

Practicality of Learning Sets Based on Flipped Classroom to Increase Students Mathematical Critical Thinking Ability in Class XI High School

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Abstract: *The method which can be used to develop one of the learning objectives of mathematics is mathematical critical thinking ability by involving students to be active in the learning process. A student who has the ability to think critically is the students that have a systematic way of thinking, awareness in thinking, and have the ability to distinguish a truth from mistakes. In fact, in the learning process students are still given information clearly and directly which created a passive learners. Students also do not have their own knowledge before the learning process begins so that they only expect knowledge from educators. The impact is there are difficulties for students in learning in class due to lack of training time in questions with varying degrees of difficulty. The lack of learning resources that are easy for students to understand is one of the reasons that students lack practice in doing exercises at home to improve their critical thinking skills mathematically. The purpose of this study is to produce a product in the form of a practical learning video to develop students' mathematical critical thinking skills in class XI. The development model used is Model Plomp which consists of three phases, namely the initial investigation phase, the prototype development phase, and the assessment phase. The subjects of this study were educators and students in class XI MIPA SMAN 5 Padang. Based on the results of observations during the learning process, students look active and can solve various questions with the results of work that increases every meeting. The results of interviewing educators and students received a positive response, and based on the questionnaire analysis also obtained practical categories. So that, it can be concluded that flipped classroom practical learning can be used to develop mathematical critical thinking skills of students in class XI.*

Keywords: Practicality, Flipped Classroom, Mathematical Critical Thinking

1. Introduction

Mathematics is one of the subjects that has an important role in the advancement of science and technology so in mathematics learning students must be the center of learning process. For this reason, students need to develop mathematical abilities, then students can be active in the learning process (The Regulation of the Indonesian Ministry of Education and Culture Number.22 2016). One of the ways is create learning conditions that provide space for students to train various abilities by utilizing technology. But in fact shows that the competencies possessed by students are still low. It showed from the result of first MID semester test in class XI of SMAN 5 Padang are still below the KKM value that has been previously set.

The results of observations in Public High Schools in the City of Padang, it showed that learning process had not focused on students. Students still have difficulty in developing concepts independently in solving problems given by educators. It can be concluded that learning mathematical ability, especially students' critical thinking ability, is still low, meanwhile a student who has ability to think critically in learning process is the student who have a systematic way of thinking, awareness in thinking, and have the ability to distinguish a truth from mistakes. It caused by students have not been trained to work on problems related to critical thinking skills due to inadequate time in class. During mathematics learning the process is still focused in one-direct learning so that students get directly the concepts and examples of questions from educators, while the problems contained in the textbook are problems that require students' critical thinking skills in their completion and it is

usually given as an assignment at home due to there is not enough time at school to solve it. However, many students have difficulty in solving the problems given and there is no available source to ask about these problems. Therefore, innovation is needed in learning sets so students will facilitate to develop mathematical critical thinking skills. Critical thinking is a skill that can be learned with more instruction and practice so the learning sets are designed based on student needs (Ebosele: 2012).

One of the sets is by using media like a learning videos. Students are asked to understand the material through learning videos at home first, than at school students have plenty of time to practice questions that can improve their critical thinking skills mathematically with the guidance of educators in the classroom. These learning process is called flipped classroom based learning.

Flipped classroom is a learning activity with a reverse idea, meaning that all activities of students in the class are reversed or changed with activities normally done outside the classroom (Nouri. 2016). Flipped classroom has existed for a long time in various forms and was popularized and formulated as a model by Bergmann and Sams (Sinaga. 2017:1932). Learning model that minimizes the number of direct instructions but maximizes one-on-one instructions. These activity utilizes technology that supports learning material for students that can be accessed both online and offline (Novis. 2016). It means that with flipped classroom based learning can facilitate students to learn at home by themselves in understanding concepts and at schools students engage in discussions in practicing mathematical critical thinking skills.

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Flipped classroom based learning by utilizing technology in the form of learning videos that contain educator explanations about the material and some sample of questions. By utilizing this learning video, students can repeat the part that is not understood so the time to study in class can be used to discuss difficult questions. The use of customized learning videos is also intended for mathematics learning as well as increasingly rapid technological developments in the Millennial Age (Roehl, 2013).

Flipped classroom learning can improve learning outcomes, sense of responsibility and influence students' learning independence (Arif, 2018: 1933). Also, with flipped classroom based learning, students can maintain learning interest so the academic ability of students increases (Abah, 2017). It can be happened because students are required to understand the material by watching the learning video before entering the class, then make students do not feel confuse on lesson material. The role of the educators during the learning process is to provide assistance when students get difficulties, do not give all of concept in subject matter, so educators can spend more time interacting with students (Karlsson, 2016).

Based on the results of Bergmann and Sams's research (2012) the advantages in using flipped classroom learning are in accordance with the activities of the "present" of students habit, helping students who have many activities, helping students who have difficulty learning, learning videos can be paused according to the wishes of students, can strengthen communication, allow educators to know their students well, educators can easily distinguish students' level of understanding. Flipped classroom also educates parents by supervising learners. While the lack of flipped classroom is how to force students for watching a learning videos prepared by educators as students' provision of lesson before starting their classes.

Human thinking can be grouped into several parts, namely: vertical thinking, lateral thinking, critical thinking, analytical thinking, strategic thinking, thinking about results, and creative thinking. Critical thinking is the activity of training or incorporating careful assessment, such as assessing the feasibility of an idea or product (DePorter, 2016:296). It can be concluded that mathematical critical thinking ability is an ability to use previously understood concepts, careful strategies with mature reasoning, and appropriate arguments in finding results or solving a mathematical problem so that the results obtained are correct and accountable.

Learning flipped based classroom with using the learning videos that are easily understood at home will also help students to improve their critical thinking skills mathematically when solving problems which is given at school. Small groups of students are formed to make student active in discuss, change ideas about their views and opinions based on the learning videos they understood to solve existing problems. It is consistent with the research conducted by Lamsa, et al. (2018) stated that the active learning process can create productive learning and improve learning outcomes. So it is very important to create a learning set based on flipped classroom by using learning videos as a learning resource which make students

understand the lesson easily. In this study, it will be seen that there were a practicality of flipped classroom based learning to improve mathematical critical thinking skills.

The aimed of this study is to produce a mathematical learning set based on flipped classroom that is practical to train critical thinking of students in class XI SMA.

2. Method

The method is research and development (R & D). Development research is a process and steps to develop a new product or perfect an existing product (Sugiyono, 2013: 407).

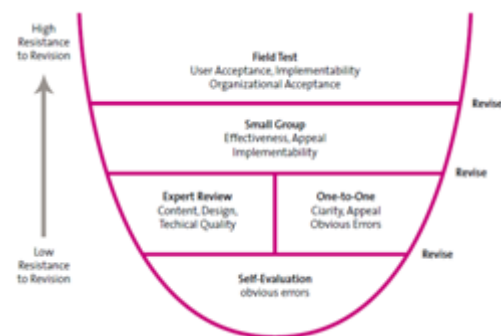


Figure 1: Formative Evaluation Layer
Source: Tessmer in Plomp (2013:36)

The development model used is the Plomp model which consists of three phases, namely the initial investigation phase (preliminary research), the phase of development or prototype making (development or prototyping phase), and the assessment phase (Plomp, 2013: 30). The subjects of this study were Mathematics educators and students in class XI MIPA of SMAN 5 Padang. Class XI students involved in the trial stage of one-to-one evaluation amounted to three people, students involved in the small group stage trials amounted to six people, and 33 students in one class were used as implementers of classroom flipped learning on field test stage. The thing that will be discussed is the practicality of learning sets in the field test.

The data collection instruments used were questionnaire sheets, interview guideline sheets, and observation sheets. Data collection techniques by means of documentation, analysis of the results of observations of the implementation in the learning process, analysis of interview results, and analysis of questionnaire data. Data analysis techniques for practicality questionnaires using a Likert scale. The Likert scale is arranged in a positive category, so that positive statements score according to Arikunto stated, score 4 for strongly agree statement (SS), score 3 for agree statement (S), score 2 for disagree statement (TS), score 1 for statements strongly disagree (STS) (Arikunto, 2008). To determine the practicality value of the learning set, the formula according to what was stated by Purwanto was used. Learning sets have been said to be practical if the average practical assessment results are more than or equal to 75 (Purwanto, 2012:102).

3. Results and Discussion

An ordinary learning process at school is when educators act as whole information providers and leaders in the class. Whereas in flipped classroom based learning can be implemented with cooperative activities where students interact directly with their friends, while educators are only facilitators to help the student in solving problems that have difficulty. These learning process will form an interaction between students and other students, also make interaction between students and educators become more intensive and well established. Research supported by previous research by Velegol (2015) states that the learning process requires the active role of students to obtain new material, learning based on flipped classroom is one of the lessons that can be applied to support it.

The practicality of learning will be seen from the results of observations in the classroom, the results of interviews of educators and students, and the results of student questionnaires. The assessment conducted on flipped classroom based learning is not only at the end of competency, but also seen during the classroom learning process. The results of observations in learning activities indicate an enhancement in active learning abilities and skills of students in applying the concept of Geometry Transformation in solving problems. In line with Moore's research (2015) which showed that students were more motivated to learn by using flipped classroom-based learning videos to obtain the expected results compared to ordinary learning models. It shows that flipped classroom learning can make an improvement in learning motivation, activeness, and learning skills so that the results obtained according to what is expected.

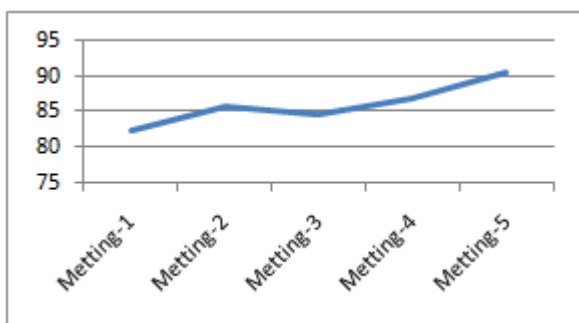


Figure 2: Obtaining the Average Value of Students

Based on Figure 2, it can be seen that the results of the average value of students appear to have increased every meeting, except at meeting 3. There was a decrease of 1.1 from the previous meeting. However, this is not a big problem because when compared to meeting 1, the average score of students in meeting 3 is still have increased by 2.3. So it can be concluded that there is an enhancement in students' critical thinking skills mathematics.

Based on the results of interviews with educators, information was obtained that the convenience obtained by the use of flipped classroom based learning. It caused by students already have the provision to study in school by understanding the material that will be discussed during the learning process in the classroom first by themselves.

Initially, educators feel unconfident that there would be an enhancement in learning outcomes, especially in critical thinking skills after seeing students' daily motivation to learn mathematics was still lacking. Many students still play and use their smartphones for personal gain during the learning process. However, after testing, it was seen that there was an enhancement towards the positive and students' critical thinking skills began to be good. By using learning videos that can be watched on student own smartphones, student can also minimize their habits in using smartphone so it must be more useful. Educators feel they have a lot of time in interacting with students to discuss questions with diverse abilities in flipped classroom based learning that is applied.

Based on the results of interviews with students, it is known that they have difficulty starting new things that are not familiar to them, namely understanding the material before learning process. Usually they do not understand the material themselves, because everything is given by educators. Some of the students have tried to understand in advance the material that will be discussed at school, but because the resources they have are not easy to understand and make those activity does not last long. By using learning videos is given before the learning process, students get easy to prepare themselves for the learning process. Flipped classroom-based learning is felt can make student self-esteem also increase because student learn to discuss together and require arguing to solve problems given by educators. It can also be seen from the learning process in the class that students compete to show the results of their work with other students during discussions and presentations. In line with the research conducted by Tsung-Lan (2019) stated that the application of classroom learning in a team can increase the learning involvement and effectiveness of students. Cheung's research (2014) also states that digital-based learning makes it easier for educators to develop students' critical thinking skills so that learning in the classroom goes as expected.

Table 1: Average Assessment Results of Questionnaire for Practical Learning Sets

Indicator of Average Practicality	Assessment of Assessment Results
Readability and Clarity of Material	88.86
Use and Ease of Use	85.39
Attraction	86.62
Time Sufficiency	89.39

Based on Table 1, it can be seen that the average results of the questionnaire assessment to assess learning using a flipped classroom based learning set shows the value of practicality above 85 for each indicator of the assessment. A learning sets are practical if the value obtained is above 75. In Table 1 can be concluded that flipped classroom-based learning sets are practical based on questionnaire analysis.

4. Conclusion

After collecting and analyzing data based on observations, interviews with educators and students, and student questionnaires, it was found that flipped classroom-based learning sets which have been developed to train

mathematical critical thinking skills were practical for students in class XI SMA.

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