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IMPLEMENTATION OF FLIPPED CLASSROOM STRATEGY IN MATHEMATICS LEARNING TO STUDENTS' COGNITIVE SKILL

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Abstract

New learning paradigm demands change of teachers' role in learning process mainly as facilitator, team based work, and use of education technology. Flipped classroom strategy is an alternative means of improving students' cognitive skill in mathematics learning. Flipped classroom strategy is in line with new paradigm of mathematics learning based on constructivism. The aim of research is to know the influence of flipped classroom strategy toward students' cognitive skills and learning activity. This research uses experiment method. A limited experiment done in a classroom of Senior High School indicates that Flipped classroom gives positive result toward the students' cognitive skill and learning activity in mathematics learning compared to the control group.
Keywords : Flipped slassroom strategy, cognitive skill, and learning activity.

Introduction

Students' cognitive skill is one of domains which should be elaborated in mathematics learning. Unfortunately, students' mathematic skill is poorly developed. This can be apparantly seen from national exam math result which is generally below expectation. Similiarly, surveys conducted by international body as Trend in International Students and Science Study (TIMSS) and Program for International Student Assessment (PISA) claims that Indonesia is among 10% of low rank countries surveyed.

TIMSS survey which was conducted by The International Association for the evaluation and Educational Achievement (IEA) in Amsterdam focussing on content domain and students' cognitive. The content domain are Number, Algebra, Geometry, Data and Probability while cognitive domain covers knowledge, application and reasoning. The survey which was conducted once every four years since 1999 suggested that Indonesia was in 34th rank from 48 surveyed countries., in 2003 Indonesia was in 35th rank from 46 surveyed countries, in 2007 was in 36th rank from 49 surveyed countries and in 2011 was in 36th rank from 40 surveyed coountries.

Accordingly, a study was conducted by PISA, once every three years, which was organized by Organization for Economic Cooperation and Developement (OECD), a United Nation body in Paris aiming at finding out students' math literacy. The study focus of PISA was students' skill in identifying and understanding and using basic mathematics needed for daily activities. This study had been started since 2000 and suggested that Indonesia was in 39th rank from 41 surveyed countries, in 2003 in 38th rank from 40 surveyed countries, in 2006 was in 50th rank from 57 surveyed countries, in 2009 was in 61st rank from 65 surveyed countries and lately in 2012 was in 64th rank from 65 surveyed countries.

Looking at the achievement lowness of Indonesian students in the survey result, Indonesian governement through Ministry of Culture and Education has indeed anticipated this situation by making curriculum change. There have been three curriculum changes implemented since 2000. They are 2004 curriculum, 2006 curriculum and 2013 curriculum. However, in spite of the change has been made in curriculum, the achievemnt of students is relatively stagnant. In fact, the role and function of teachers in mathematics learning show no changes.

On the other hand, along with rapid development of the use of constructivism theory and information communication and technology (ICT) in learning, the transformation of teachers' role and ways in giving the material in the classroom is immediately needed. Using constructivism learning principle, teacher is expected to become facilitator for students inside or outside the classroom. The excelence of ICT is hopefully used by teachers to improve quality and effectiveness of learning under new paradigm e.g students centred, real context based, team based (cooperative), stimulating senses and using multimedia with various technology education.

The use of education technology to improve quality and effectiveness of learning has allowed a new strategy to implement; Flipped Clasroom Startegy. It was first introduced in 2007 in United States by Jonathan Bergman and Aroon Sams in Woodland Park High School. Technology education and learning activity are two key factors in flipped clasroom *strategy*. It assigns students to watch learning videos from teacher at home and discuss it with friends. Hence, classroom time is used to enrich and improve students' undertanding on material given by teachers' assistance. Consequently, teacher becomes consultant in the classroom learning. A study in US recommends that before implementing Flipped Clasroom Strategy, roughly 50% students failed in English and 44% students failed in Mathematics, while having implemented Flipped Clasroom Strategy, the result shows 19% students failed in English and 13% students failed in Mathematics. (www.knewton.com, 11 October 2014).

Similiarly, Brent (2013) suggested that flipped clasroom is a strategy which allows teacher to lessen the number of direct instruction in learning activity and to increase interaction among students and teachers. Flipped Clasroom Strategy makes use of technology providing online material for students. In Flipped Clasroom Strategy students study not only in the classroom but also outside the classroom by accessing material given by teachers repeatedly using internet or learning videos. In first phase, students study the learning video material at home or other places. Then, in the second phase, students try to implement the knowledge and information from learning video by solving problem and practising, for instance by group discussion. Teacher gives an introduction of material to students, for this reason, there is more time for teachers and students to interact. Hence, the clasrooom learning can be possibly conducted in the form of inquiry or project.

Research Method

This research uses experimental method. Dependent variable in the research is students cognitive skill and independent variable is learning strategy and students' learning participation. The research was conducted in SMA Negeri 1 Surakarta. The learning model used was Flipped Clasroom Strategy as treatment to the experiment class; XI Science 2 students and convensional strategy (expository method enriched by drillor exercise as treatment to the controll class; XI Science 1 students. The Control

and experimental group were selected by using cluster random sampling. Test method was used to find out the success of Flipped Clasroom Strategy and convensional for students' cognitive skills. The researcher used interview and observation to find out students' participation in learning. By comparing two classes, it is expected to find out the difference of students' cognitive skill between Flipped Clasroom Strategy and Convensional Startegy.

Finding and Discussion

The implementation of Flipped Clasroom Strategy in experimental group uses learning video dowloaded from www.khanacademy.org. The topic was the probability with permutation and combination of subtopics. The downloaded video was given to the experimental groupto be copied, studied and discussed with friends. Due to limitation of infrastructure, video was not presented on line but offline. The example of video can be seen in Figure 1. After that, students were asked to work in group to discuss and finish the tasks under the assistance of teacher to enrich and add concepts of topic taught. Learning in experimental groupwas done by research team. While, classroom learning in control group was done by using expository method continued with drill or exercise and homework.

The implementation of Flipped Clasroom Strategy has been responded positively by teachers and students. Generally, students like the strategy in mathematics learning. This might be caused by new variation of techniques implemented in learning. The result of experiment on students' cognitive skill is shown in Table 1. Students' cognitive skill is obtained from students' test score for probability topic, subtopic permutation and combination.

Table 1.Cognitive Skill Description of Experimental groupand Control group

Interval	x_i	Experiment Class		Control Class	
		f_i	$x_i f_i$	f_i	$x_i f_i$
41-50	45.5	1	45.5	2	91
51-60	55.5	0	0	2	111
61-70	65.5	4	262	7	458.5
71-80	75.5	8	604	7	528.5
81-90	85.5	14	1197	11	940.5
91-100	95.5	4	382	2	191
Score		31	2490.5	31	2320.5
Average			80.48		74.74

As what can clearly be seen in Table 1, from all 31 students in experiment class, there are 18 students or 58.06% students have very good score (more than 81). While in control group there are 13 students or 41.94% sudent get very good score. Similiarly, looking at the overall average score it apparantly be seen that experimental grouphas 80.48 average score while control group is 74.74. Therefore, it can be concluded that Flipped Clasroom Strategy relatively gives a better result to students' cognitive skill.

Flipped clasroom strategy implementation is generally accepted well by teachers and students. Some students said that with Flipped Clasroom Strategy they feel more ready for classroom learning because they previously have watched the material to

learn in the following day. Other students suggested that by using Flipped Clasroom Strategy they could stop and continued learning process as they needed appropriately. For this reason, using flipped clasroom strategy, students had better understanding of topic studied and became more ready for the clasroom activity or completing task or exercise.

Students were able to have more time to discuss and interact with teacher in classroom, as they had studied the video at home. Face to face teachers' assistance in discussing or finishing task is more meaningful for students. Teachers' help and assistance during the students do exercise or finish question in classroom makes students feel more comfortable and enthusiastic in learning. This might occur as whenever students found difficulty in learning, there was a teacher ready to help them. Accordingly, Roshan (2013) has found that flipping her math class leads to more powerful classroom interactions.

Flipped Clasroom Strategy enables the application of blended learning, presenting video online and offline or classroom discussion, exercise to complete test as the enrichment for students. Blended learning can overcome weakneses of e-learning, particularly originality of work submitted on line way. In blended learning, assignments or students' work can be done in classroom base, so that the teacher is able to observe students' ability authentically.

Meanwhile, two way ANNOVA unbalanced cell with 5% significance is obtained F_A = 3,801< F_{table}= 4,01 and Sig = 0,056> 0,05. This implies that H_0 is accepted, it means that there is no statistically significant difference between students taught using Flipped Clasroom Strategy from students taught using convensional strategy. In experimental group using Flipped Clasroom Strategy the average of students cognitive skill is 80,48 while in control group (using convensional learing strategy), the average of students cognitive skill is is 74.74. This suggests that in spite of higher experimental group score average compared to control group average score, the difference is not statistically significant. The similar research conducted by Marlowe (2012) shows that students score was increasing yet, the difference was not statistically significant.

The insufficiency on implementation of Flipped Clasroom Strategy in classroom learning can be a factor which makes students' cognitive skill is not statitically significant. Besides, researcher found students watched the video in their own personal computer. This enables the students to be distracted as they watched the video while listening to music. The students might also not understand the material in video that made them not ready to take part in classroom discussion. This in line with Natalie's (2012) claim that Flipped Clasroom Strategy has its limitation in its implementation. First, quality of video might be poor. Second, students merely watch lecturing in the video, this might lead them to do other activities such as watching the video while watching baseball match or even listening to music. Third, students may need more support to make sure they understand the material given in the video. Fourth, students cannot pose question to instructor when they are watching video.

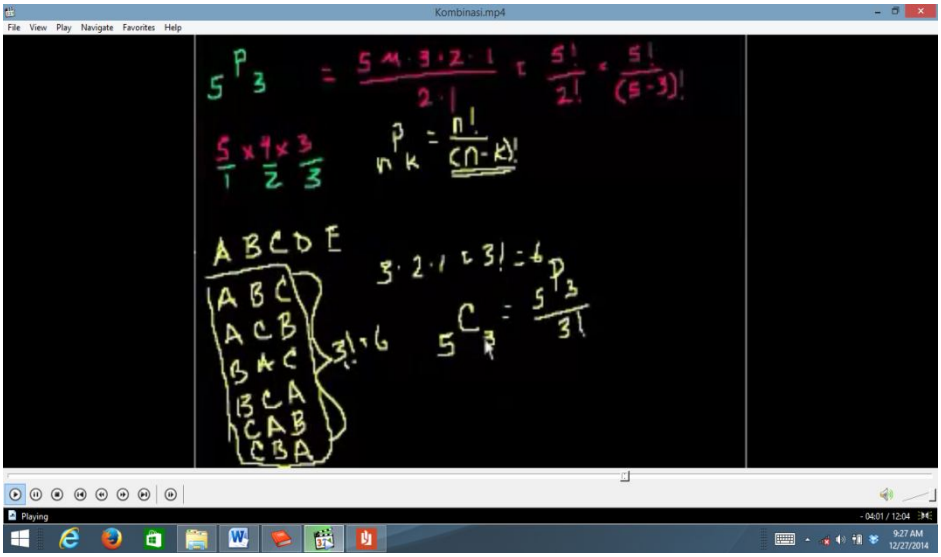

Figure 1.Example of Video Display for Experiment

It is, of course, the quality of the video is important to be considered by teachers in implementing Flipped Clasroom Strategy. If the video quality is poor, the students become uninterested in the material learned. Vice versa, good quality of video help and trigger students' interest to study the material. The videos used in this experiment were downloaded from Khan Academy website which is widely shared and used by mathematics teachers. As what can be clearly seen in picture 1, learning video used only presents general concept of material studied and some examples of concept application. Learning video in Khan Academy mostly recorded in 8 to 12 minutes for presenting a certain mathematical concept of a topic or subtopic. However, the video in Khan Academy does not include quiz or exercise for students.

A learning video should be well arranged by considering its content or its technical making. Bennet (2013) suggested that in making learning video should consider *sound check, brevity, clarity, interaction, and accesibility*. The Sound quality of video should be well recorded. Make sure that the teachers' voice is clearly heard and free from any disturbing background noise that annoys the students' concentration when they are watching it. ***Brevity*** is necessary to be considered in making video. Brevity means it should be made brief and short. Length of the video should be from 7 to 12 minutes. This is meant to avoid unnecessary students' boredome in watching the video. Clarity aspect should be quaranteed in making learning video. The concept of material given should be selected carefully. This is to prevent the students from studying wrong concept in the video. Aspect of interaction can be good thing to be inserted in the video. For instance, giving quiz, illustrated examples, animation, etc. Last but not least, is accessibility aspect of the video. This means video should be easily accessed by students in online or offline way, and can be played in any electronic devices such as smartphone, tablet or personal computer.

Roshan (2013) suggested that to make sure that the students watch the video, there should be a quiz and question to answer for student to submit in online way to the teacher. By using this technique, interaction aspect can take place. Furthermore, Roshan added that the quiz can be in the form of multiple choice, fill in the blank, or short answer question. The Benefit of using multiple choice or fill in the blank assignment form is that the teacher can have automatic scoring. Short answer question will give a

general students' understanding on material given. By looking at the quiz result, teacher can plan the better learning activity in the classroom, for instance by grouping students according to quiz result. Moreover, teacher may identify students who need special assistance or which group needs enrichment material even organizing discussion startegy in classroom and others.

Conclusion

New learning paradigm should be students centred, interactive, team based, stimulating senses and using multimedia. The use of education technology has become essential need to improve quality of learning. Flipped Classroom Strategy is the answer for the use of education technology which gives learning opportunity through activity for better learning environtment. Implementation of Flipped Classroom Strategy is in line with constructivism principle in mathematics learning. Teacher as facilitator provides learning video for students to study at home while teacher give assistance to students group in the classroom and help students understand concept which is previously watched at home.

Restricted implementation of Flipped Classroom Strategy has shown a better learning outcome in experimental class. Accordingly, this strategy can be an alternative for teachers to change and improve learning quality using education technology. Better infrastructure and intensified help from teachers in clasroom through implementation of Flipped Classroom Strategy can improve students' cognitive skill. After all, the change of teachers role and teaching method in learning is answer for mathematics students low achievement.

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