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The blended learning with Whatsapp media on Mathematics creative thinking skills and math anxiety

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ABSTRACT

The blended learning was a learning model that combines offline and online learning. There are two types of blended learning models used in this research, namely the flipped classroom model and the station rotation model. In these models, the teacher would use WhatsApp as a media for online learning. The purpose of this research was to determine the effect of blended learning models on mathematical creative thinking skills and math anxiety of public junior high school students in Sukoharjo Regency, Central Java Province. The research method used was quasi-experimental by sampling using stratified cluster random sampling techniques. There were three schools selected as research samples, namely Mojolaban 1 Public Junior High School, Mojolaban 2 Junior High School, and Grogol 3 Public Junior High School. The data collection used a written test and questionnaires methods which were carried out after the treatment was given. The data analysis technique used a one-way multivariate analysis of variance. This research shows that the blended learning models were better than the direct learning model on mathematical creative thinking skills, but judging from the magnitude of math anxiety, the direct learning model was better than the station rotation learning model.

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1. INTRODUCTION

Mathematics is one of the universal sciences that underlies the development of modern technology today and has an important role as a means of solving life problems [1]. Mathematics contains definitions, a set of assumptions, postulates, axioms and theorems or propositions that are used to solve mathematical problems [2]. In solving mathematical problems, mathematical thinking skill is needed. Mathematical thinking skill is a thought process that involves the ability to collect information both deductively and inductively, analyze information, and make generalizations to develop understanding and gain new knowledge [3]. Mathematical thinking skill is divided into two kinds, namely low thinking skills (LOTS) and high thinking skills (HOTS) [4].

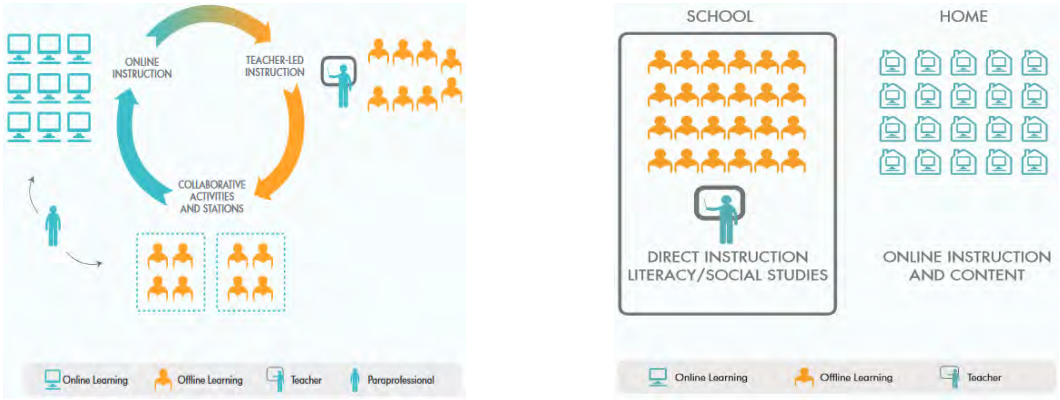
Based on the results of the national exam, the national average of math subject for junior high school students in 2017 was 50.31 (category D), while in 2018 was 43.34 (category D); for Central Java Province, the average in 2017 was 48.65 (category D), and in 2018 was 45.63 (category D); as for the city/regency level, Sukoharjo Regency obtained an average score of 51.69 (category D) for 2017, and 50.68 (category D) for 2018 [5, 6]. From this data, it can be seen that there was a decrease in the national math test

scores of Indonesian students at the junior high school level from 2017 to 2018. This decrease was due to an increase in the percentage of items in the HOTS [7]. These results indirectly indicate that the low mathematics learning achievement of Indonesian students at the junior high school level, especially in Sukoharjo Regency, is caused by the low of student's high order mathematical thinking skills. One of HOTS that needs to be developed is the ability to think creatively [8].

Creative thinking requires imagination, intelligence, insight, and ideas in accordance with certain objects, problems, and conditions that are being faced [9]. Creative thinking in mathematics does not have to always produce truly new solutions, but these solutions are new to certain individuals [10, 11]. For example, when students can solve mathematical problems using different ways than those taught by the teacher, they can be said to have good mathematical creative thinking skills. There are three indicators of mathematical creative thinking ability, namely fluency, flexibility, and authenticity [11]. Fluency is the ability to provide more than one mathematical answer. Flexibility is the ability to provide more than one mathematical way by using different concepts. Authenticity is the ability to provide unusual mathematical solutions.

In addition to the mathematics creative thinking skill, other things need to be a concern for teachers, namely math anxiety. Math anxiety is described as a strong feeling of tension and fear that a person has when confronted with a mathematical problem [12]. This anxiety can trigger a variety of cognitive, affective, and physical reactions [13]. Cognitive reactions are indicated in the form of negative self-talk, empty thoughts, and avoidance of mathematics. Affective reactions are indicated in the form of lack of confidence, fear of looking stupid and losing identity. Physical reactions include sweating, impulses in heart rate, tension, and nausea. Math anxiety is indicated as one of the factors that interfere with the development of students' mathematical creativity [14]. This is because students with high levels of anxiety will find it difficult to present more than two different answer ideas correctly, and are less able to make solutions in their way [15].

To overcome these problems we need a learning model that combines direct, cooperative, and online learning to increase student learning time. Blended learning is a set of teaching strategies that combine face-to-face teaching programs and computer or online teaching programs [16, 17]. Initially, there were six types of blended learning models, namely the face-to-face driven model, rotation model, flex model, online lab model, self-blended model, and enriched virtual model, but Staker and Horn [18] decided to remove the face-to-face driven model and online lab model so there are only four blended learning models which are then used today. The rotation model is divided into four types, namely station rotation, lab rotation, flipped classroom, and individual rotation [17]. In this research, the station rotation model and the flipped classroom model are selected as a comparison to the direct learning model. The syntaxes for both models are shown in Figure 1 [17].



(a) (b)

Figure 1. The syntaxes of online and offline learning on blended learning model
(a) Station rotation model (b) Flipped classroom model

The station rotation model and the flipped classroom model are chosen because the percentage of direct face-to-face learning is still greater than online learning considering the school learning system in Indonesia still prioritizes classroom learning, whereas online learning is only as a support. The similarities between the two models are the existence of direct learning by teachers, cooperative learning between students and online learning using technology. The difference between the two models lies in when online

learning takes place. In the station rotation learning model, online learning takes place after class learning has ended, and in the flipped classroom learning model, online learning is carried out before classroom learning occurs. Online learning on the station rotation model is applied to strengthen students' understanding of the teaching material that has been given during class learning. In the flipped classroom model, online learning is done by sending teaching materials to students through online media to prepare students before attending class learning.

In contrast to previous studies where blended learning was using Moodle [19, 20], Google Classroom [21, 22], or Edmodo [23] as online learning platforms, in this study, both blended learning models, namely the station rotation model and the flipped classroom model, will be combined with WhatsApp as an online learning medium for teaching mathematics. This is because through WhatsApp the teacher can send a variety of learning content in the form of videos or files, and can interact directly with students through video calls or chat. Based on the description above, the purpose of this research is to determine the effect of blended learning models, the station rotation model and the flipped classroom model, on mathematical creative thinking skills and math anxiety.

2. RESEARCH METHOD

This research was conducted in Sukohajo Regency, Central Java. The population was all students of State Junior High School in the even semester of the 2018/2019 academic year. This research is a quasi-experimental type because not all independent variables that might affect the dependent variable can be fully controlled by the researcher [24]. The independent variable of this research is the learning model, while the dependent variables are the mathematical creative think skills and math anxiety. There are three types of learning models used in this research, namely the station rotation learning model, the flipped classroom learning model, and the direct learning model. The design used in this research is 3 x 1 factorial.

The sample in this research was seventh grade students in the even semester of 2018/2019 academic year drawn from three public junior high schools in Sukoharjo Regency. The sampling uses stratified cluster random sampling technique in which schools will be divided into three categories, namely high, medium and low based on the average results of the national math exams in the academic year 2018/2019. Categorizing needs to be done considering mathematics learning outcomes between schools are not the same [24]. In each category one randomly selected of state junior high schools was chosen so that three schools were selected, namely Mojolaban 1 Public Middle School for high level, Mojolaban 2 Public Middle School for medium level, and Grogol 3 Public Middle School for low level. In each school, three classes of seventh grade were randomly selected, one class as the first experimental group, one class as the second experimental group, and one class as a control group, so there were nine classes sampled. The total number of students in each group is the first experimental groups consist of 85 students, and the second experimental groups consist of 85 students, and the control group consists of 76 students, so the total is 246 students.

Collecting data in this research uses the written test method in the form of essay and questionnaire methods. The written test and questionnaire have been validated by experts and statistically valid. The written test method is used to collect data about students' creative thinking skills, and the questionnaire method is used to collect data about mathematical anxiety. Both data are post-treatment data. The assessment rules in the test instrument are the minimum score is 0 and the maximum score is 4. Alternative answers to the questionnaire instrument are always (A), often (O), rarely (S), and never (N) with the assessment rules namely A = 4, O = 3, S = 2, N = 1 for positive items, and A = 1, O = 2, S = 3, N = 4 for negative items.

The data analysis technique in this study uses a one-way multivariate analysis of variance. This test is carried out because there is one independent variable and two dependent variables [25]. The calculation of this analysis uses the help of the IBM SPSS Statistics 23 application. If H0 is rejected, the test will continue with one-way analysis of variance and Post Hoc test. The Post Hoc test in this research uses the Scheffe method. The method is chosen because it produced the least mean difference [26].

3. RESULTS AND ANALYSIS

3.1. Data description

The data analyzed in this research are the final data of mathematical creative thinking skills and math anxiety. Both of these data are obtained from the results of giving posttests and questionnaires conducted after treatment. The results of both data for the first experimental group (1), second experimental group (2), and control group (3) can be seen in Table 1.

Table 1. Descriptive statistics

Variable	Group	Mean	Std.Deviation	N
Mathematical Creative Thinking Skills	1	24.00	13.179	85
	2	26.88	11.572	85
	3	14.74	9.896	76
	Total	22.13	12.706	246
Math Anxiety	1	61.98	9.500	85
	2	58.17	11.945	85
	3	55.87	9.120	76
	Total	58.78	10.566	246

Table 1 shows that the average value of mathematical creative thinking skills for each group is the first experiment = 24.00, the second experiment = 26.88, and control = 14.74, with an overall average value is 22.13. In addition, Table 1 also shows that the average value of students' math anxiety for the first experimental group was 61.98, the second experimental group was 58.17, and the control group was 55.87, with an overall average value is 58.78.

3.2. Multivariate analysis

The purpose of hypothesis testing in this research is to determine whether the learning models give effect to the results of mathematical creative thinking skills and math anxiety. The test of this hypothesis use multivariate analysis with the help of SPSS. The results of data analysis of this hypothesis can be seen in Table 2.

Table 2. Multivariate analysis tests

	Effect	Value	F	Hypothesis df	Error df	Sig. (p)
Intercept	Pillai's Trace	.978	5456.451	2	242	.000
	Wilks' Lambda	.022	5456.451	2	242	.000
	Hotelling's Trace	45.095	5456.451	2	242	.000
	Roy's Largest Root	45.095	5456.451	2	242	.000
Model	Pillai's Trace	.246	17.022	4	486	.000
	Wilks' Lambda	.760	17.778	4	484	.000
	Hotelling's Trace	.308	18.532	4	482	.000
	Roy's Largest Root	.280	33.960	2	243	.000

Based on Table 2, for the Pillai's Trace test, the value of $F = 17.022$ with $p < 0.001$, for the Wilks' Lambda test, the value of $F = 17.778$ with $p < 0.001$, for the Hotelling's Trace test, the value of $F = 18.532$ with $p < 0.001$, and for the test Roy's Largest Root, the value of $F = 33.960$ with $p < 0.001$. From the whole test, the p-value is smaller than the value of $\alpha = 0.05$, so H_0 in multivariate is rejected which means that there are significant differences in mathematical creative thinking skills and math anxiety between learning models. Because H_0 is rejected, data testing uses one-way analysis of variance needs to be done.

3.3. Analysis of variance

Testing with one-way analysis of variance is to see the effect of the independent variable on dependent variables by comparing the mean of some population. The results of this analysis can be seen in Table 3.

Table 3. Tests of between-subjects effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.(p)
Corrected Model	Creative Thinking	6371.031	2	3185.506	23.327	.000
	Math Anxiety	1545.719	2	772.860	7.278	.001
Intercept	Creative Thinking	117366.991	1	117366.991	859.467	.000
	Math Anxiety	844496.928	1	844496.928	7952.641	.000
Model	Creative Thinking	6371.013	2	3185.506	23.327	.000
	Math Anxiety	1545.719	2	772.860	7.278	.001
Error	Creative Thinking	33183.560	243	136.558		
	Math Anxiety	25804.354	243	106.191		
Total	Creative Thinking	160075.000	246			
	Math Anxiety	877162.109	246			
Corrected Total	Creative Thinking	39554.573	245			
	Math Anxiety	27350.073	245			

Table 3 shows that the F value for the variable of mathematical creative thinking skills is 23.327 with $p < 0.00$, while the F value for the mathematics anxiety variable is 7.278 with $p = 0.001$. Both dependent variables have p values less than $\alpha = 0.05$, so H_0 is rejected for both hypotheses. Based on these results, it can be concluded that learning models affect mathematical creative thinking skills and math anxiety. Therefore, the Post Hoc test needs to be done.

3.4. Post hoc test

Post Hoc test is conducted to know which learning model that give a different effect on the both dependent variables namely, mathematical creative thinking skills and math anxiety. There are several methods in the Post Hoc test, one of which is the Scheffe method. The results of the test can be seen in Table 4.

Table 4. Scheffe result

Dependent Variable	(I) Model	(J) Model	Mean Difference (I-J)	Std. Error	Sig.(p)
Mathematical Creative Thinking Skills	Station Rotation	Flipped Classroom	-2.88	1.793	.276
		Direct	9.26	1.845	.000
	Flipped Classroom	Station Rotation	2.88	1.793	.276
		Direct	12.15	1.845	.000
	Direct	Station Rotation	-9.26	1.845	.000
		Flipped Classroom	-12.15	1.845	.000
Math Anxiety	Station Rotation	Flipped Classroom	3.81	1.581	.056
		Direct	6.11	1.627	.001
	Flipped Classroom	Station Rotation	-3.81	1.581	.056
		Direct	2.30	1.627	.371
	Direct	Station Rotation	-6.11	1.627	.001
		Flipped Classroom	-2.30	1.627	.371

According to Table 4, here are the results of the tests if viewed from the mathematical creative thinking skills. First, the comparison between the station rotation learning model and the flipped classroom learning model has a value of $p = 0.276$ and this value is greater than $\alpha = 0.05$ so that H_0 is not rejected. Therefore, it can be concluded that there is no significant difference between the station rotation learning model and the flipped classroom learning model in the aspect of mathematical creative thinking skills. This is because the syntaxes of the two learning models are not much different. The difference lies when online learning with WhatsApp support is implemented, in the station rotation learning model, online learning is done after offline learning in class is complete while in the flipped classroom learning model, online learning is done before learning in class occurs.

Second, the comparison between the station rotation learning model and the direct learning model gets a value of $p < 0.001$, and this value is smaller than $\alpha = 0.05$, so H_0 is rejected, which means there is a significant difference between the station rotation learning model and the direct learning model viewed from the aspect of mathematical creative thinking skills. If seen in Table 1, the average of mathematical creative thinking skills in the first experimental group was 24.00, while the control group was 14.74. Thus, it can be concluded that the station rotation learning model is better than the direct learning model seen from the aspect of mathematical creative thinking skills. This result is consistent with the previous research which showed that students with station rotation learning model had greater mathematical performance improvement than students with traditional learning model [27]. This is because the various activities that exist in learning station rotation can bring a sense enthusiasm and joy for students, and make students able to interact better with teacher and other students during traditional class and online learning so the students get the help they need in learning [28, 29].

Third, just like the comparison between the station rotation learning model and the direct learning model, the p-value in the comparison of the flipped classroom learning model and the direct learning model is also smaller than 0.001, so H_0 is rejected which means there are significant differences between both models. If seen from Table 1, the second experimental group (26.88) has a higher average of mathematics creative thinking skills than the control group (14.74), so it can be concluded that the flipped classroom learning model is also better than the direct learning model viewed from the aspect of mathematical creative thinking skills. This result is consistent with previous research which shows that the flipped classroom learning model has a positive effect on students' mathematical achievement, and students with this learning model have better math performance than students with direct learning models [30-33]. This is because in the flipped classroom learning model, the content of teaching materials, either in the form of videos, teaching

material files and others that have been sent by the teacher to students through online media can be used to help students prepare for learning in class so they will be more easily understand the content of teaching materials, and allow them to control over their learning - not only at home but also in the classroom [34]. In addition, the flipped classroom learning model can also stimulate student curiosity, and increase engagement and communication between students and teachers [35].

Overall, it can be concluded that the blended learning models are better than the direct learning model in the aspect of mathematical creative thinking skills. This is supported by previous research which shows that blended learning can provide positive results on student mathematics learning outcomes and students with blended learning have a better understanding of mathematical concepts than students with conventional learning [19, 20]. These happen because 1) blended learning gives positive results to students' learning desires and mathematical beliefs; 2) students' discussion and feedback with the blended learning model is more active than students with the traditional learning model; 3) blended learning can help students to be happier and more motivated to learn mathematics and can help students in learning mathematics [19], [36]. In addition, schools can also take advantage of blended learning to help students who are academically lagging behind and need additional academic growth in one school year [37].

Table 4 also shows the results of the tests if viewed from the math anxiety. First, the p-value from the comparison of the station rotation learning model and the flipped classroom learning model is 0.056. This value is higher than $\alpha = 0.05$, so H_0 is not rejected, which means there is no difference between both models in terms of aspects of math anxiety. Second, the p-value from the comparison of the station rotation learning model and the direct learning model is smaller than $\alpha = 0.05$, which is 0.001 so H_0 is rejected. This means that there are significant differences between both models. If seen from Table 1, the average of the first experimental group was 61.98, and this value was greater than the average of the control group which was 55.87. Based on these results, it can be concluded that the direct learning model is better than the station rotation learning model viewed from the aspect of math anxiety. Third, for the comparison of the flipped classroom learning model and the direct learning model, p-value = 0.371. This p-value is greater than $\alpha = 0.05$ so H_0 is not rejected. This shows that there is no significant difference between the both models in the aspect of math anxiety. Overall, it can be concluded that direct learning does not have a significant difference with flipped classroom learning, although when viewed from the average score in Table 1, the average of math anxiety in students who are given the direct learning model (55.87) is lower than students who are given the flipped classroom learning model (58.17), and better than the station rotation learning model (61.98) if seen from mathematical anxiety. This happens because in the station rotation and flipped classroom learning model, students when discussing in groups or when an independent task tries to get the best score that will indirectly foster a competitive environment between students, and this will bring shame and uncertainty to be able to do mathematics, especially in those whose performance is not good [13]. This is exacerbated by the lack of pre-class learning preparation in the station rotation model, such as the flipped classroom learning model, which can help students, especially students with underperformance, be more ready to accept teaching material and competence.

4. CONCLUSION

The results of this research indicate that there are significant differences in mathematical creative thinking skills and math anxiety between the station rotation learning model, the flipped classroom learning model, and the direct learning model. Judging from the mathematical creative thinking skills, the station rotation learning model is as good as the flipped classroom learning model and better than the direct learning model; and the flipped classroom learning model is better than the direct learning model. Judging from the math anxiety, there is no difference between the station rotation learning model and the flipped classroom learning model, the direct learning model is better than the station rotation learning model, and the flipped classroom learning model is as good as the direct learning model. The results of this research prove that the blended learning model is better than the direct learning model in the aspect of mathematical creative thinking skills, but not better than the direct learning model, even the direct learning model is better than the station rotation learning model viewed from the aspect of math anxiety.

Therefore, researchers provide advice to teachers to apply blended learning models, station rotation or flipped classroom, if they want to improve students' mathematical creative thinking skills. If the teacher wants to reduce the math anxiety, the direct learning model can be a better solution. And finally, if the teacher wants to improve mathematical creative thinking skills, but with the risk of math anxiety that is not much different from the direct learning model, then the flipped classroom learning model can be the best alternative.

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