ANALYSIS OF THE STUDENTS' ENGAGEMENT IN THE PROCESS OF LEARNING MATHEMATICS USING A FLIPPED-CLASSROOM APPROACH TO TRIGONOMETRY[(*)]

MM. Yunika Nugraheni [1,2] [*], Parmamita Suryaningrum[2], M. Andy Rudito[2]

[1]Mathematic Teacher, SMAK PENABUR Summarecon Bekasi, West Java, 17142, Indonesia and
[2]Master's Student of Mathematic Education, Sanata Dharma University, Special Region of Yogyakarta, 55281, Indonesia

[*]Correspondence purposes, e-mail: mm.yunika.nugraheni@gmail.com

Abstrak: Pandemi covid-19 yang melanda berbagai wilayah di dunia berdampak pada bebagai sektor tak terkecuali sektor pendidikan. Hal ini menyebabkan kegiatan belajar mengajar harus dilakukan dalam jaringan (daring) untuk meminimalisir penularan wabah ini. Namun pembelajaran secara daring ini mengalami beberapa tantangan baik bagi guru maupun bagi siswa salah satunya adalah keterlibatan siswa dimana siswa cenderung pasif dan hanya menerima materi yang diberikan guru. Hal ini menyebabkan guru harus mendesain pembelajaran yang kreatif dan menarik guna membuat siswa tertarik dan aktif baik emosi, kognitif maupun perilaku siswa. *Flipped classroom* merupakan salah satu pendekatan pembelajaran dimana guru memandu konsep secara efektif dengan menciptakan lingkungan belajar yang interaktif yang memberikan kesempatan bagi siswa untuk berpartisipasi secara aktif. Tujuan dari penelitian ini adalah 1) Mengetahui desain pembelajaran menggunakan *flipped classroom* untuk meningkatkan keterlibatan siswa dalam belajar matematika. 2) Mengetahui pengaruh flipped classroom dalam meningkatkan keterlibatan siswa dalam pembelajaran. Metode yang digunakan adalah kajian literatur dan kuantitatif melalui kuisioner. Subjek dari penelitian ini adalah siswa kelas X yang mengikuti pembelajaran matematika dengan pendekatan *flipped classroom* pada materi trigonometri. Penelitian ini menghasilkan rancangan pembelajaran berupa desain pembelajaran menggunakan *flipped classroom* untuk meningkatkan keterlibatan siswa. Selain itu berdasarkan hasil kuisioner dapat disimpulkan bahwa *Flipped classroom* berpengaruh untuk meningkatkan keterlibatan siswa dalam pembelajaran matematika..

Kata kunci : *Keterlibatan siswa, Flipped classroom, Pembelajaran matematika*

Abstract: The COVID-19 pandemic that has hit various regions of the world has an impact on various sectors, including the education sector. This causes teaching and learning activities to be carried out online to minimize the transmission of this pandemic. However, online learning experiences several challenges for both teachers and students, one of which is students' engagement where students tend to be passive and only accept the material provided by the teacher. This causes teachers to design creative and interesting learning to make students interested and active both emotionally, cognitively and student behavior. Flipped classroom is a learning approach where the teacher guides concepts effectively by creating an interactive

learning environment that provides opportunities for students to participate actively. The aims of this research are 1) Knowing the learning design using flipped classroom to increase student involvement in learning mathematics. 2) Knowing the effect of flipped classroom in increasing student's engagement in learning. The method used is a literature review and quantitative through a questionnaire. The subjects of this study were students of class X who took part in learning mathematics with a flipped classroom approach on trigonometry material. This study resulted in a learning design in the form of a learning design using a flipped classroom to increase student engagement. In addition, based on the results of the questionnaire, it can be concluded that the flipped classroom has an effect on increasing student's engagement in learning mathematics..

Keywords: *Student's engagement, Mathematics learning, Flipped classroom*

INTRODUCTION

The COVID-19 pandemic has affected many countries, including Indonesia. The government took certain steps in order to address the problem (Buana, 2020). One of those steps is the social-distance movement. The government's decision has a tremendous impact on education. It leads to numerous policies, one of which is online learning. It was developed to reduce the spread of this outbreak. It is a learning activity that enables networks (internet, LAN, WAN) as a communication medium, interaction, and facilities. It is also supported by a number of different learning services (Kurniasih, 2012).

However, there are several challenges to online learning, one of which is student engagement. According to the results of research conducted by Andri Anugrahana, only 50% of students were fully engaged, while 33% were actively involved. In comparison, 17% were less engaged and involved in online learning (Anugrahana, 2020). This refers to student engagement. Student engagement, as defined by Handelsman, Briggs, Sullivan, and Towler (2005), is student participation in learning from four perspectives: skill engagement, emotional engagement, participation engagement, and performance engagement (Lidiawati & Helsa, 2021). It means having the full ability to actively participate in the learning process. An effective approach is required, allowing students to participate actively in learning. An innovative learning approach using technology can be used to improve student engagement. The flipped classroom approach is one of several learning approaches that can be used. The teacher effectively guides the concept in this approach by establishing an interactive learning environment (Flipped Learning Network, 2014).

A flipped classroom encourages students to engage actively in class. This is supported by research indicating that this approach promotes active student engagement in the classroom (Enfield, 2013). According to Hurley, the flipped classroom provides opportunities for active engagement in classroom activities (Hurley, 2014). Students' attitudes regarding the approach may improve as a result of in-class

activities. Students obtain learning experiences through a variety of activities. In this approach, the active learning process in the classroom may have a significant impact on students' level of engagement.

Based on the background that has been provided, this research aims to identify the learning design and the impact of using a flipped classroom in enhancing student engagement in learning mathematics.

RESEARCH METHOD

The research used a literature review by reviewing studies related to student engagement and flipped classrooms. A questionnaire with five alternative answer choices on a scale of 1 to 5 was also used in this research. The student engagement questionnaire was derived from the Student Engagement Questionnaire (Reeve & Tseng, 2011), which consisted of 10 items about students' behavior (2 items), emotions (3 items), and cognitive abilities (3 items). The researcher distributed the questionnaire after the students had completed the flipped classroom approach to learning. A total of 39 students from the X Social Studies class participated in this research. Furthermore, the researchers used quantitative analysis to analyze student engagement based on the score of the completed student engagement questionnaire. The score was then divided into three categories, indicating that students were either less involved, moderately involved, or very involved in their learning. The following formula was used to set score boundaries in each category (Azwar in Hidayatullah & Shadiqi, 2020).

Table 1. Category Formula

Category	Description
$x < (\mu - \sigma)$	Low
$(\mu - \sigma) \leq x < (\mu + \sigma)$	Medium
$x \geq (\mu + \sigma)$	High

RESULTS AND DISCUSSION

1. Flipped Classroom

A flipped classroom is a learning technique that involves a blended learning approach by reversing the traditional learning environment and delivering learning content outside the classroom (online) (Susanti & Hamama Pitra, 2019) . The term "flipped classroom" refers to a blended learning model of meaningful and active learning activities involving metacognitive tasks carried out collectively and individually in a pre-arranged classroom where cognitive activities are low and self-learning is carried out in accordance with the pace of learning carried out outside of school using videos, slides, articles, and notes on a digital platform. The use of the flipped classroom approach is divided into two stages. Firstly, outside the classroom, where self-study is done through an online platform, and secondly, inside the classroom, where activities are discovery-based. This means that the activities outside the class serve as the basis for the activities inside the classroom.

Cognitions play a significant role in learning within the context of flipped classroom practices and applications. This refers to the most recent Blooms cognitive taxonomy, which is useful for understanding how the flipped classroom concept works in practice. In general, lower-level cognitive abilities (remembering and understanding) are performed outside of the flipped classroom, and higher-level cognitive skills (application, analysis, evaluation, and creation) are performed within the organized classroom. Therefore, according to Bloom's revised taxonomy levels of cognitive abilities, flipped classroom activities begin and continue in the classroom.

Within the context of flipped classroom practice, students work independently outside of the school environment by utilizing digital media and platforms. As a result, they acquire a basic level of knowledge before entering the classroom and assume responsibility for their studies. They can use digital media tools to develop strong social interactions with their teachers and peers. Students at this stage communicate questions they don't comprehend and can't address on their own with others. This development shows the significance of teaching support, often known as scaffolding. Therefore, it can be concluded that students are in the zone of proximal growth and require suitable scaffolding. Moreover, adequate assistance should be offered to students in this zone (Çevikbaş & Argün, 2017).

The following stages can be used to implement the flipped classroom approach in the classroom: 1) Prior to the face-to-face learning process, students must study the upcoming meeting material independently at home using video shows. Students are divided into groups of four to five in class. 3) During the teaching and learning process, the teacher facilitates the discussions. 4) The teacher gives a quiz or test to assess the students' comprehension of the learning material (Nurkhasanah, 2021).

2. Student Engagement

Student engagement in learning activities is an important and widely researched component in education. It is a significant educational outcome for students as a measure of their own positive functioning, but it is more significant for predicting academic achievement and progress. Student engagement, according to Chapman, can be quantified through self-reported questionnaires, checklists, and rating scales, work sample analyses, direct observation, and focused case studies (Cevikbas & Kaiser, 2021). Student engagement is also a well-understood construct, with three components that include behavioral elements, emotional aspects, and cognitive aspects.

Table 2. Student Engagement Indicator

Engagement	Indicator	
Behavior	Persistence	Deliver and answer question

Engagement	Indicator	
	Stick to the task	Ask for support and feedback
	Give an effort	Interaction with teachers and classmates
	Achieve high scores	Participate in discussion and group project
	Pre-lesson preparation	Avoid disruptive behavior
Emotional	Interested	Satisfaction
	Comfortable	Desire, willingness
	Happy	Responsibility for learning
	Enthusiastic	Confident, feel sufficient
	Enjoy	Motivation and focus on learning
Cognitive	Think hard	Self-monitoring and self-assessment
	Plan to learn	Try to be a mathematician
	Prefer difficult tasks	Aware of the learning objective
	Prove and disprove	Look for further information
	Independent work style	Write down any errors and revise them
	Make an evaluation comment	Make connection between learning topic
	Solve problem in different approach	Remember and practice the previous learning

3. Learning Design Using The Flipped Classroom Approach

Asynchronous (prior to learning)

a. The teacher uploads the material to the LMS, which contains learning guidelines. b) Assignment completion guidelines c) Attainable abilities d) Offline and online learning activities to be completed e) Scope of the assessment (aspects, procedures, and assessment instruments to be used). f) The benefits of the material to be studied. g) Division of student groups h) Books/links to books that students are required to read. i)Learning resources (video/ppt).

b. Students watch the video provided by the teacher on Moodle, which is connected to Edpuzzle. The use of Edpuzzle can assist teachers in monitoring students' ability to analyze the video as a whole. It is also possible to ask questions in Edpuzzle.

c. Students develop a deeper understanding of the material through critical thinking.

d. Students create a list of questions connected to the material (critical thinking, creativity, literacy).

The synchronous (during learning)

a. The teacher creates a comfortable learning environment by running the Nearpod program.

b. The teacher reminds students of the online learning class's rules.

c. The teacher relates the previous material to the material to be learned through the Matching-Pairs Nearpod activity.

d. The teacher divides the class into groups (breakout room OL).

e. The teacher helps students discuss the questions they have about the material in the LKPD (collaboration, critical thinking).

f. The teacher assists students in answering questions that will be addressed in accordance with the competencies to be obtained through small group discussions. (collaboration, critical thinking, creativity, communication, literacy in reading and writing, literacy in technology)

g. The teacher assists students in processing and analyzing the outcomes of addressing material-related difficulties (critical thinking, collaboration, creativity, technological literacy).

h. The teacher assists students in making conclusions after solving material-related challenges (communication, critical thinking, literacy, collaboration).

i. Students present the results of their work on LKPD-related problems (breakout room closes, students return to the main room) (communication, technological literacy).

j. Students and teachers listen to other students' presentations on how to solve the difficulties outlined in the LKPD.

k. Students play Time to Climb games in Nearpod to measure their level of knowledge.

l. Students and the teacher come to conclusions about the material discussed.

m. Students present themselves by writing on the Nearpod collaboration board.

n. Students pay attention to the teacher's feedback on the learning process and results.

o. Students pay attention to the teacher's next learning plan.

4. Duration of Students' Watching Learning Videos

The data shown in Figure 1 was derived from the statistics that reflect the percentage of time students spend watching videos on Edpuzzle.
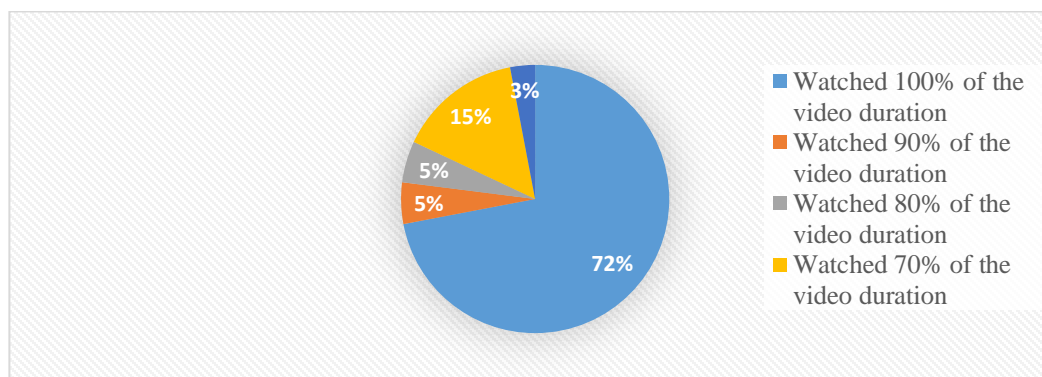

Figure 1. Picture of The Duration of Watching The Video

Teachers could monitor students' engagement while watching videos using Edpuzzle. According to this data, the majority of students watched the entire film.

5. Questionnaire Findings

Table 3 shows the range of student engagement scores based on the questionnaire results and calculations to determine the score boundaries in each category of emotional, cognitive, and behavioral student engagement.

Table 3. Category of Student Engagement

Description	Category		
	Emotional	Cognitive	Behavioral
Less engaged	$x < 9$	$x < 8$	$x < 12$
Moderately engaged	$9 \leq x < 13$	$8 \leq x < 13$	$12 \leq x < 17$
Well engaged	$x \geq 13$	$x \geq 13$	$x \geq 17$

Based on the overall score of the questionnaire that students completed and the results of the categorization using the score limitations in Table 3, a description of student engagement is obtained and provided in Table 4.

Table 4. Description of Student Engagement

Description	Number of students		
	Emotional	Cognitive	Behavioral
Less engaged	2	1	4
Moderately engaged	18	22	22
Well engaged	19	16	13

6. Data Analysis

According to Tables 3 and 4, the emotional engagement of the 39 students who participated in the class was moderate. It was evidenced by the small number of students who were less engaged. Further analyses revealed that students who were less engaged had a score of 8, which was pretty close to the description range of moderately engaged. Furthermore, it indicated that students were passionate and focused on following the activities in the classroom during the learning process, as evidenced by students responding quickly when the teacher delivered directions or questions, and while discussing in groups, students followed with enthusiasm. Besides, the questionnaire results revealed that 24 out of 39 students were very enthusiastic about the learning process. The observation results on Edpuzzle revealed that 72% of students viewed the entire video. It proved that students were interested in watching the learning video provided.

Then, for cognitive student engagement, it was discovered that students were quite cognitively engaged during the learning process. It was demonstrated by the small number of students who

were less engaged, namely 1 student, and the huge number of students who were quite engaged, namely 22 students. Furthermore, the results of the questionnaire showed that 22 out of 39 students actively presented their ideas. When discussing in groups, students took notes and corrected their notes actively.

The number of students who were moderately engaged (22 students) and the small number of students who were less engaged (4 students) demonstrated behavioral student engagement. According to the questionnaire results, 34 students paid attention to peers who expressed their ideas, and 38 students actively took notes on the subject studied. Furthermore, during the learning process, students were actively participated when discussing in groups and in classical discussions. Based on Chapman's indicators, it can be concluded that students are generally engaged.

CONCLUSIONS AND SUGGESTIONS

By using the flipped classroom approach, students were enthusiastic, joyful, motivated, and focused on learning. Besides, the flipped classroom approach also enabled students to be excited about solving the problems provided by the teacher. In addition, the students were able to actively engage in both group and classical discussions. It could be concluded that the learning design using the flipped classroom approach made the students actively engaged in their learning in terms of emotion, cognition, and behavior. Furthermore, the result of this research also revealed that the flipped classroom approach had a significant effect in enhancing students' engagement.

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