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Effectiveness of the Flipped Classroom Model on the Students' Mathematical Creative Thinking Skills

N K Nida
Mathematics Education
Sebelas Maret University
Surakarta, Indonesia
nairinidza@gmail.com

B Usodo
Mathematics Education
Sebelas Maret University
Surakarta, Indonesia
budi_usodo@yahoo.com

D R S Saputro
Mathematics Education
Sebelas Maret University
Surakarta, Indonesia
dewiretnoss@staff.uns.ac.id

Abstract. The Flipped Classroom model is one type of Blended Learning model. In this model, the teacher will provide learning content to students through a website or social media before applying classroom learning. This study uses WhatsApp as a medium for sending content to students. WhatsApp is one of the social media applications on smartphones, tab, or computer that can be directly downloaded in the Play Store application, for Android devices, the App Store, for iOS devices, or Microsoft Store, for Windows devices. The purpose of this study is to determine the effect of applying the Flipped Classroom model to the Mathematical Creative Thinking Skill of Public Junior High School students in Sukoharjo District, Central Java Province. The research method used is a quasi-experiment with sampling using stratified cluster random sampling technique. There are three schools selected as the research samples, namely Mojolaban 1 Public Junior High School, Mojolaban 2 Public Junior High School, and Grogol 3 Public Junior High School. Data collection in this study used a mathematical creative thinking skill test method which is carried out after the treatment was given. The data analysis technique uses Mann-Whitney analysis. The result shows that the implementation of the Flipped Classroom model is more effective in increasing students' Mathematical Creative Thinking Skills than the direct learning model.

Keywords: creative, flipped, mathematical, thinking

I.INTRODUCTION

Mathematics is one of the sciences that must be studied by Indonesian students from elementary school to high school level. It is uncommon for some majors to make mathematics as a compulsory subject when they are still in their first semester. This shows how important mathematics is in the modern era. Unfortunately the mathematics learning achievement of Indonesian students is still low, especially for junior high school level. This can be seen from the results of the 2017 and 2018 National Exams.

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 [1][2]. 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 caused an increase in the percentage of items in the High Order Thinking Skills (HOTS) [3].

One aspect of HOTS is Mathematical Creative Thinking Skills [4][5]. This indirectly shows that the low mathematics learning achievement of Indonesian students at the junior high school level, especially in Sukoharjo Regency, because students' mathematical creative thinking skills still have not reached the target set by the government. This is consistent with the preliminary observations on March 9, 2019 at Gatak 2 Public Junior High School which showed that most students tended to only be able to think convergent, when they was given a problem that had many possible answers, students only answered with one best answer [6].

One effort to develop this skill is to create an active classroom environment such as cooperative learning model, because without an active learning process students cannot develop the capacity to think, reason, and solve problems mathematically [7]. However, it cannot be denied that currently cooperative learning in the classroom is still felt lacking for students. This can be seen from the increasing number of users of online learning applications such as Ruangguru from 2016 to 2017. In 2016, there were only around 1 million Ruangguru application users, but in 2017 these application users increased 5-fold to 6 million with the majority of users being students of Junior and Senior High School [8]. As a teacher in the millennium, as it is now, it is fitting for teachers to adapt and innovate with existing technology so that they can always be connected with their students. Therefore, the Blended Learning model can be an option for teachers to combine cooperative learning with online learning [9][10].

There are four different models in Blended Learning, namely Rotational Models, Flex Models, Self-Blended Models, and Enriched Virtual Models [11]. Rotational Models are divided into four models, namely Station Rotation, Lab Rotation, The Flipped Classroom, and Individual Rotation. Of all types, the Flipped Classroom model is one of the Blended Learning models that can be applied in Indonesia because the main learning is in the classroom rather than online learning, and based on preliminary observations it has been found that internet facilities in most computer laboratories are inadequate. This can be an obstacle for the implementation of other models. Therefore, the purpose of this research was to know the effect of the Flipped Classroom model on students' mathematical creative thinking skills.

II. THEORETICAL BACKGROUND

A. *Mathematical Creative Thinking Skills*

Creativity is defined as cognitive skills in submitting solutions to a problem or making something useful or new from the ordinary [12]. In creative thinking an individual needs imagination, intelligence, insight, and ideas in accordance with objects, problems, and certain conditions that are being faced based on the capacity of the individual's own abilities [13]. The ability to think creatively in the present is not only limited to the fields of art such as dancing, singing, drama, etc., but also has expanded to various aspects of other fields, such as mathematics. In mathematics, creativity does not only produce truly new solutions, but also solutions to new problems are creative products for certain individuals [14][15]. For example, when students can solve mathematical problems using different methods than those taught by teachers in the classroom, it is also called mathematical creative thinking skills.

The mathematical creative thinking skills can be observed through the solution of non-routine mathematical problems [15]. This is because finding sharing solutions in non-routine problems requires flexibility in thinking, as well as knowledge and mathematical analysis. There are four indicators in mathematical creative thinking skills, namely (1) fluency, the ability to get lots of ideas, lots of answers, lots of problem solving and lots of questions smoothly, provide many ways to do various things, think of more than one answer; (2) flexibility, the ability to produce varied ideas, answers, or questions, see problems from different perspectives, and look for many different alternatives or directions, be able to change the perspective or thought; (3) originality, the ability to give birth to new and unique expressions, think and find unusual ideas, and make unusual combinations; (4) elaboration, the ability to enrich and develop an idea or product and detailing the details of an object so that it becomes more interesting [14][16]. Some experts only divide the indicators of mathematical creative thinking skills into three aspects where elaboration is part of originality [15].

B. *Flipped Classroom Model*

Flipped Classroom is defined as a pedagogical strategy in which the elements that should be done in the classroom will be done outside the classroom, and the elements done outside the class will be done in class [11]. The point is that all procedures performed on traditional face-to-face activities such as providing subject content and teacher explanations regarding content will be provided online before face-to-face meetings in class, while class time is devoted to more interesting activities, more practice, and more collaborative studies. The diagram of The Flipped Classroom Model can be seen in Figure 1 [9].

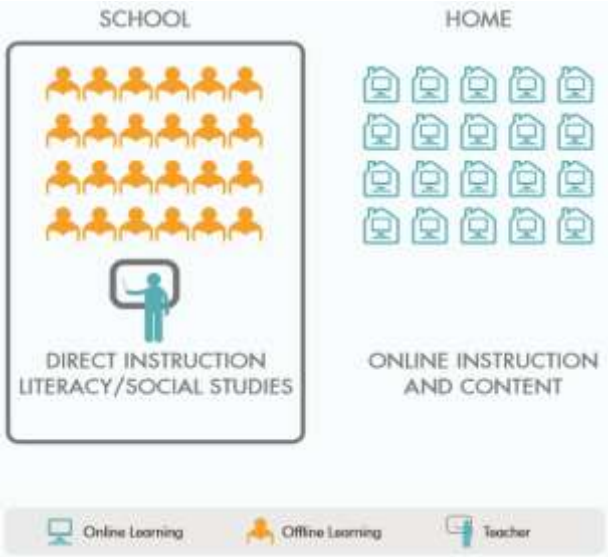

Fig. 1. Flipped Classroom Model Diagram

Based on Figure 1, the Flipped Classroom model has two stages namely home learning and classroom learning. Home learning consists of two parts, namely the delivery of teaching material content and direct learning by the teacher. In this study, the learning activities that will be carried out by the teacher in the classroom are games, cooperative learning with problem based learning model, and assigning assignments to students, while online learning is done before facing in class using WhatsApp which can be downloaded directly by students and teachers through the Play Store, App Store, or Microsoft Store applications.

C. *Direct Learning Model*

The direct learning model is a teacher-centered learning method [17]. This learning model can take the form of lectures, demonstrations, training or practice, and group work [18]. In addition, this learning model can also be used to transfer knowledge directly from the teacher to students. The syntax of the direct learning model, namely: (a) orientation, when teacher explains the learning objectives, the background of the lesson, the importance of the lesson, and prepares students for learning; (b) presentation, when teacher explains the teaching material in the form of a concept or skill in stages; (c) structured exercises, when teacher plans and gives initial guidance to students in the form of sample questions); (d) guided training, when teacher checks the students' success in doing the task by giving them the opportunity to practice, and seeing whether they are able to give feedback or not; (e) independent training, when teacher plans further instructions in the form of giving exercises independently at home or in class [18].

III. METHODOLOGY

This research was conducted in Sukoharjo Regency, Central Java Province, with the research subject being all VII grade Public Junior High School students in the second semester of the academic year 2018/2019. This study is a quasi-experimental study because not all independent variables that may affect the dependent variable can be

controlled entirely by the researcher [19]. The independent variable of this study is the learning model, and the dependent variable is the mathematical creative thinking skills. A group of students who were given the Flipped Classroom model was called the experimental group, while a group of students who were given the direct learning model was called the control group.

Sampling in this study used the stratified cluster random sampling technique based on the results of the Junior High School 2017/2018 National Examination. This technique is done because the students' mathematics learning outcomes among schools were not the same so the schools need to be classified into three levels, namely high, medium, and low. At each level one school would be taken and two classes would be taken in each school randomly, one as the experimental group, and one as the control group. Schools that have been selected are Mojolaban 1 Public Junior High School (high), Mojolaban 2 Public Junior High School (medium), and Grogol 3 Public Junior High School (low) with details, the experimental group consisted of 89 students and the control group consisted of 81 students.

The instrument of this research is a test of mathematical creative thinking skills in the form of essays consisting of 4 items about the area and circumference of the quadrilateral and triangle. This test has been validated both by expert judgment and statistically. The rating rule for this test is that the minimum score is 0 and the maximum score is 4.

IV. RESULT AND DISCUSSION

The data analysis technique in this study uses one-way analysis of variance (ANOVA) or Mann-Whitney analysis. ANOVA is used if all the prerequisite tests are fulfilled, namely the sample data is normally distributed and homogeneous, while the Mann-Whitney analysis is used if there are unqualified prerequisite tests. The normality test used in this study is the One-Sample Kolmogorov-Smirnov Test and obtained calculations as in Table 1.

TABLE I. ONE-SAMPLE KOLMOGOROV-SMIRNOV TEST

		Experimental	Control
N		89	81
Normal Parameters[a,b]	Mean	27.25	14.51
	Std. Deviation	10.553	9.307
Most Extreme Differences	Absolute	0.116	0.129
	Positive	0.116	0.121
	Negative	-0.109	-0.129
Test Statistic		0.116	0.129
Asymp. Sig. (2-tailed)		0.005[c]	0.002[c]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

Based on Table 1, the Asymp Sig. (2-tailed) results for the experimental and control groups were 0.005 and 0.002. The Asymp Sig (2-tailed) value of the experimental group and the control group is smaller than the significance level, $\alpha = 0.05$. Thus, it can be concluded that H_0 is rejected for both groups, which means that the score data resulting from the test of mathematical creative thinking skills of the students in both group are not normally distributed.

The second prerequisite test is the homogeneity test using the Levene's Test of Equality of error Variances with the results of calculations as in Table 2.

TABLE II. LEVENE'S TEST OF EQUALITY OF ERROR

F	df1	df2	Sig.
1.522	1	168	0.219

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + Treatment

Table 2 shows the Sig. = 0.219 and this is greater than the level of significance, $\alpha = 0.05$. Based on this, it can be concluded that H_0 is accepted which means the score data from the test results of mathematical creative thinking skills of the experimental group students and the control group are homogeneous.

Table 1 shows the test score data of mathematical creative thinking skills of both groups, experiment and control, were not normally distributed. Based on this, the analysis technique carried out is the Mann-Whitney analysis with the results of calculations as shown in Table 3.

TABLE III. MANN-WHITNEY TEST STATISTICS [A]

	Value
Mann-Whitney U	1320.000
Wilcoxon W	4641.000
Z	-7.201
Asymp. Sig. (2-tailed)	0.000

a. Grouping Variable: Treatment

Table 3 shows Asymp Sig. (2-tailed) = 0.0000 so the value of Asymp. Sig. (2-tailed) / 2 = 0.0000 / 2 less than the significance level, $\alpha = 0.05$. Thus, H_0 is rejected which means that the average score of mathematical creative thinking skills of the experimental group and the control group is significantly different.

Table 1 shows that the average score of the mathematical creative thinking skills of the experimental group ($\mu_1 = 27.25$) is higher than the control group ($\mu_2 = 14.51$), so it can be concluded that the Flipped Classroom model is more effective than the direct learning model. This result is relevant to previous studies which showed that Blended Learning especially Flipped Classroom models had a positive effect on mathematics learning outcomes [20][21] and were significantly better than traditional learning models [22]. This happens because after being given a Blended Learning model (1) student learning desires, learning processes, learning methods, mathematical beliefs, and the total score of mathematics learning attitudes are positive and statistically significant; student discussions and feedback with the Blended Learning model are more active than student discussions with traditional learning models [22]; (2) students become prefer mathematics, more motivated to do mathematics, and 89% of students believe that Blended Learning has helped them in learning mathematics [21]; (3) teachers are enthusiastic in implementing learning with Flipped Classrooms model and students seem very motivated to learn mathematics [23].

Table 1 also shows although the Flipped Classroom model is more effective than the direct learning model, the average score of the mathematical creative thinking skills

of the experiment group ($\mu_1 = 27.25$) is still has not reached 50 such as control group ($\mu_2 = 14.51$). This happens because the Flipped Classroom model using WhatsApp media has several weaknesses. Here are some of the weaknesses of the model found in this study, namely (1) there is no notification or list of data in the WhatsApp media which shows that the teaching material or video sent by the teacher has been downloaded by all students and this makes it difficult for teachers to know which students have not downloaded the file or video, (2) there is no separation of space for discussion and sending files on WhatsApp making it difficult for students who were previously offline to find teaching material files sent by the teacher among many chats from online discussions, and this can make students being lazy to find and download these files.

V. CONCLUSION

There are several things that can be concluded from the results of this study. First, the Flipped Classroom model is more effective than the direct learning model to improve students' mathematical creative thinking skills. Second, overall the average mathematical creative thinking skills of students who are given a Flipped Classroom model or direct learning model are still relatively low. This can be seen from the average score of mathematical creative thinking skills that have not even reached 50. Third, Flipped Classroom model using WhatsApp has several weaknesses, those are: no notification or listing for students who have downloaded files or videos, and no separation of space for discussion and sending files on WhatsApp. Therefore, it is necessary to conduct further research related to Blended Learning, especially the Flipped Classroom model with different learning design and online media so that in the future there will be found a design of the Blended Learning model that is suitable to improve Indonesian students' mathematical creative thinking skills better.

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