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The Effect of Blended Learning Type of Flipped Classroom on Mathematical Problem Solving Ability in Solid Figures Topic

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Abstract

This study aimed to find out the ability to solve math problems in solid figures topic before flipped classroom type blended learning was applied to grade IX students of SMPN 2 Sokaraja in the 2019/2020 school year and to know the influence of flipped classroom type blended learning on the problem-solving skills of solid figures topic in Grade IX of SMPN Sokaraja in the 2019/2020 school year. By looking at the objectives, statistical testing was conducted to test the effectiveness formulated in the research hypothesis. To test the significance of mean differences over two different groups due to the use of multiple treatments on an independent variable can be done with a parametric statistical test using the -t-test. Before conducting parametric statistical tests, the data we obtained must fulfill the requirements of conducting tests with parametric tests including, normal and homogeneous distribution. If the data meets the requirements of a hypothesis test with a parametric test, but if it does not meet the requirements then the hypothesis test is conducted with a non-parametric test. The previous analysis resulted that the problem-solving skills of students taught with a blended learning model flipped classroom type are better than conventional learning models. Descriptively, when viewed from the average score of overall math problem-solving skills for students taught with a blended learning model flipped classroom type was 44.22, while those taught with conventional models was 38.17. From the average of each level of math problem-solving ability, the one taught with a blended learning model flipped classroom type was 4.42 and the one taught with conventional learning model was 3.82. It was explained, that the model of learning blended learning type flipped classroom was very influential on the ability to understand problems, the ability to plan solutions, the ability to complete, and the ability to re-examine the results of work.

Keywords: Blended Learning, Flipped Classroom, Problem-Solving Ability

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INTRODUCTION

The main purpose of learning is to teach students, how to learn well, how to raise students to learn with all their potential to solve problems throughout their lives. This is by the four pillars of education defined by UNESCO, namely: learning to know, learning to do, learning to be, learning to live together (Zainal & Arifin, 2012). Learning activities are activities carried out in the learning process, namely between teachers and students to achieve learning objectives. The activities carried out here are focused on students, because the activity in the learning process makes learning more meaningful. According to Ainurrahman (2012), student learning activities that are driven by learning motivation are a sign that students already have the self-awareness to study wholeheartedly. Therefore, the activity of students in the learning process is important, because it is a measure of the ability to understand knowledge and its

functions to be actualized so that this learning activity is important to involve all components in the educational process, including the use of information technology as a medium in learning.

Advances in science and technology in various fields of life bring changes, especially in improving the quality of education. While the needs of 21st-century learning allow learning to be carried out using distance methods using ICT (Information Communication Technology), this learning trend is called distance learning (E-Learning) or blended learning using the web (Nasution et al., 2019).Online learning has advantages with the many learning resources provided, where teachers and students can reach a very wide range of learning resources. This learning also has a weakness, namely the absence of direct interaction between teachers and students. This causes the non-verbal elements in the interaction to be not conveyed perfectly (Charles R. et al., 2005). According to Saavedra & Opfer (2012) access to learning in the 21st century has become easier, faster, and cheaper. The use of information and communication technologies (ICT) makes a big change in learning. There is a shift in the role of the teacher wherein conventional learning the teacher is the only source of learning. However, with the development of ICT, the teacher's role in learning is as a facilitator. The use of ICT and the development of e-learning have become the starting point for the emergence of blended learning-based learning. Blended learning according to Garrison and Vaughan "At its simplest, blended learning is the thoughtful integration of classroom face to face learning experiences with online learning experiences" (Garrison & Vaughan, 2008). Therefore, blended learning is an integration of face-to-face learning with online learning. Blended learning is described as a model for learning in which teachers use technology, usually in filling out web-based instructions, daily tasks, or perhaps as the instructor's main guide. Blended Learning is a combination of face-to-face learning models with e-learning based learning models. This learning model facilitates students during the learning process. From the definitions of these experts, it can be concluded that blended learning is the mixing of two or more strategies or learning methods to get the expected learning outcomes (Allen et al., 2007). By applying the Blended Learning model, there will be changes, where the learning process does not only listen to material descriptions from the teacher but students can use e-learning facilities that can be accessed anywhere and anytime. There are 3 documentations of the understanding of Blended learning proposed by Charles R. et al. (2005), namely the combination of learning strategies, the combination of learning methods, and the combination of online learning and face-to-face learning.

To support blended learning, an appropriate learning model is needed, one of which is the flipped classroom model. Prayitno & Masduki (2017), stated: "Flipped Classroom is a learning model that reverses the traditional method, which is usually given in class and students work at home". Essentially in a flipped classroom what is learned in class is learned at home, and homework done at home is now done in class (Bergmann & Sams, 2012). The traditional model of instruction is teacher-centered; the teacher gives lectures during the lesson and assigns students homework to do at home. The flipped classroom, or inverted classroom, reverses traditional education: the teacher delivers the content outside the classroom with videos prepared by him/her and uses class time for active learning by having students collaborate and interact with each other (Mok, 2014). As a result of the flipped classroom, students find more opportunities to get engaged with more activities in class and to have discussions about the concepts involved. However, the teacher should very carefully plan activities, videos, presentations, or study notes to deliver content outside of the classroom.

Based on Education and Culture Ministerial Regulation No. 24 of 2016 (Susanti, 2017) regarding Core Competencies and Basic Competencies in primary and secondary education, it can be seen that the objectives of the curriculum in learning mathematics on knowledge competence are to understand, apply, and analyze factual, conceptual, procedural and metacognitive knowledge based on their curiosity about science, technology, art, culture, and humanities with insight into humanity, nationality, state, and civilization related to the causes of phenomena and events, as well as applying procedural knowledge in specific fields of study according to their talents and interests to solve problems. According to (Saad & Ghani, 2008), a mathematical problem is defined as a situation that has a clear goal but is faced with obstacles due to the lack of a known algorithm to decipher it to obtain a solution. Meanwhile, Polya (1973) describes mathematical problems in two types, namely problems to find and problems to prove. The problem to find is a problem that aims to find, determine, or get the value of a particular object that is not known in the problem and gives the appropriate conditions.

Several previous studies have found that flipped classrooms can help students become more interested and enjoy learning activities (Wanner & Palmer, 2015); can increase student satisfaction (Bösner et al., 2015), and increase their creativity (Al-Zahrani, 2015). The flipped classroom uses a higher student-centered approach than the traditional method (Lopes & Soares, 2018).

METHOD

The design used in quasi-experimental research refered to a class that has been formed previously, both as a control group and an experimental group (Dantes, 2012), as shown in the Figure 1.

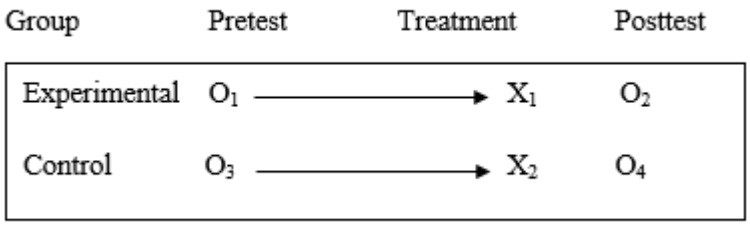

Figure 1. Design Quasi-Experimental Research

Description:

O_1 : The ability of the experimental group before being given treatment

O_2 : The ability of the experimental group after being given treatment

X_1 : Treatment with Blended Learning model

X_2 : Treatment with Conventional learning model

O_3 : The ability of the control group before being given treatment

O_4 : The ability of the control group after being given treatment

Data Collection Tools

In this study, the population was 9th (IX) grade even semester students of SMPN 2 Sokaraja, Banyumas Regency, Central Java Province, then the sample was determined by using cluster random sampling technique. The samples used in this study were 2 classes with details of 1 class as the experimental class, and 1 class as the control class. From the results of the technique using cluster random sampling, it was obtained that class IX F (the number of students was 32) was the experimental class, and class IXD (the number of students there were 30) was the control class. The research instrument used in this study was a test instrument to measure the ability to solve mathematical problems after finishing learning the solid figures topic. Before the test kit was used, the instrument was first tested in classes other than class IX F and IX D, namely class IXE to determine its content validity and face validity. Content validity and face validity were using 1 mathematics teacher at SMPN 2 Sokaraja, and 1 lecturer in Mathematics Education FKIP UM Purwokerto.

To test the significance of the difference in the Mean of more than two different groups due to the use of treatment on an independent variable, it can be done by using parametric

statistical tests using t-test. Before performing parametric statistical tests, the data we obtained must fulfill the requirements for testing with parametric tests including normal and homogeneous distribution. If the data met the requirements, the hypothesis was tested using parametric tests, but if it did not meet the requirements, then the hypothesis was tested using non-parametric tests.

RESULT

Quantitative data were obtained from the results of the math problem-solving ability test which was conducted after learning ended (after the 6th meeting). The students measured were students of class IX F (as the experimental class) with a total of 32 students on Table 1.

Table 1. List of Scores on Mathematics Problem Solving Ability of Class IXF

No	Students' Name Code	Score Question Number						Total	Score	Final Score
		1	2	3	4	5	6			
1	F1	6	2	10	4	2	2	26	4,33	43,33
2	F2	10	4	4	6	4	4	32	5,33	53,33
3	F3	3	3	5	6	4	3	24	4,00	40,00
4	F4	10	2	10	4	4	2	32	5,33	53,33
5	F5	10	4	10	7	4	4	39	6,50	65,00
6	F6	6	2	10	4	2	2	26	4,33	43,33
7	F7	4	2	4	4	4	4	22	3,67	36,67
8	F8	2	2	4	4	4	2	18	3,00	30,00
9	F9	10	2	10	4	2	0	28	4,67	46,67
10	F10	2	2	4	4	4	3	19	3,17	31,67
11	F11	6	2	4	4	4	2	22	3,67	36,67
12	F12	6	2	3	3	3	3	20	3,33	33,33
13	F13	4	4	3	5	4	4	24	4,00	40,00
14	F14	10	8	10	3	3	2	36	6,00	60,00
15	F15	10	2	10	4	2	2	30	5,00	50,00
16	F16	10	2	10	4	5	2	33	5,50	55,00
17	F17	10	8	10	4	3	3	38	6,33	63,33
18	F18	8	3	4	2	4	0	21	3,50	35,00
19	F19	4	4	4	5	3	2	22	3,67	36,67
20	F20	4	4	4	5	4	3	24	4,00	40,00
21	F21	10	6	8	6	6	4	40	6,67	66,67
22	F22	3	2	6	5	5	0	21	3,50	35,00
23	F23	6	4	10	5	4	4	33	5,50	55,00
24	F24	6	6	10	6	4	4	36	6,00	60,00
25	F25	6	4	3	0	2	2	17	2,83	28,33
26	F26	4	2	8	6	5	2	27	4,50	45,00
27	F27	6	4	10	6	3	0	29	4,83	48,33

No	Students' Name Code	Score Question Number						Total	Score	Final Score
		1	2	3	4	5	6			
28	F28	3	2	4	4	2	0	15	2,50	25,00
29	F29	3	3	5	6	4	3	24	4,00	40,00
30	F30	4	4	4	5	4	4	25	4,17	41,67
31	F31	4	4	4	5	4	4	25	4,17	41,67
32	F32	3	2	6	5	5	0	21	3,50	35,00
Total		193	107	211	145	117	76	849	141,5	1415
Average		6,03	3,34	6,59	4,53	3,66	2,38	26,53	4,42	44,22

Based on the Table 1, the highest average in answering question number 3, followed by the average number of students answering question number 1. This was because questions number 3 and 1 were easy to understand and in terms of language were also easy to be understood. While the question with the lowest average was question number 6, this was because question number 6 is an applicative question. Quantitative data were obtained from the results of the math problem-solving ability test which was conducted after learning ended (after the 6th meeting). The students measured were students of class IX D (as the control class) with 30 students.

Table 2. List of Scores on Mathematics Problem Solving Ability of Class IXD

No	Student's Name Code	Score Question Number						Total	Score	Final Score
		1	2	3	4	5	6			
1	D1	4	3	4	6	4	2	23	3,83	38,33
2	D2	4	0	4	3	3	0	14	2,33	23,33
3	D3	4	2	6	3	2	2	19	3,17	31,67
4	D4	4	2	4	2	4	2	18	3,00	30,00
5	D5	10	2	8	6	4	2	32	5,33	53,33
6	D6	4	2	8	0	1	2	17	2,83	28,33
7	D7	10	2	4	2	4	3	25	4,17	41,67
8	D8	4	2	4	4	3	2	19	3,17	31,67
9	D9	10	2	3	2	4	3	24	4,00	40,00
10	D10	4	2	4	2	4	0	16	2,67	26,67
11	D11	10	2	4	2	4	0	22	3,67	36,67
12	D12	5	1	4	2	4	0	16	2,67	26,67
13	D13	10	0	4	3	0	0	17	2,83	28,33
14	D14	10	6	5	4	4	4	33	5,50	55,00
15	D15	3	2	3	2	2	1	13	2,17	21,67
16	D16	10	2	4	2	4	0	22	3,67	36,67
17	D17	10	3	4	5	4	2	28	4,67	46,67
18	D18	4	0	3	0	4	0	11	1,83	18,33
19	D19	2	2	2	4	4	4	18	3,00	30,00

No	Student's Name Code	Score Question Number						Total	Score	Final Score
		1	2	3	4	5	6			
20	D20	10	2	4	3	4	3	26	4,33	43,33
21	D21	10	2	4	4	2	2	24	4,00	40,00
22	D22	4	2	4	3	4	3	20	3,33	33,33
23	D23	10	2	4	2	2	2	22	3,67	36,67
24	D24	4	2	4	3	4	2	19	3,17	31,67
25	D25	10	5	10	5	4	4	38	6,33	63,33
26	D26	10	4	10	4	4	3	35	5,83	58,33
27	D27	5	2	5	6	4	4	26	4,33	43,33
28	D28	10	2	10	6	4	2	34	5,67	56,67
29	D29	10	2	2	2	3	3	22	3,67	36,67
30	D30	10	2	10	6	4	2	34	5,67	56,67
Total		215	64	149	98	102	59	687	114,51	1145,01
Average		7,17	2,13	4,97	3,27	3,40	1,97	22,90	3,82	38,17

Based on the Table 2, the highest average in answering question number 3, followed by the average number of students answering question number 1. This was because questions number 3 and 1 were easy to understand and in terms of language were also easy to be understood. While the question with the lowest average was question number 6, this was because question number 6 is an applicative question. Based on the table, the average mathematical problem solving ability of the experimental group (Class IXF) and the average mathematical problem solving ability of the control group (Class IXD), can be presented in the Figure 2.

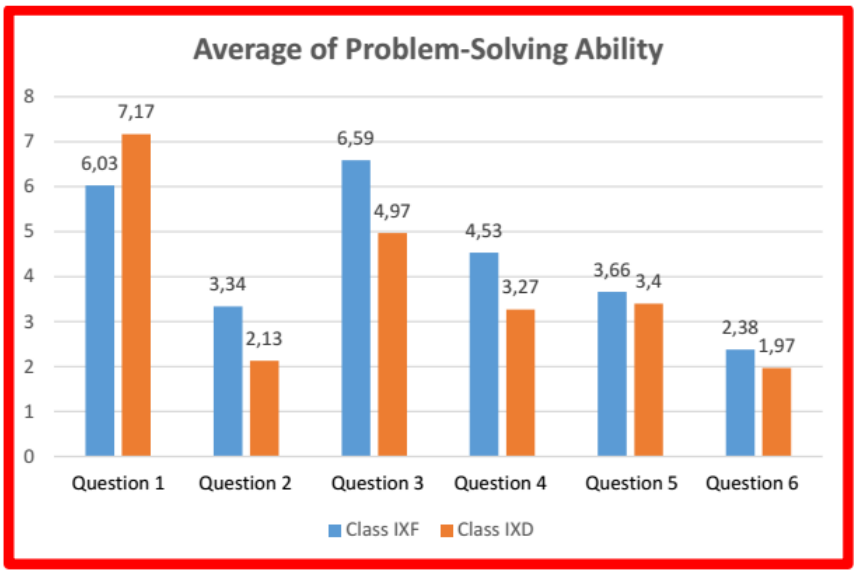

Figure 2. Histogram of Average Problem-Solving Ability Class IX D and IX F

Based on the diagram, the average mathematical problem-solving ability for questions number 2 to number 6 in the experimental group was better than the control group. However, for question number 1 the average problem-solving ability of the control group was better than the experimental group. This is probably because question number 1 has a low level of problem-solving ability. And also when viewed from the term of the language was easy to understand. The results of the normality test of students' mathematical problem-solving abilities based on Blended Learning Type Flipped Classroom (experimental class), and conventional learning as shown in Table 3.

Table 3. Normality Test of Mathematical Problem Solving Ability

		Unstandardized Residual
N		30
Normal Parameters[a]	Mean	.0000000
	Std. Deviation	11.75877316
Most Extreme Differences	Absolute	.115
	Positive	.115
	Negative	-.080
Kolmogorov-Smirnov Z		.630
Asymp. Sig. (2-tailed)		.823

Based on the table above, it was known that the mathematical problem-solving abilities of students who are taught using the Flipped Classroom Type Blended Learning learning model (experimental class) and conventional learning (control class) were normally distributed. The results were based on the score of Sig. Kolmogorof-Smirnov test was 0.823 > 0.05. The results of the homogeneity of variance test for the two groups of data are presented in the following Table 4.

Table 4. Independent Samples Test

		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
Problem-Solving Ability	**Equal variances assumed**	**.017**	**.895**	**-2.136**	**60**	**.037**	**-6.2354**	**2.9188**	**-12.0739**	**-.3969**
	Equal variances not assumed			**-2.133**	**59.174**	**.037**	**-6.2354**	**2.9238**	**-12.0857**	**-.3852**

Based on the Table 4 above, the score of sig. Levene's Test for Equality of Variances was 0.895 > 0.05, meaning that the data variance for Class IXD and IX F was homogeneous or the same. So the interpretation was seen in the Equal variances assumed line. About the fulfillment of the prerequisite test, it can be continued to find out the difference in the mathematical problem-solving abilities of students who are taught by learning Blended Learning Type Flipped Classroom and conventional learning by using the t-test. Based on the results of the t-test calculations as in the table above, the output of the Independent Samples Test on the Equal variances assumed line shows the score of Sig. (2-tailed) was 0.037 < 0.05, and it was concluded that H0 was rejected, and Ha was accepted. This meant that there was a significant difference between the average problem-solving ability of class IX D and class IX F.

DISCUSSION

There are differences in mathematical problem-solving abilities taught by using the blended learning model of the flipped classroom type and using the conventional learning model. Even the problem-solving abilities of students who were taught with blended learning type flipped classroom were better than those taught with conventional learning models. Blended learning is a new methodology in learning that includes face-to-face and online learning that combines traditional learning with activities using computer media through the use of tablets, smartphones, and other technologies where this will attract students more than face-to-face learning or online learning only (Capone et al., 2017).

The causes of problem-solving abilities taught using the blended learning model of the flipped classroom type were better than those taught using conventional learning models were 1) Learning using the blended learning model of the flipped classroom type was student-centered, and the teacher only provided an introduction to the material that was not too long (just enough), 2) The result of number 1 was that students were not bored in learning, and could express their ideas optimally, 3) In flipped classroom blended learning, the development of materials and questions referred to problems that were often encountered or faced in everyday life. While conventional learning was less attractive, did not develop children's thinking potential and students' problem-solving abilities, so students were not able to solve difficult problems, especially related to problem-solving abilities which were HOTS categories. Conventional learning made learning less meaningful, because of the inability of most students to relate what they have learned to their daily lives.

From the presentation of the research results, it was known that the blended learning model of the flipped classroom type can improve mathematical problem-solving abilities, and was better than students who are taught using conventional learning models. Based on the stages of problem-solving skills presented in this study, students who were taught using the conventional model for problem number 1 were better, because the level of the questions was still low. However, for the sixth distant problem, those who were taught and used to the blended learning model of the flipped classroom type were better than those taught with conventional learning. This shows that the flipped classroom can increase student satisfaction (Talan & Sevinc, 2019), because the flipped classroom using a student-centered approach in learning, making students more responsible for their learning process so that the rate of success in learning with the flipped classroom was higher than the traditional method (Lopes & Soares, 2018). This was in line with Garrison & Vaughan (2008), which says that blended learning is flexible learning, besides the use of e-learning or online learning is one form of flexible learning. Students who did not have a learning experience through e-learning can quickly become interested in learning activities as well as students who have previously studied through online lectures (Asarta & Schmidt, 2020). The type of blended learning used is Flipped-Classroom following the idea that blended learning includes several elements of student control over time, place, way, and/or speed.

From the results of the previous analysis, it was found that the problem-solving abilities of students who were taught with the blended learning model of the flipped classroom type were better than those taught with the conventional learning model. Descriptively, when viewed from the acquisition of the average score of overall mathematical problem-solving abilities for students who were taught with the blended learning model of flipped classroom type was 44.22, while those who were taught using the conventional model was 38.17. It was very easy to see the impact of the learning used. When viewed from the average of each level of mathematical problem-solving ability, those taught with the blended learning model of the flipped classroom type were 4.42 and those taught with the conventional learning model were 3.82. It was explained that the blended learning model of the flipped classroom type greatly influenced the ability to understand problems, the ability to plan solutions, the ability to solve, and the ability to re-examine work results. The results of this study also showed the consistency of the results of the latest research that compared to traditional methods, the flipped classroom was significantly able to improve mathematics learning achievement (Wei et al., 2020), and was very beneficial to learning achievement across various disciplines and various levels of education (Strelan et al., 2020; Wei et al., 2020).

CONCLUSION

Based on the results of the discussion that has been described in the previous parts, it can be concluded that there are differences in the ability to solve mathematical problems in the Curved Side-Space material of students who receive blended learning model type flipped classroom and students who receive conventional learning models.

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