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# Flipped classroom in mathematics instruction: Teachers' perception

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**Abstract.** Student-centered learning paradigm requires a learning model which is able to facilitate the students constructing their knowledge actively. The flipped classroom is a student-centered learning model that integrates technology in its implementation. This study aims to describe the teachers' perception about the use of the flipped classroom model in mathematics instruction. The data were collected through an interview and were analyzed using qualitative methods. The subject of this study were five teachers from public and private schools in Yogyakarta. The result showed that the flipped classroom: (i) can motivate and make students active in learning mathematics; (ii) can train students' critical thinking skill; (iii) can train students' problem-solving skill. Besides, the use of the flipped classroom in mathematics instruction would be optimal when it is combined with the other learning methods, especially for the new learning topics that require a prior conceptual understanding.

## 1. Introduction

The development of science and technology has an impact on various fields of life directly, including education. When talking about education, it is closely related to the learning process carried out at schools. Student-centered learning paradigms also influence learning implementation. Learning is expected to be able to prepare competent and globally-competitive human resources in order to process information properly and correctly. Ideally, 21st-century learning can bridge the gap in how students live and learn. As a learning practitioner, the teacher needs to pay attention to the lives of students after learning in school. A teacher is the one who knows about the students' characteristics in learning, the effective learning to engage students in learning and how to motivate students to get good learning achievement. Motivation is a stimulus that gives power (energy) to someone to carry out an activity, which directs it to be right for the intended purpose and keeps it stable towards what has been done [1]. Student learning motivation can increase along with the mathematics learning activities in the classroom [2]. The increase of mathematics learning can be obtained through the selection of learning models that are in accordance with the characteristics of students and the learning objectives to be achieved. One learning model that can facilitate students to learn actively both inside and outside the classroom is learning with a flipped classroom setting.

Flipped classroom or reverse setting learning is a learning approach that changes the learning habits directly in class into individual learning spaces. One-to-one student interactions that are maximized in



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learning change the focus of learning to be student-centered so that students are more actively involved in the learning process. The student-centered learning approach used by the teacher can involve students in building knowledge actively and can motivate the students to work together to evaluate the learning process [3]. Students build knowledge from what is learned, deliberately prove the validity of that knowledge, and correct wrong knowledge [4]. Thus, students who learn in this way are more likely to achieve meaningful learning. This approach is usually said to be active learning, which is a learning process that involves students in several activities so that they are encouraged to reflect on ideas and how they use ideas [4]. Teachers record and narrate video learning of themselves explaining subject matters, or taking videos from internet sites [5]. Therefore, flipped classroom needs to be understood by the teacher as an alternative model of mathematics learning. This is in line with the Foertsch's finding which showed that the flipped classroom has a positive effect on students and learning [6].

Driscoll's study in the flipped classroom showed that 80% of 203 students have more constant and positive interactions with teachers and peers during class time, have more access to material and instruction, are more able to work at their own pace, can use more choices to demonstrate learning, and view learning as a more active process. In addition, nearly 70% of 203 students reported that they were more likely to have choices in what learning assignments to use, more likely to be involved in collaborative decision making with other students, more likely to be involved in critical thinking and problem-solving [7]. Another study shows that one of the benefits of the flipped classroom is to involve students and develop critical thinking skills [8]. Furthermore, students in the flipped classroom are more willing to work together and engage in classroom activities compared to students in traditional classroom environments. These students prefer innovation in the class that is reversed when compared to students in traditional classes. A study by Setyaningrum shows that students who learn in the integrated-technology learning approach have a better understanding [9]. The current study supports the idea that the integration of technology into the classroom may be a motivating factor for learning the content by giving more interest to students in the core subject classes, one of which is mathematics [10].

## 2. Methods

This study was a qualitative approach. In a qualitative descriptive view, researchers tried to understand the meaning of events and their links to ordinary people in certain situations [11]. The use of qualitative descriptive methods was intended to describe the symptoms or phenomena that appear in the study. Students' learning activities in class and at home was an activity of the teaching and learning process and a social event where the teacher with students conducts social communication to achieve the learning objectives. In order to be focused and in-depth, this study would discuss the teacher's perception of the flipped classroom setting used in mathematics learning viewed from the length of teaching. So that, the purpose of this study was to describe the teacher's perception of mathematics learning that was "reversed" using the flipped classroom setting.

The subjects of this study were five mathematics teachers from public or private schools. Two participants had teaching experience of more than 15 years, one with teaching experience between 5-15 years, and two teachers with less than 5 years of teaching experience. The five teachers consisted of junior high school, vocational high school, high school teachers from three districts in the province of Yogyakarta, which were Sleman, Bantul, and Gunungkidul.

**Table 1.** Characteristics of the participants

		Participant	Percentage
Gender	Male	2	40%
	Female	3	60%
Age	Less than 30 y.o.	2	40%
	30 to 50 y.o.	2	40%
	More than 50 y.o.	1	20%

		Participant	Percentage
Teaching experience	Less than 5 years	2	40%
	5 to 15 years	1	20%
	More than 15 years	2	40%
Educational Background	Undergraduate	2	40%
	Postgraduate (on going)	2	40%
	Postgraduate	1	20%

Data collection was carried out by structured interviews based on the interview guidelines sheet which was carried out directly to 4 math teachers and 1 person through online chat applications. The steps of data collection in this study are:

- a. Preparing interview questions.
- b. Validating interview questions to expert lecturers.
- c. Requesting the approval of the participants to be interviewed by filling out a statement of willingness as a participant.
- d. Conducting interviews directly with participants. This was done to the participants who can be interviewed face to face.
- e. Asking the participants to answer the questions on the interview guidelines sheet regarding the mathematics teacher's perception of mathematics learning with the flipped classroom setting. This was done to resource persons who could not be interviewed face to face.
- f. Analyzing data from interviews.
- g. Interpreting and concluding research results.

The data obtained were then analyzed based on the following qualitative data analysis procedures [12]:

- a. Processing and preparing data for analysis.
- b. Reading the entire data.
- c. Starting coding all data.
- d. Implementing the coding process to describe the settings, participants, categories, and themes that will be analyzed.
- e. Showing how these descriptions and themes will be presented again in a narrative or qualitative report.
- f. Making qualitative data interpretations.

### 3. Result and Discussion

This study examines how the flipped classroom setting can be used as an alternative design of mathematics learning, related to understanding and provision of experience during teaching time. The interview activity was conducted within 3 days from January 4 to 6, 2018. The interviews are conducted by visiting the subjects at the school where they teach, at home, and on campus. On the other hand, speakers who could not be visited directly, interviews were conducted through the help of online chat applications. The questions asked consisted of 7 questions with a choice of Yes or No answers which continued by giving sub-questions to explore more detailed answers.

**Table 2.** Data from interview

Categories	Teacher Perception	
	Positive	Negative
Initial knowledge about flipped classroom	20%	80%
Experience using the flipped classroom	80%	20%
Flipped classroom can facilitate students to learn mathematics	100%	0%
The flipped classroom is suitable for all mathematics topic	20%	80%

Categories	Teacher Perception	
	Positive	Negative
Flipped classroom can train students' critical thinking	100%	0%
Flipped classroom can make students to actively learn mathematics	100%	0%
Flipped classroom can train students' problem solving	80%	20%

According to the subjects' answers to the questions posed, all interviewees gave a positive view of the use of a flipped classroom setting in mathematics learning. This is in line with research by Foertsch which shows that flipped classroom has a positive effect on learning [6]. Although 4 out of 5 teachers have never heard the term flipped classroom before, after being given an explanation by researchers, they believe that flipped classroom can provide more experience to students in building their knowledge. Here are explanations of the teacher's opinion in using the flipped classroom model in mathematics learning.

### *3.1 Can motivate and make the students active in learning mathematics*

All teachers agree that flipped classroom can make students active in mathematics learning both in class and at home given the students are motivated to learn. At home, motivated students have an awareness to learn because there has been learning independence. Meanwhile, when having discussions in class, students will be easier to express their opinions because they already have initial knowledge. However, for students who have not been motivated, this is difficult to do because students still rely on explanations and formation of knowledge by teachers (traditional teaching). Thus when in class, they will tend to be more passive and wait for instructions from the teacher. These result is in line with Strayer's findings that, in general, students in reverse classes are more willing to work together and engage in classroom activities compared to students in traditional classroom environments [10].

Flipped classroom learning can be done in several ways, through an online chat application by creating a discussion group on math questions specifically for 12th grade students with clear rules, asking students to study at home through various sources of books, worksheets, internet, and using the e-feature learning in Google to facilitate students learning at home. Although one in five has not experienced learning with the flipped classroom setting, all interviewees' agree that flipped classroom can motivate students to learn. T2 and T5 argue that relative motivation to students and supporting facilities. This means, if students are facilitated by learning resources that suit with their needs, it can be said that the flipped classroom makes students motivated to learn. While T1 stated that, "students can be motivated because it is more interesting, seeing that most students already have an Android handphone if optimized, it can motivate students to learn."

Since students were motivated, the teacher agrees that the flipped classroom can facilitate students learning mathematics. T5 states that on time students can be facilitated learning because the hours in class are more limited, while in the dorm or at the house there are more hours. Besides, school hours are sometimes used for non-academic activities. T4 and T3 state that by reading the material or teaching material provided, students can learn to understand because they must have the material to be discussed in class. While according to T4 and T5, in principle, the flipped classroom can facilitate students to learn, because students can learn at any time according to their learning moods.

On the other hand, most of the teachers do not agree that flipped classroom is suitable for all mathematics material, considering that each learning model or method must be adapted to the characteristics of students and the mathematics material itself. The principle is that the teachers agree to use the flipped classroom in learning mathematics, but it will be more optimal if it is combined with other learning methods especially for the material that is new to students and requires conceptual understanding first. T2 adds that for simple material and students have prior knowledge, the flipped classroom is suitable for learning mathematics.

### *3.2 Can train students' critical thinking skill*

Most teachers agree that flipped classroom can train critical thinking skills. In line with the research conducted by Herreid and Schiller who found that one of the benefits of the flipped classroom was developing critical thinking skills [8]. If students have learned material at home, then they already have provision or knowledge. Next, the teacher can confirm the learning outcomes of each student through class discussion activities, both presentations and work on questions. Thus students will try to criticize what they have learned and their friends with the knowledge that has been obtained.

The role of the teacher to direct class discussion is in accordance with the learning objectives and to provide reinforcements of material to students. Only one teacher has a different opinion, T2, he states that the ability to think critically is relative to students' mathematical abilities. Students who have higher abilities tend to be easier to crystallize the material that has been studied compared to students who have lower mathematical abilities.

### *3.3 Can train students' problem-solving skill*

According to Driscoll's findings, all teachers agree that flipped classroom can facilitate students to practice problem-solving skills if the teaching aid or learning topic provided is related to problem-solving and when having group discussions, students are given problem-solving problems [7]. The teacher challenges were to be able to present teaching aid or learning topic or video learning that contains problem-solving questions accompanied by clear instructions and steps. Based on the previous questions, the teachers have agreed that flipped classroom can make students motivated, think critically, and learn actively. So that, when facing problems that are not routine and can not only be completed with one step, students will still try to solve the problem.

## **4. Conclusion**

In general, teachers responded positively to the use of flipped classroom settings in mathematics learning. First, even though most of the participants have never heard the term flipped classroom, they believe that flipped classroom can motivate learning and make students active in learning mathematics. Indirectly, using a flipped classroom can make students actively understand the material given by the teacher to learn at home, whether in the form of material in videos, web, books, blogs, handouts. In addition, with the help of group chat students can communicate with teachers and other students at agreed times. Even when in class, students can interact with teachers and other friends through discussion activities to solve a problem.

Second, most participants agree that a flipped classroom setting can train critical thinking skills. The activeness of the students in learning due to the emergence of motivation in students supports the development of their cognitive processes. Students who tend to be active in learning will know many things. Therefore, it will be easy to ask why and how things can happen. This is a psychologically normal thing because in the process of cognition students will create knowledge schemes that will link the initial knowledge they have with new knowledge.

Third, all informants agreed that flipped classroom settings can train problem-solving skills if the teaching aid or learning topic provided contains problem-solving content. Thus the teacher plays a role to provide teaching aid or learning topics or videos that contain problem-solving questions accompanied by clear instructions and steps. Providing non-routine questions accompanied by clear instructions and work steps can help students get used to solving problems. Eventually, students can solve a problem by themselves without the help of the teacher.

These are some of the findings in this study which generally contribute to the study of mathematics learning with the flipped classroom setting, especially in mathematics learning design research with an effective flipped classroom model in terms of motivation, critical thinking skills, and problem-solving abilities. The results of this study can be used as a reference by teachers or other researchers to use a flipped classroom in learning mathematics by taking into account students' characteristics and math materials.

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