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THE EFFECTIVENESS OF FLIPPED CLASSROOM ASSISTED BY GOOGLE CLASSROOM IN ENHANCING STUDENT ENGAGEMENT IN GROUP DISCUSSIONS

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ABSTRACT

Mathematics instruction in schools still often relies on conventional, teacher-centered approaches, limiting students' opportunities to interact, discuss, and collaborate in groups, resulting in low levels of student engagement, particularly in group discussions. This study aims to analyze the effectiveness of the Flipped Classroom model assisted by Google Classroom in enhancing student engagement in group discussions during mathematics instruction. A quantitative approach with a pre-experimental one-group pretest-posttest design was employed, involving 30 students from Class XI-B of SMA Negeri 1 Lubuk Pakam, selected through purposive sampling. Data were collected using an observation sheet and a student response questionnaire, and analyzed using descriptive statistics, the N-Gain test, the Shapiro-Wilk normality test, and the Paired Sample t-test. The results showed that the average engagement score increased from 61.533 (pretest) to 105.833 (posttest), with an average N-Gain of 0.774, categorized as high; 73.3% of students fell into the high improvement category and 26.7% into the moderate category. The student response questionnaire showed that 50.0% of students rated the experience as "very good," 46.7% as "good," and 3.3% as "fair." The Paired Sample t-test yielded a calculated t-value of 22.481 with a significance value of $0.000 < 0.05$, so H_0 was rejected and H_1 was accepted, confirming that the Flipped Classroom assisted by Google Classroom effectively enhances student engagement in group discussions.

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1. INTRODUCTION

Education is a crucial process in shaping an individual's personality, skills, and knowledge so that they can actively participate in social life and national development.

As mandated by Law of the Republic of Indonesia No. 20 of 2003 on the National Education System, education is a conscious and planned effort to create a learning environment in which students actively develop their potential. In the context of 21st-century education, the learning process is no longer oriented solely toward cognitive achievement but also toward students' active engagement, which reflects their abilities in collaboration, communication, and critical thinking.

Mathematics, as an abstract and challenging subject, requires learning strategies that can enhance student engagement in the classroom learning process. Empirically, traditional teacher-centered mathematics instruction often fails to provide adequate opportunities for students to actively interact, discuss, or collaborate to gain a deep understanding of the material. Siregar (2021) found that teacher-centered instruction limits students' opportunities to construct their own knowledge when solving problems and reduces their interaction with classmates. This situation results in low levels of interactive student activity in the classroom, including during group discussions which should serve as the primary vehicle for the collaborative development of mathematical understanding. Nasution et al. (2023) also found that mathematics instruction that does not make optimal use of technology results in low levels of active student participation during lessons. These findings indicate the need for a deeper understanding of the concept of student engagement itself, particularly its underlying dimensions, as a foundation for designing more effective learning strategies.

Student engagement encompasses three interrelated dimensions: behavioral, emotional, and cognitive engagement (Fredricks et al., 2004). Behavioral engagement relates to students' actual participation in learning activities, emotional engagement encompasses affective reactions such as interest and enthusiasm, while cognitive engagement involves students' mental investment in deeply understanding the material. Schlechty (2011) adds that student engagement can also be measured by the extent to which students voluntarily participate in learning activities and the extent to which they devote their attention, energy, and resources to achieving learning objectives. In group discussion-based mathematics learning, these three dimensions serve as important indicators determining the quality of interaction and students' success in collaboratively constructing mathematical understanding, thus requiring a learning model capable of optimally facilitating all three dimensions.

One learning model with the potential to enhance student engagement is the Flipped Classroom. The Flipped Classroom model offers an innovative approach that shifts the delivery of content outside the classroom, allowing face-to-face time to be focused on discussion, collaboration, and problem-solving activities (Bergmann & Sams, 2012). Pramita & Maysarah (2024) demonstrated that the implementation of the Flipped Classroom with 11th-grade high school students in North Sumatra had a significant impact on students' mathematical literacy skills, indicating that this model is effective in improving the quality of mathematics learning at the high school level. In this model, students study the material independently before face-to-face instruction, then use class time for activities that require active engagement. Ramadhani et al. (2022) recommend integrating the Flipped Classroom with cultural contexts and digital technology as an innovative solution to improve the quality of mathematics learning, particularly to foster more meaningful student engagement.

Implementing the flipped classroom requires adequate digital platform support. Google Classroom, as a Learning Management System (LMS), provides features for distributing materials, assigning tasks, and providing comments and feedback that support

students' independent learning outside the classroom (Iftakhar, 2016). Currently, various LMS platforms are available to support online and blended learning, such as Edmodo, Schoology, Canvas, Moodle, Edlink, etc. However, Google Classroom was selected for this study due to its easy and free accessibility, its seamless integration with Google Workspace for Education services (such as Google Docs, Drive, and Meet), its simple and familiar interface for both students and teachers, and its widespread adoption in Indonesian schools, including the research site. Setyaningsih & Hidayat (2025) demonstrate that using Google Classroom as a learning tool has been shown to increase student engagement because it facilitates more flexible interaction and communication between students and teachers. Gobang et al. (2025) add that Google Classroom effectively strengthens learning interactions between students and teachers through easily accessible digital features.

Several previous studies have demonstrated the effectiveness of the Flipped Classroom in educational contexts. Zainuddin & Halili (2016), through a review of research trends on the Flipped Classroom across various disciplines, concluded that this model consistently has a positive impact on student engagement and learning outcomes in diverse educational contexts. Jauhariningsih (2023) also reported that the implementation of the Flipped Classroom model using Google Classroom had a positive effect on the motivation and learning outcomes of high school students, indicating the effectiveness of this model in the context of secondary schools in Indonesia.

Nevertheless, most previous studies have focused more on cognitive learning outcomes, motivation, or specific mathematical skills, rather than on student engagement in group discussions specifically. Studies that specifically examine student engagement in group discussions through the implementation of the Flipped Classroom model supported by Google Classroom in mathematics instruction remain relatively limited, leaving an empirical gap that needs to be addressed. The novelty of this study lies in its integration of the Flipped Classroom model with Google Classroom, specifically designed to measure all three dimensions of student engagement (behavioral, emotional, and cognitive) within the context of group discussions in mathematics instruction, an area that has not been extensively explored in previous research. This study is expected to provide a scientific contribution in the form of empirical evidence on the effectiveness of integrating the Flipped Classroom and Google Classroom in enhancing multidimensional student engagement, as well as serving as a reference for teachers and researchers in designing more interactive and collaborative mathematics learning strategies. Therefore, this study aims to analyze the effectiveness of implementing the Flipped Classroom assisted by Google Classroom in enhancing student engagement in group discussions during mathematics instruction in the 11th grade at SMA Negeri 1 Lubuk Pakam.

2. METHOD

This study employed a quantitative approach using a pre-experimental design in the form of a one-group pretest-posttest design. This design was chosen because the study's objective was exploratory-experimental in nature namely, to determine whether or not there was an increase in student engagement after the intervention was implemented, without having to compare two groups simultaneously. In line with Sugiyono (2022), this design is appropriate when researchers wish to compare pre- and post-intervention conditions within the same group in a measurable and systematic manner.

Table 1. One-Group Pretest-Posttest Design

Initial Observation	Intervention	Final Observation
O_1	X	O_2

Notes:
$\boldsymbol{O_1}$ = Initial observation (Pretest)
$\boldsymbol{X}$ = Implementation of the Flipped Classroom using Google Classroom
$\boldsymbol{O_2}$ = Final observation (Posttest)

The study was conducted at State Senior High School 1 Lubuk Pakam, Deli Serdang Regency, North Sumatra, during the even semester of the 2025/2026 academic year, specifically from April 20 to May 4, 2026. This study encompassed the stages of instrument preparation, treatment implementation, and the collection and analysis of research data. The study population consisted of all 11th-grade students at SMA Negeri 1 Lubuk Pakam for the 2025/2026 academic year. The study sample comprised 30 students from Class XI-B, selected using purposive sampling. The selection of Class XI-B was based on several considerations, namely: (1) the class exhibited initial engagement levels in the moderate category, making it suitable for intervention, (2) the class was deemed representative and aligned with the study's objectives based on recommendations from the mathematics teacher. Sugiyono (2022) states that purposive sampling is an appropriate technique to use when sample selection is based on specific considerations relevant to the research objectives.

The implementation of the Flipped Classroom learning model, supported by Google Classroom, is carried out through five syntactic stages. First, the pre-class stage: the teacher uploads instructional videos, reading materials, and worksheets via Google Classroom for students to study independently before the face-to-face session. Second, the initial learning stage: the teacher conducts an apperception activity, reinforces key concepts, and gives students the opportunity to ask questions about material they do not yet understand. Third, the core activity stage: students discuss in small groups to solve problems, exchange opinions, and develop solutions together under the guidance of the teacher as a facilitator, Google Classroom continues to be used to revisit the material. Fourth, the presentation stage: each group presents the results of their discussion, the teacher provides feedback, and students respond to the results of other groups. Fifth, the closing and reflection stage: the teacher and students jointly summarize the material, and students share their reflections via Google Classroom.

The research instruments consist of a student engagement observation sheet that measures three dimensions based on the framework by Fredricks et al. (2004) namely, behavioral, emotional, and cognitive dimensions with each dimension comprising five indicators and 10 statement items. The second instrument is a student response questionnaire used as supporting data to determine students' perceptions of the implementation of the learning model. Student response questionnaire results were categorized using ideal score criteria based on the ideal mean (Mi) and ideal standard deviation (SDi), referring to Azwar (2012). With 30 statements on a 1-5 scale, the ideal minimum score was 30 and the ideal maximum score was 150, yielding Mi = 90 and SDi = 20. Score categories were determined as follows: scores ≥ 120 were categorized as "very good," $100 \leq$ score < 120 as "good," $80 \leq$ score < 100 as "fair," $60 \leq$ score < 80 as "low," and scores < 60 as "very low". Both instruments underwent a validation process by expert faculty members before being used in the study. Both instruments used a Likert

scale with the student engagement observation sheet consisted of 30 statements rated on a 1-4 scale (1 = very poor, 2 = poor, 3 = good, 4 = very good), resulting in a total observation score ranging from 30 to 120. Meanwhile, the student response questionnaire consisted of 30 statements rated on a 1-5 scale (1 = strongly disagree to 5 = strongly agree), resulting in a total questionnaire score ranging from 30 to 150. This difference in scale range was applied because the observation sheet involves behavioral assessment made directly by an observer, whereas the questionnaire involves students' self-perception, which requires a finer gradation of response. The indicators for the three dimensions measuring student engagement are shown in table 2**.**

Table 2. Indicators for the Observation Sheet and Student Response Questionnaire

Dimensions of Student Engagement	Indicators
Behavioral	Students actively participate in discussions
	Express opinions or ideas
	Respond to classmates' opinions
	Engage in group problem-solving
	Follow group rules and roles
Emotional	Show interest and enthusiasm
	Positive attitude toward discussions
	Confidence in expressing opinions
	Respect for classmates' opinions
	Willingness to cooperate
Cognitive	Expressing opinions with supporting reasons
	Asking relevant questions
	Connecting the material to prior knowledge
	Engaging in problem-solving
	Summarizing the results of the discussion

Data analysis was conducted using descriptive statistics, the N-Gain test, the normality test, and hypothesis testing. The N-Gain values were then interpreted based on Hake's (1999) criteria: an N-Gain value < 0.30 falls into the low category, 0.30 ≤ N-Gain < 0.70 falls into the moderate category, and N-Gain ≥ 0.70 falls into the high category. The normality test was performed on the difference score between final observation and initial observation (d = final observation – initial observation), as this is the data used in the Paired Sample t-Test hypothesis testing. The Shapiro-Wilk normality test was chosen because the sample size in this study was less than 50 (n = 30). According to Razali & Yap (2011), the Shapiro-Wilk test has been shown to be more powerful and sensitive for small samples (n < 50) than the Kolmogorov-Smirnov test, making it more appropriate for this study. Hypothesis testing was conducted using the Paired Sample t-Test with a significance level of $\alpha = 0.05$. The statistical hypotheses tested in this study were formulated as follows, H_0 stated that the implementation of the Flipped Classroom model assisted by Google Classroom is not effective in enhancing student engagement in group discussions, while H_1 stated that the implementation of the Flipped Classroom model assisted by Google Classroom is effective in enhancing student engagement in group discussions. H_0 was rejected if the significance value (p) < 0.05, indicating that H_1 was accepted. All statistical analyses were performed using IBM SPSS Statistics 2022.

3. RESULTS AND DISCUSSION

3.1. Results

Descriptive Statistics for the Pretest and Posttest

Based on the descriptive statistical analysis, the mean score for the initial observation (pretest) was 61.533, with a minimum of 30, a maximum of 85, and a standard deviation of 15.668. The mean score for the final observations (posttest) increased to 105.833, with a minimum of 82, a maximum of 118, and a standard deviation of 10.021, as presented in Table 3. The smaller standard deviation of the final (posttest) observations indicates that the data distribution became more homogeneous after the implementation of the learning model, meaning that the increase in engagement occurred more evenly among all students.

Table 3. Descriptive Statistics for Initial (Pretest) and Final (Posttest) Observations

	N	Min	Max	Mean	Std. Deviation
Pretest	30	30	85	61.533	15.668403
Posttest	30	82	118	105.833	10.020955

Table 4. Descriptive Statistics by Dimension in the Initial Observation (Pretest)

	Dimensions of Student Engagement		
	Behavioral	Emotional	Cognitive
Mean	21.267	19.867	20.4
Standard Deviation	6.017	4.918	5.373
Minimum Value	10	10	10
Maximum Value	30	27	29

Table 5. Descriptive Statistics by Dimension in the Final Observation (Posttest)

	Dimensions of Student Engagement		
	Behavioral	Emotional	Cognitive
Mean	34.967	35.233	34.633
Standard Deviation	4.206	3.081	3.899
Minimum Value	27	27	28
Maximum Value	40	39	40

Analysis based on the dimensions of engagement shows an increase across all dimensions. In the pretest, the average score for the behavioral dimension was 21.267, for the emotional dimension 19.867, and for the cognitive dimension 20.40. After implementing the learning model, the average scores for these three dimensions increased to 34.967 (behavioral), 35.233 (emotional), and 34.633 (cognitive). These findings indicate that the Flipped Classroom assisted by Google Classroom is capable of enhancing student engagement comprehensively not only in terms of physical participation but also in terms of enthusiasm and cognitive engagement.

Results of the Student Response Questionnaire

A student response questionnaire was administered at the end of the study to determine students' perceptions of the implementation of the learning model. The analysis results showed an average questionnaire score of 120.367 with a standard

deviation of 14.192. The minimum score obtained by students was 86, and the maximum was 147. The distribution of student responses based on score categories is presented in table 6**.**

Table 6. Descriptive Statistics of the Student Response Questionnaire

	N	Minimum	Maximum	Mean	Std. Deviation
Questionnaire	30	86	147	120.367	14.192

Table 7. Distribution of Student Response Questionnaire Score Categories

Score	Category	Frequency	Percentage (%)
X > 120	Very Good	15	50,0%
100 < X ≤ 120	Good	14	46,7%
80 < X ≤ 100	Fair	1	3,3%
60 < X ≤ 80	Poor	0	0,0%
X ≤ 60	Very Poor	0	0,0%

Based on the categorization criteria in table 7, 15 students (50.0%) fell into the "very good" category, 14 students (46.7%) fell into the "good" category, and 1 student (3.3%) fell into the "fair" category. No students were categorized as “poor” or “very poor”. These findings indicate that students responded positively to the implementation of the Flipped Classroom assisted by Google Classroom, with the majority (96.7%) demonstrating “good” or “very good” perceptions of the learning model. This high percentage of positive responses indicates that nearly all students responded favorably to the implementation of the Flipped Classroom assisted by Google Classroom and experienced its benefits in the learning process.

N-Gain Test Results

The N-Gain test was conducted to measure the extent of the increase in student engagement between the conditions before and after the implementation of the learning model. The N-Gain calculation results for the 30 students are presented in Table 8 below.

Table 8. N-Gain Calculation Results

	N	Minimum	Maximum	Mean	Std. Deviation
N-Gain	30	0,506	0,956	0,774	0,135

Based on the N-Gain criteria (Hake, 1999), this mean falls into the high category. These results indicate that there was an enhancing in student engagement following the implementation of the Flipped Classroom assisted by Google Classroom. The categorization of N-Gain criteria is shown in table 9**.**

Table 9. N-Gain Categorization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Moderate	8	26,7	26,7	26,7
	High	22	73,3	73,3	100
	Total	30	100	100	

Based on Table 9, 22 students (73.3%) fell into the high improvement category and 8 students (26.7%) into the moderate category. No students fell into the low category.

The high percentage of students in the high improvement category indicates that the implemented learning model was able to produce significant and meaningful changes in student engagement.

Prerequisite Tests and Hypothesis Testing

The normality test using the Shapiro-Wilk test, as shown in Table 10, yielded a significance value of 0.085 > 0.05. Therefore, the difference data (d = final observation – initial observation) are considered to be normally distributed.

Table 10. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Difference	.115	30	.200*	.939	30	.085

The fulfillment of these parametric assumptions justifies the use of the Paired Sample t-Test as a hypothesis testing tool. The results of the hypothesis test are presented in table 10**.**

Table 11. Paired-Sample t-Test

Paired Differences					t	df	Sig. (2-tailed)
Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
			Lower	Upper			
-44,3	10,793	1,97	-48,33	-40,269	-22,481	29	0,000

Based on Table 11, the Paired-Sample t-Test yielded a calculated t-value of 22.481 with 29 degrees of freedom and a significance level (Sig., 2-tailed) of 0.000 < 0.05. The calculated t-value (22.481) also exceeds the critical t-value (2.045), so H_0 is rejected and H_1 is accepted. Thus, there is a significant difference in student engagement before and after the implementation of the Google Classroom-assisted Flipped Classroom learning model in mathematics instruction in Class XI-B at SMA Negeri 1 Lubuk Pakam

3.2. Discussion

The results of this study consistently show that the Flipped Classroom assisted by Google Classroom, is effective in enhancing student engagement in group discussions during mathematics instruction. These findings align with the research by Agustini (2021), who found that the combination of the Flipped Classroom and Google Classroom can enhance students' overall learning activities, including their engagement in discussions and the completion of collaborative tasks. Fauzan et al. (2021) also confirmed that integrating the Flipped Classroom with Google Classroom creates a more active, creative, and student-centered learning environment. Lo & Hew (2021), through a systematic review of mathematics journal articles from 2011 to 2020, also confirmed that the Flipped Classroom consistently enhances all three dimensions of student engagement in mathematics learning compared to traditional instruction.

The improvements observed across all dimensions of engagement behavioral, emotional, and cognitive reflect the intervention's success in bringing about comprehensive change. In the behavioral dimension, students who prepared via Google Classroom before class tended to be more active in expressing their opinions and

contributing to discussions. In the emotional dimension, with the highest average final observation score (35.233), students demonstrated greater enthusiasm and self-confidence during discussions. Yusuf (2025) also confirms that the Flipped Classroom significantly increases students' enthusiasm and sense of responsibility for their learning. On the cognitive dimension, students became more active in asking questions, presenting mathematical arguments, and engaging in in-depth problem-solving a finding consistent with Ramadhani's (2021) research, which shows that students' active engagement in discussions is directly proportional to their mathematical communication skills.

The average N-Gain value of 0.774, which falls into the high category, indicates that the increase in student engagement is not only statistically significant but also pedagogically meaningful. This finding aligns with the conclusion by Fianingrum et al. (2022), who stated that the Flipped Classroom contributes to students' learning autonomy and mathematical literacy. Faro et al. (2024) also found in the context of higher education that the Flipped Classroom significantly enhances all three dimensions of student engagement using a research design that integrates quantitative and qualitative data, thereby providing a strong foundation for generalizing the findings.

The finding that 96.7% of students rated their experience as either "very good" (50.0%) or "good" (46.7%), with only 3.3% in the "fair" category, reinforces the conclusion that this model is well-received by students as a meaningful learning experience. Suaidah & Pasaribu (2022) demonstrated that learning utilizing interactive digital media promotes increased communication and active student participation. Taufik et al. (2021) demonstrated that the features available in Google Classroom effectively promote student engagement because they provide opportunities for active participation through structured digital discussions and interactions.

The success of this study was also due to several supportive contextual factors. First, the characteristics of the students in Class XI-B as a generation accustomed to using digital technology facilitated the adoption of Google Classroom without significant technical obstacles. Second, the learning cycle design which combines independent learning outside the classroom with structured discussions in class created a mutually reinforcing learning ecosystem. Sulistiowati et al. (2025) emphasize that student readiness, technological accessibility, and the quality of teachers' strategies are determining factors in the effectiveness of the Flipped Classroom, all of which were met in the context of this study.

The main contribution of this study lies in expanding the empirical evidence that the effectiveness of the Flipped Classroom is not limited to cognitive aspects but also encompasses affective and social aspects through students' active engagement in mathematics group discussions. This shift in focus provides evidence that the success of the Flipped Classroom can be assessed not only by learning outcomes but also by the quality of student interaction and participation throughout the learning process. These findings align with the objectives of the Merdeka Curriculum, which emphasizes collaboration, communication, and critical thinking as essential 21st-century skills that must be developed in mathematics education.

4. CONCLUSION

This study shows that the implementation of the Flipped Classroom assisted by Google Classroom, is effective in enhancing student engagement in group discussions during mathematics lessons in Class XI-B at SMA Negeri 1 Lubuk Pakam. The enhancing in engagement was evident in behavioral, emotional, and cognitive dimensions,

indicating that students became more active participants, more enthusiastic about the learning process, and more engaged in mathematical thinking and problem-solving. These findings suggest that the integration of the Flipped Classroom and Google Classroom can serve as an alternative learning approach that fosters a more active, collaborative, and student-centered learning environment. Therefore, mathematics teachers can utilize this learning model to encourage student engagement in group discussion activities, while further research is recommended to test its application across a wider variety of subject matter, educational levels, and research designs to obtain a broader picture of its effectiveness.

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