre-test* score
S_{max} : maximum score

N-gain was calculated with the aim of seeing the increase of interest and learning outcomes that occurred in the experimental and control groups. Furthermore, this N-gain will be analyzed further using multivariance analysis with the manova test technique with the help of SPSS (Santoso:2002; Candiasa, 2007).

Results and Discussion

The results of this study are to measure the interest and learning outcomes of mathematics in students who are taught using a problem-based learning model and students who are taught using a conventional model. One-way manova design pretest-posttest nonequivalent control group design was used to analyze the data obtained. The data obtained in this study are as follows: 1) data on students' interest in learning who follow the conventional learning model, 2) data on student learning outcomes who follow the conventional model, 3) interest in learning who participates in learning with problem-based learning models, 4) results in data learning that follows learning with a problem-based learning model. In the following, data related to the central tendency of each measured variable will be presented in table 3.

Table 3. Recapitulation of Interest Scores and Student Learning Outcomes

Data Statistics	**Y_1A_1**	**Y_2A_1**	**Y_1A_2**	**Y_2A_2**
Mean	70,97	67,50	79,81	79,80
Median	71,00	66,50	79,00	79,00
Modus	63,94	63,94	78,45	71,86
standard deviation	4,71	6,90	5,18	5,18
variance	22,25	48,00	26,86	26,86
Range	20,00	30,00	20,00	20,00
Maximum score	82,00	85,00	92,00	92,00
Minimum score	62,00	55,00	72,00	72,00

Information:

Y1A1: Interest in learning data that follows the conventional learning model
Y2A1: Data on learning outcomes that follow the conventional learning model
Y1A2: Interest in learning data that follows the problem-based learning model
Y2A2: Data on learning outcomes that follow the problem-based learning model

Furthermore, the data obtained were tested using one-way manova. The analysis prerequisite test was carried out before the manova test with the help of SPSS 24 for windows, the prerequisite tests were the normality test and the homogeneity test of variance. The results of the analysis prerequisite test can be seen in Tables 4, 5, and 6.

Table 4. Normality Test For Data Normality

	Learning model	**Kolmogorov-Smirnov**			**Shapiro-Wilk**		
		Statistic	**df**	**Sig.**	**Statistic**	**Df**	**Sig.**
interest to learn	conventional	.108	36	.200*	.973	36	.520
	PBL	.157	38	.059	.911	38	.055
Learning outcomes	conventional	.142	36	.063	.958	36	.182
	PBL	.190	38	.061	.923	38	.152

Based on table 4, it appears that the values obtained from calculations using the kolmogorov-smirnov and shapiro-wilk statistical tests for the two dependent variables have a significant number greater than 0.05, thus all data distributions are according to conventional learning models and based on learning models is normally distribute.

Table 5. Test of Homogeneity of Variance Between Groups Using Levene's Test

	F	**df1**	**df2**	**Sig.**
Learning interest	.001	1	72	.981
Learning outcomes	2.447	1	72	.122

Table 6. Tek Box's m Test

Box's M	7.937
F	2.566
df1	3
df2	1033163.632
Sig.	.053

Based on table 5 and table 6, shows that levene's statistical value and the value of box's m show a significance greater than 0.05, meaning that the variance between groups is homogeneous and the data between the variance matrices is not homogeneous. From these data, it shows that manova analysis can be done. The next prerequisite test carried out is the correlation test between the dependent variables (multicollinearity test). The results show that to see the dependent variable in each applied learning model, namely learning interest (y1) and learning outcomes (y2), the tolerance value and vif for all variables are 1.00, meaning that there is no multicollinearity between the dependent variables, thus it can be concluded that there is no multicollinearity between the dependent variables. Therefore, data testing can be continued with a one-way manova analysis. The hypotheses proposed in this study are as follows: (1) there is no difference in learning interest between students who follow the problem-based learning model and students who take conventional learning in grade v elementary school in cluster xv, Buleleng district, (2) there is no difference in mathematics learning outcomes between students who follow the problem-based learning model and students who take conventional learning in grade v elementary school in cluster xv, Buleleng district, (3) there is no difference in learning interest and mathematics learning outcomes between students who follow the problem-based learning model and students who take Conventional Learning in grade v elementary school in cluster xv, Buleleng district.

Based on the results of the analysis using one-way manova, the following data were obtained:

Table 7. Calculation Results of Learning Interest and Student Learning Outcomes with One-Way Manova

Source	**Dependent Variable**		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	dimension1	Learning Interest	1011.280[a]	1	1011.280	38.734	.000
		Learning outcomes	2791.371[b]	1	2791.371	75.085	.000
Intercept	dimension1	Learning Interest	412297.226	1	412297.226	15791.666	.000
		Learning outcomes	401343.966	1	401343.966	10795.738	.000
Model Pembelajaran	dimension1	Learning Interest	1011.280	1	1011.280	38.734	.000
		Learning outcomes	2791.371	1	2791.371	75.085	.000

Testing the first hypothesis through the F variance statistic, with the criteria for rejecting H0 if the Sig < 0.05. The results of the analysis showed that the statistical value of F = 38.734 with Sig <0.05. This means that Ho is rejected or in other words, that there is a difference in learning interest between students who take part in problem-based learning and students who take conventional learning. Testing the second hypothesis through the F variance statistic with the reject criteria H0 if the Sig < 0.05. The results of the analysis show that the statistical value of F = 75,085 with Sig < 0.05. This means that Ho is rejected or in other words, that there is a significant difference in the learning outcomes of students who follow the problem-based learning model compared to those who follow conventional learning. Testing the third hypothesis can be seen from the results of the analysis based in table 8.

Table 8. Recapitulation of Calculation Results of Learning Interest and Student Learning Outcomes with One-Way Manova

Effect		**Value**	**F**	**Hypothesis df**	**Error df**	**Sig.**
Intercept	Pillai's Trace	.997	12066.053[a]	2.000	71.000	.000
	Wilks' Lambda	.003	12066.053[a]	2.000	71.000	.000
	Hotelling's Trace	339.889	12066.053[a]	2.000	71.000	.000
	Roy's Largest Root	339.889	12066.053[a]	2.000	71.000	.000
Learning model	Pillai's Trace	.593	51.827[a]	2.000	71.000	.000
	Wilks' Lambda	.407	51.827[a]	2.000	71.000	.000
	Hotelling's Trace	1.460	51.827[a]	2.000	71.000	.000
	Roy's Largest Root	1.460	51.827[a]	2.000	71.000	.000

The results of the analysis show that the F value for pilae trace, wilk lambda, hotelling trace, roy's largest root has a sig < 0.05. This means that the F price for pilate trace, wilk lambda, hotelling trace, roy's largest root is significant. This shows that Ho is rejected, in other words, the alternative hypothesis (Ha) which states that there are differences in learning interest and mathematics learning outcomes between students who follow the problem-based learning model and students who take conventional learning in grade V elementary school, cluster XV, Buleleng district is accepted.

The results showed that there was a significant difference between the learning interest obtained by students who participated in problem-based learning compared to students who followed conventional learning models. Student interest in the group of students who were taught in problem-based learning was higher than those students who were taught in the conventional group. In other words, problem-based learning is superior to conventional learning. From the results of statistical analysis, the findings of this study are consistent with the results of previous studies (Yuliati, 2016; Ismail, 2018; Aiman & Ahmad, 2020). However, some questions need to be clarified and explained.

Why is the problem-based learning model superior to conventional learning? The problem-based learning model is based on a constructivist view of learning, which is thinking skills-based learning. Theoretically, giving contextual problems with problem-based strategies will provide opportunities for optimal involvement of mental processes, such as observing, classifying, communicating, measuring, and predicting. These activities are process skills that underlie the achievement of maximum learning outcomes, critical thinking skills and problem-solving skills (Kenedi, 2018).

The application of problem-based learning models can arouse students attention, curiosity arises because of the problems presented in children's daily lives so that learning becomes fun. Problem-based learning can make learning effective because the teacher provides direct experience and leads to a more abstract experience. A pleasant learning environment causes students interest in learning with problem-based learning to be higher than in conventional learning. The constructivist view views that problem-based learning models deliver the learning into contextual teaching texts that are related to their everyday real world. This will provide opportunities for all children to actively participate in building their knowledge.

Conventional and problem-based learning affect differently in student learning outcomes because problem-based learning provide opportunities for students to embed knowledge in long-term memory (not rote memory) the value of information is based on individual needs (not determined by the teacher), linking new information with prior knowledge and facts or problems that exist around the student's environment (not overcrowding students with a pile of information), and conduct authentic assessments through the application of realistic problems (not just to meet formal academic needs).

Related to learning mathematics in elementary school (Abdurrahman, 2009) stated the section of mathematics studies in elementary school includes 3 parts, namely arithmetic, algebra, and geometry. Arithmetic and counting are parts of mathematics that deal with the intertwined character of real numbers with their main calculations involving addition, subtraction, multiplication, and division. In short, arithmetic or counting is an understanding of numbers.

Bringing real situations into learning mathematics in schools is needed. This will be able to grow and develop positive student actions when learning mathematics, which is expected to be an idea to understand and interpret everyday situations as an interesting thinking process. Such mathematical goals can be achieved if the teacher is successful in bringing students into the child's daily life. In this case, the teacher not only maths everyday experiences but also makes no day without mathematics. The findings of this study are consistent with the results of previous studies (Handika & Wangid 2013; Pradnyana, et al, 2013; Ghati, 2018).

Conclusion

The conclusions of the study are as follows: (1) there is a significant difference in the learning interest of students who follow the problem-based learning model with conventional learning as evidenced by the results of the calculations for the variable interest in learning, the statistical value of $F = 38.734$ with a significance level of <0.05 ; (2) there is a significant difference in learning outcomes of mathematics following the problem-based learning model compared to conventional learning with a statistical value of F = 75.085 with a significance level of <0.05; (3) there are differences in learning interest and mathematics learning outcomes of students who follow the problem-based learning model and conventional learning based on the results of F for pilae trace, wilk lambda, hotelling trace, roy's largest root has a significantly less than 0.05. In other words, there are differences in learning interest and mathematics learning outcomes between students who follow the problem-based learning model and students who take conventional learning in grade V elementary school, cluster XV, Buleleng district.

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