Experimentation of the Flipped Classroom Learning Model Based on Student's Self-Regulated Learning

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Abstract. A flipped classroom is an innovative approach that focuses on student centered learning. It swaps the arrangement of knowledge different from traditional classroom. This study aims to describe the learning outcomes of SMP Negeri 1 Sewon students in which learned using Flipped Classroom Learning Model comparing to the Direct Learning Model, and to find out whether the flipped classroom learning model is effectively used in mathematics learning. This is quasi-experimental research. The research subjects were divided into 2 groups, namely the experimental group (using flipped classroom learning model) and control group (using direct learning model). The results showed that the flipped classroom learning model was more effective than direct learning model in terms of its self-regulated learning (SRL). It can seem from the results of statistic data analysis which shows a significant difference. So, it can be concluded that flipped classroom model can be used as an alternative learning in the classroom.

Key words: direct learning model; flipped classroom model; self-regulated learning

INTRODUCTION

Along with the development of technology, the world of education is also experiencing changes. It would be inflict a transformation in the world of education which from conventional education to more innovative education. Prediction the use of synchronous Computer-based Multimedia Communication (CMC) (at the same time between teachers and students) and asynchronous (not at the same time) would be increase. Utilization of this technology is known as e-learning.

The existence of technological developments is considered very helpful learning activities. This is because both of students and teachers can easily obtain more information and learning resources by accessing the internet or online-based applications. Information technology is a infrastructure (hardware, software, usewere) system and methods for obtaining, sending, processing, interpreting, storing, organizing and using data meaningfully [1], [2].

The development of education in Indonesia is marked by the enactment of the 2013 curriculum which has the aims to prepare individuals to have the abilities and life skills as individuals and citizens who are faithful, productive, creative, innovative, and affective and able to contribute to community life, nationhood, stateless, and civilized [3]. The learning method that applied in this curriculum is the scientific approach. The scientific approach was chosen because it was considered as the most effective learning approach in implementing 2013 curriculum in which there is active role of teachers as educational staff who capable in implementing of innovative learning.

On the perspective of National Education Development, education must play a greater role in building all human potential in order to become subjects that develop optimally and benefit society and national development [4]. Whereas in terms of the quality of education, it still indicates the uneven quality of education [5]. One contributing factor is the usege of IT (Information Technology) which is not optimal for teachers and students in welcoming the era of the industrial revolution 4.0 [6]. Teachers are still the center of learning and prefer to use direct learning methods without put in the role of technological development in teaching and learning [7].

Similar learning processes still occur in many schools, where is teachers choose to use the easiest method to implement, the effect is learning becomes dry meaning, because only the teacher has the role of providing information, while students tend to be passive in learning. In addition, the long learning time in class becomes a new problem because it is getting reduced, as in mathematics subject which only gets 5 hours of learning time in one week. This learning time is considered to be shorter than the policy in the KTSP curriculum which provides 6 hours of learning time in one week [8].

This is also happened in SMP Negeri 1 Sewon

as the object of this study which implemented the 2013 curriculum. In this school, learning activities still rarely used IT and there are constrained in learning time in schools which are considered very short to deliver the same material. Therefore, it needs an innovative learning models with 2013 curriculum that can optimize the usege of IT with the aims that students can learn independently, be guided, be active and be able to gather information easily from the results of technological developments, and there is no time limit for students to study. One of learning model that can be used is Flipped Classroom, it is a learning model with a reverse implementation that's students learn with the help of learning videos and materials that can be accessed independently by students through the internet. In addition, in the Flipped Classroom learning model, learning is done by group discussions through collaborative projects, practical skills and receiving feedback from students' progress in learning so the time of learning becomes more effective.

Based on the description above, this study aims to describe the effectiveness of Flipped Classroom Learning Models compare to Direct Learning Models, the learning outcomes among high, medium, and low SRL, and describe mathematics learning achievement with Flipped Classroom and Direct Learning Models in each category of self-regulated learning.

METHODS

The population of this study was all students of grade VIII at SMP Negeri 1 Sewon in the 2019/2020 school year as many as 225 students. The sample used in this study was grade VIII B and D whose selected by purposive sampling technique. This is based on the research objectives to be achieved. Grade VIII B as many 32 students as a control group (the group that does not get treatment that is with the direct learning model and grade VIII D as many 32 students as an experimental group (the group that's given treatment with Flipped Classroom learning model).

Straight line equations that was choosen as

learning material which is it learned in grade VIII of odd semester in 2019/2020. Researcher used documentation, learning outcomes tests and self-regulated learning questionnaire to collect the data [9]. The data obtained was empirical data which will be analyzed. For learning outcomes instruments refer to content validity ($V \geq 0.4$), distinguishing features ($D \geq 0.3$), level of difficulty ($P \geq 0.3$), and reliability ($r_{11} = 0.769$) of the 8 items given, all of them have fulfilled the established criteria. Whereas in the self-regulated learning questionnaire, referring to the content validity criteria ($V \geq 0.4$), internal consistency ($r_{xy} \geq 0.3$) and reliability ($r_{11} = 0.90$), of the 35 items, all of them met the requirements for use.

For the prerequisite test analysis, the normality test with the Kolmogorov-Smirnov test and the homogeneity test with the Levene-Test. Test data analysis using two-way analysis of variance with unequal cells.

RESULTS AND DISCUSSION

Two samples must be stated in a balanced condition before conducting this research. The data that used to balancing test was mid semester assessment data. Then the normality test, homogeneity test and balancing test using the T-test. Based on the normality test using the Kolmogorov-Smirnov test at a significance of 5%, the Sig.=0.573. So the value of Sig.=0.573>α=0.05, means that the data has a normal distribution. While based on the results of the variance homogeneity test with the Levene-test at a significance level of 5%, the Sig.=0.137. So the value of Sig.=0.137>α=0.05, consequently the data has homogeneous variance. Based on the balance test using the Independent Samples T-Test at a significance level of 5%, the Sig.=0.054. So the value of Sig.=0.054>α=0.05, it means that the two samples did not have differences in cognitive abilities.

Before the two-way variance analysis test had carried out, the normality test and homogeneity test as a prerequisite for normality and homogeneity could be seen in Table 1 and the results of homogeneity analysis prerequisites test in Table 2.

Table 1. Summary Test for Analysis Normality Prerequisites

Normality Test	The amount of data	*Kolmogorov-Smirnov Z*	*Asymp. Sig. (2-tailed)*	Decision	Conclusion
Flipped Classroom	32	0,978	0,295	H_0 accepted	Normal data
Direct Learning	32	0,842	0,478	H_0 accepted	Normal data
Low SRL	9	0,383	0,999	H_0 accepted	Normal data
Medium SRL	43	1,346	0,053	H_0 accepted	Normal data
High SRL	12	0,684	0,738	H_0 accepted	Normal data

Table 2. Summary Tests of Homogeneity Analysis Prerequisites

Data	Levene Statistic	Sig.
Posttest	1,858	0,116

Based on Table 1 and Table 2, it can be seen that the sample came from populations that are normally distributed and had a homogeneous variance. Therefore, hypothesis testing can be done using two-way analysis of variance with unequal cells. Previously it can be seen the average value of the results of students' post-test seen from the class group and the level of self-regulated learning. It is available in Table 3.

Table 3. Average Summary and Marginal Average of Each Cell

Learning Model	Self-regulated learning			Marginal Average
	Low	Medium	High	
Direct Learning Model	43,83	65,23	92,50	64,63
Flipped Classroom	46,00	79,95	94,63	80,44
Marginal Average	44,92	72,59	93,56	

The results of two way variance analysis calculations with unequal cells at a significance level of 5% could be seen in Table 4.

Table 4. Summary of Calculation Results of Two Way Variance Analysis with Unequal Cells

Source	JK	dk	RK	F	F_{tabel}	Conclusion
Learning Model (A)	373,6	1	373,6	4,7	4,01	H_0 rejected
Self-regulated learning (B)	10818,1	2	5409,1	68,5	3,16	H_0 rejected
Interaction (AB)	515,1	2	257,5	3,3	3,16	H_0 rejected
Error	4582,5	58	79,0	-	-	-
Total	356156,0	64	-	-	-	-

Table 4 shows that: 1) on the main effect of line (A), i.e. in the learning model, the value of F_{count} =4.728 with DK = $\{F \mid F > F\_ (0.05; 1.58)=4.01\}$. So the $F_{count} \in$ DK or the value of $F_{count} > F_{table}$ was 4.728>4.01. As a result, H_0 was rejected, it means that it could be said that there were significant differences between the learning models applied in the experimental class and the control class; 2) In line self-regulated learning (B) obtained F_{count}=68.461 with DK=$\{F \mid F > F\_ (0.05; 2.58)= 3.16\}$. So the $F_{count} \in$ DK or the value of $F_{count} > F_{table}$ is 68.461>3.16. As a result H_0 was rejected, it means that it could be said that there were significant differences between groups of students with low, medium, and high SRLs; and 3) In line of interaction (AB), the value of

F_{count}=3.620 with DK={F│F> F_ (0.05; 2.58)=3.16}. So the $F_{count} \in$ DK or the value of $F_{count} > F_{table}$ was 3,620>3.16. As a result H_0 was rejected, it means that it could be said that there was a significant interaction between learning models with self-regulated learning.

Based on the results of the two-way Anova analysis test, it was found that H_0A was rejected, so that further tests were carried out after the analysis of variance by the *Scheffe* method, namely the comparison test between lines. The following results were comparative tests between lines.

Table 5. Comparative Test Summary Between Lines

Komparasi	H_0	H_1	F	$F_{(1, 62)}$	Conclusion
a_1 vs a_2	µ1. = µ2	µ1. ≠ µ2	16,038	4,00	H_0 rejected

Based on Table 5 in the comparison test between lines, the critical area value is DK={F | F> 4.00}, thus it could be said that there were differences in the average between the rows because $F_{count} \in$ DK is F_{count}=16.038> F_{table}=4.00. It means that there were significant differences between the flipped classroom learning model and the direct learning model. This was reinforced by the difference in the marginal mean values of the two models, where the marginal average in the experimental class with the flipped classroom learning model had an average of 80.44 while the marginal average in the control

class with the direct learning model had an average of 64.63. So it can be concluded that the class given the flipped classroom learning model had an average value better than the direct learning model. As a result, the flipped classroom learning model can be said to be more effective in improving student mathematics learning outcomes. Based on the results of the two-way Anova analysis test, it was found that H_0B was rejected, so it is necessary to do further tests after the analysis of variance by the *Scheffe* method 'using a comparative test between columns. The results of comparative tests between columns available in Table 6.

Table 6. Summary of Comparability Between Columns

Komparasi	H_0	H_1	F	F_{tabel}	Conclusion
b_1 vs b_2	µ1. = µ2	µ1. ≠ µ2	42,318	4,03	H_0 rejected
b_1 vs b_3	µ1. = µ3	µ1. ≠ µ3	1172,020	4,38	H_0 rejected
b_2 vs b_3	µ2 = µ3	µ2 ≠ µ3	33,610	4,02	H_0 rejected

Based on Table 6 in the comparison column between critical values obtained from each column, it could be concluded as follows; (1) In line 1 (b_1 vs b_2), the F_{count} value of 42.318 was obtained with DK={F│F>F_(0.05;1.50) =4.03}. So the $F_{count} \in$ DK or the value of $F_{count} > F_{table}$ was 42.318> 4.03. As a result, H_0 was rejected, it means that there was a difference between the first and second column, or there were differences in learning outcomes between groups of students with low and medium SRLs; (2) In line 2 (b_1 vs b_3), the F_{count} value was 1172.020 with DK={F│F>F_(0.05; 1.19)=4.38}. So the $F_{count} \in$ DK or the value of $F_{count} > F_{table}$ was 1172.020>4.38. As a result H_0 was rejected, it means that there was a difference between the first and third column, or there were differences in learning outcomes between groups of students with low and high SRLs; and (3) In line 3 (b_2 vs b_3) the F_{count} value of 33.610 was obtained with DK={F│F>F_ (0.05; 1.53)=4.02}. So the $F_{count} \in$ DK or the value of $F_{count} > F_{table}$ was 33.610>4.02.

As a result, H_0 was rejected, it means that there was a difference between the second and third column, or there were differences in learning outcomes between groups of students with medium and high SRLs.

Based on the results of the two-way analysis of variance analysis, it was found that H_0AB was rejected, so it was necessary to carry out further tests after the analysis of variance by the *Scheffe* method using a comparison test between cells in each category of learning models and self-regulated learning. The results of the double comparation test between cells in the same row are described as follows:

For the Flipped Classroom Learning Model, the results of the test were; (1) Groups of students with low and medium self-regulated learning from the statistical calculation results obtained that the value of F_{count} =97.192> F0.05; 1; 22 = 4.30 so $F_{count} \in$ DK which means H_0 was rejected. So it can be said that there were significant differences in learning outcomes between groups

of students with low and medium self-regulated learning; (2) Groups of students with low and high self-regulated learning, from the calculation results statistically obtained that the value of F_{count} = 368,842> F0.05; 1; 9 = 5.12 so F_{count} ∈ DK which means H_0 was rejected. So it can be said that there were significant differences in learning outcomes between groups of students with low and high self-regulated learning; and (3) groups of students with medium and high self-regulated learning, from the statistical calculation results obtained that the value of F_{count} = 48.186> F0.05; 1; 27 = 4.21 so F_{count} ∈ DK which means H_0 was rejected. So it can be said that there were significant differences in learning outcomes between groups of students with medium and high self-regulated learning.

As for the Direct Learning Model, the results obtained from the calculation as follows: (1) Groups of students with a low and medium self-regulated learning from the statistical calculation results obtained that the value of F_{count} = 14.753> F0.05; 1; 26 = 4.23 so F_{count} ∈ DK which means H_0 was rejected. So it can be said that there were significant differences in learning outcomes between groups of students with low and medium self-regulated learning; (2) The group of students with low and high self-regulated learning from the calculation results statistically obtained that the value of F_{count} = 814,462> F0.05; 1; 8 = 5.32 so F_{count} ∈ DK which means that H_0 was rejected. So it can be said that there were significant differences in learning outcomes between groups of students with low and high self-regulated learning; and (3) groups of students with medium and high self-regulated learning from the statistical calculations obtained that the value of F_{count} = 15.913> F0.05; 1; 24 = 4.26 so F_{count} ∈ DK which means that H_0 was rejected. So it can be said that there were significant differences in learning outcomes between groups of students with medium and high self-regulated learning.

Both the flipped classroom and the direct learning model, groups of students with high self-regulated learnings had better learning outcomes compared to groups of low or medium self-regulated learning, and groups of students with medium self-regulated learnings had better learning outcomes compared to groups of students with low SRLs. It could be happen because students with high self-regulated learning had the excellence in learning mathematics including confidence with the ability possessed, able to explore mathematical ideas and the willingness to try various methods

of solving problems, had a strong determination, interest and curiosity to find something the new and the tendency to reflect on thought processes and patterns [10] [11]. So, learning objectives are achieved and produce better learning outcomes.

Whereas students with medium self-regulated learning have better learning outcomes compared to students with low self-regulated learning, because students with medium self-regulated learning will be more confident with their abilities, can explore mathematical ideas and try various methods to solve problems, have a strong determination, interest and curiosity to find something new and a tendency to reflect on the thought process than students with low self-regulated learnings [12]. So that student learning outcomes with medium self-regulated learning are more optimal than students with low self-regulated learning.

Whereas the results of the double cell inter comparison test in the same column are described as follows: (1) The low SRL group in the flipped classroom learning model with the direct learning model from the statistical calculation results is obtained that the value of F_{count} = 0.757 <F0.05; 1; 7 = 5.59 so F_{count} ∉ DK which means H_0 was accepted. So it can be said that there was no significant difference in learning outcomes between groups of students with the flipped classroom learning model and groups of students with direct learning models; (2) The medium SRL group in the flipped classroom learning model with the direct learning model from the statistical calculation results obtained that the value of F_{count} = 21.704> F0.05; 1; 41 = 4.08 so the F_{count} ∈ DK which means H_0 was rejected. So it can be said that there were significant differences in learning outcomes between groups of students with flipped classroom learning models and groups of students with direct learning models; and (3) the medium SRL group in the flipped classroom learning model with the direct learning model from the statistical calculation results obtained that the value of F_{count} = 1.269 <F0.05; 1; 10 = 4.96 so the F_{count} ∉ DK it means that H_0 was accepted. So it can be said there was no significant difference in learning outcomes between groups of students with a flipped classroom learning model and groups of students with a direct learning model.

Based on the test decision it can be concluded that in students with low self-regulated learning there is no difference in mathematics learning outcomes between students who are subjected to the flipped classroom learning model and

students who are subjected to the direct learning model. This is possible because students with low self-regulated learning tend to be less enthusiastic, less interested and less active in following the learning process so that students' understanding of straight line equation material becomes less [13]. Thus at the low self-regulated learning, researchers have not been able to guarantee the interaction between students who are subjected to the flipped classroom learning model and the direct learning model. This is given that the self-regulated learning is very necessary for students to survive in the face of problems, take responsibility in their learning, and develop good work habits in mathematics. These results are in line with earlier research who explains that self-regulated learning is highly dependent on the intrinsic and extrinsic factors of each individual [14]. Therefore, it takes a strong desire from students to be able to meet all indicators of SRL.

While in groups of students with medium mathematical SRL, there are differences in learning outcomes between students who get the flipped classroom learning model and students who get a direct learning model. This is because the grouping of students during learning is not based on random grouping but is grouped based on students' academic ability on PTS scores [15]. So that it can provide different learning outcomes on different learning models. In addition, the results of this calculation are in line with earlier research, who state that in the self-regulated learning group there are differences in learning outcomes between the experimental group and the control group based on the student's initial ability and appeal to mathematics [16], [17].

Meanwhile, in the group of students with high self-regulated learning there is also no difference in learning outcomes between students who are subjected to the flipped classroom learning model and students who are subjected to the direct learning model [18], [19]. This is because students with high self-regulated learning both have confidence with their abilities, can explore mathematical ideas and try various methods to solve problems, strong determination, interest and curiosity to find something new and a tendency to reflect on the thought process. So students with high self-regulated learning will get the same amount of information during the learning process so that they can provide the same good learning achievement. This is in accordance with the results of other research which explains that self-regulated learning, communication skills and creative thinking are important abilities that

must be possessed by students in learning mathematics, so there is a need for learning approaches that enable students to observe and explore to build knowledge independently [20] [21].

CONCLUSION

Based on the results and discussion, several conclusions can be drawn as follows: the flipped classroom learning model can provide better learning outcomes compared to the application of the direct learning model. This can be seen from the acquisition of better student mathematics learning outcomes, where in the group of students who get a flipped classroom learning model (80.44) had an average higher than the group of students with a direct learning model (64.63). In addition, based on the results of the statistical test, the results show that there were significant differences between the experimental class with the flipped classroom learning model and the control class with the direct learning model. Student learning outcomes with high self-regulated learning seen from the average learning outcomes had better results compared to groups of students who had medium or low self-regulated learning. This is confirmed by the statistical test results, where the test results show that there were significant differences between groups of students who had a high to medium self-regulated learning or low.

The results of the analysis on each learning model show that mathematics learning outcomes of students with high self-regulated learning always had better learning outcomes than groups of students with medium or low self-regulated learnings. This happens in each learning model both in groups of students with flipped classroom learning models and groups of students with direct learning models. The results of the analysis conducted on each student's self-regulated learning can be decided that in groups of students with high and low SRLs there was no significant difference from student learning outcomes. However, groups of students with self-regulated learning were showing significant differences between the flipped classroom learning model and the direct learning model.

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