

The Implementation of Flipped Classroom Model with Self-regulated Learning (SRL) on Learning Results for Studying Physics Material

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Abstract:

The Flipped Classroom is a variation of the learning model that can be given to students. This experiment describes the impact of providing a Flipped Classroom model with a Self Regulated Learning (SRL) strategy on students' learning outcomes. This research uses a quasi-experiment type with a one-group pre-test and post-test design. The sample was selected using a random sampling technique. This experiment details that applying the Flipped Classroom model with the SRL strategy has an impact on improving learning outcomes. The research results found that the average score for studying Physics Material on the pre-test was 53.00, while it increased to 76.50 on the post-test. This comparison is descriptively shown by a significant increase in understanding of the material after implementing this learning model. This study uses a paired sample t-test, and it was found that there was a significant increase in learning outcomes in the Study of Physics Material. These findings confirm that applying the Flipped Classroom model with the SRL strategy quantitatively improves learning outcomes in the Study of Physics Material and creates interactive learning. Active involvement of students in the learning process has an impact on increasing cognitive abilities, according to Bloom's Taxonomy (revised edition). Studying Physics material using the Flipped Classroom with the SRL strategy can improve learning outcomes and create more effective and interactive learning experiences.

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Introduction

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Generation z is very close to technology and, at the tertiary level, is required to prepare themselves to enter the world of work (Fridayani et al., 2022). Educators are required to be able to face the characteristics of Generation Z by mastering aspects of technological knowledge in addition to having to have PCK (Pedagogical Content Knowledge) or what is known as TPACK (Technological Pedagogical Content Knowledge) (Latip et al., 2023). The use of technology is a basis that educators need to pay attention to now, but technology is only part of it. Technology is a tool used in teaching and learning to create meaningful experiences and make students more independent and active in learning (Meliani et al., 2022). The flipped classroom concept can create meaningful experiences and active learning.

Flipped Classroom includes an innovative learning approach that focuses on students by flipping traditional classroom learning (Darmawati, 2022). Flipped Classroom learning is preferred by students and lecturers in several aspects, and learning outcomes are significantly higher than traditional learning (Hoshang et al., 2021). Educators carry out flipped Classroom learning by maximizing offline and online interaction offline and online interaction and minimizing direct instruction. The flipped classroom model has many benefits, such as students being more independent, creative, critical in dealing with problems, and open to new knowledge, leading to positive opinions (Tresnawati et al., 2022). This is because the Flipped Classroom can improve learning outcomes and can adapt to educational developments (Baig & Yadegaridehkordi, 2023).

Educators must carefully determine learning models to motivate students to learn and not feel bored with monotonous or frequently used models. Student boredom can reduce their Self Regulated Learning (Luo & Wang, 2023). Self-regulated learning is the level at which students are independent, set learning targets, manage themselves in learning, actively regulate and motivate themselves towards tasks, and manage a conducive atmosphere, which has an impact on good behavior (Putra et al., 2020) and meta-cognitive abilities.

Students must be able to control themselves to achieve success during the learning process. Self-regulated learning (SRL) is the process of students controlling their logical thinking, emotions, and actions to achieve success in the learning process (Brenner, 2022). Self-regulated learning (SRL) is a process that needs to be built by students who actively try, observe, motivate, and regulate their actions. This process is limited to the learning objectives that have been set and the surrounding environmental situation. In SRL, students, apart from playing a role in receiving information, also play an active role in managing their learning (Tsusayya et al., 2023). So SRL is a process where students are independent, control themselves in learning, manage a conducive learning environment, and actively motivate and organize themselves with various tasks and determining learning goals.

Learning strategies describe how students' metacognition, will, and motivation are demonstrated in real action. Learning strategies can describe how SRL students have. Students with learning strategies will achieve maximum learning outcomes (Shafrinia & Fitriana, 2023). According to several studies, maximum learning outcomes can be obtained effectively with SRL strategies, especially in understanding principles, concepts, facts, and procedures (Tarumasely, 2020). SRL strategies are

related to learning success because students become independent ([Supriyadi et al., 2022](#)). SRL, or Self-Regulation Strategy, refers to the planning that students manage and organize to achieve learning goals. 10 SRL strategies involve 1) evaluating tasks independently; 2) organizing and managing learning materials; 3) planning and setting learning objectives; 4) searching for related information; 5) making notes of important things; 6) creating a conducive learning atmosphere; 7) anticipate consequences after completing the task; 8) practice and memorize; 9) seek help; and 10) reviewing notes/lesson materials ([Zimmerman, 2002](#)).

Studying high school physics material is a course that discusses physics in high school/MA. Essential Competencies (KD) in the SMA/MA Physics curriculum cover various aspects of Physics lessons that need to be studied to deepen students' physics concepts and reduce misconceptions. This prepares students for Field Learning Practices (PPL) and as prospective teachers. If we examine this high school/MA physics material, 14 meetings will be needed; therefore, blended learning, namely the flipped classroom, is needed to maximize learning time. In the flipped classroom model, students are provided with resources to learn the theoretical aspects of the subject at home, allowing them to apply SRL strategies such as independent evaluation, planning, setting objectives, and seeking help in the classroom. This maximizes learning time and fosters a more interactive and engaging learning environment.

In the flipped classroom, information is delivered online or offline via WAG/Google Classroom/zoom/face-to-face in class or through voice messages, videos, or short presentations. In each presentation of information, researchers always relate daily life to related concepts. Interactive learning in the classroom is implemented to increase interaction, student activity, and deeper learning. Implementing the flipped classroom model can increase this interaction. Apart from student involvement, the flipped classroom can also develop active learning and podcasting ([Jaya, 2023](#)). Based on this explanation, the researcher finally decided to analyze the effect of implementing the flipped classroom model with the Self Regulated Learning (SRL) strategy, which refers to learning outcomes. The research was conducted for students taking the SMA/MA Physics Material Study.

Research Method

The research was chosen using the Quasi Experiment type ([John W. Creswell, 2017](#)). The research was designed with a one-group pre-test and post-test design. In this design, one experimental group receives a specific treatment. This research involved a pre-test and post-test before and after treatment to measure its impact. Essay tests are used to evaluate students' cognitive learning outcomes. The pretest is carried out before treatment or intervention, while the posttest is carried out after treatment. Therefore, this research was designed to observe differences in learning outcomes before and after implementing treatment in one experimental group.

The research was carried out in the Physics Material Study course in the Physics Education study program at UIN Sunan Kalijaga Yogyakarta. The research took place during the even semester of the 2023/2024 academic year with 46 students. The sample was selected using a random sampling technique and consisted of 20 students.

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The first research instrument is a measurement instrument in the form of cognitive learning outcome test questions starting from level C1 (remembering) to C6 (Creating), carried out through pre-tests and post-tests. The second instrument is the RPS, which contains the Flipped Classroom model with SRL strategies. There are various methods and steps for teaching and learning activities, starting from meetings 1-14. The third instrument is the LKPD, which contains material and steps for student learning activities. The data collected was obtained from distributing cognitive learning results questions.

The research instrument underwent a rigorous validation process, initially by two expert validators, to ensure its validity. After necessary revisions, the instrument was deemed suitable for the research. The essay test questions were also subjected to tests for validity, reliability, and difficulty, with the results confirming their validity and reliability.

Data analysis involved the mean value data from the pre-test and post-test, followed by a paired sample t-test. However, before this, a normality test (as a prerequisite) was conducted using the Shapiro-Wilk test. This test aimed to ensure that the data used in the t-analysis could be assumed to be data originating from a normal distribution. Analysis of this data will explain how the Flipped Classroom model with the Self Regulated Learning (SRL) strategy impacts student cognitive learning outcomes at the higher-order thinking Skills (HOTs) level. The value of the paired samples t-test will help measure the significance of the difference between the pretest and posttest in the context of this research.

Results and Discussion

Pre-test questions are given to measure/analyze students' initial abilities. Then, students are given treatment using the Flipped Classroom model with the SRL strategy. After the learning, students are given post-test questions to determine any changes after the learning treatment. Based on data analysis (with SPSS), the scores between pre-test and post-test are obtained as in Table 1.

Table 1. Paired Sample Statistical Results

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test	53.00	20	10.183	2.277
	Post-test	76.50	20	6.304	1.410

Based on the results in Table 1, it is known that the average pre-test learning outcome score is 53.00 < post-test 76.50. This can be seen descriptively by the fact that there is a significant difference between the pre-test and post-test in the average learning outcome scores. Then, to show whether these differences are significant, they must be analyzed based on Table 2 below.

Table 2. Results of Paired Sample Relationships

		N	Correlation	Sig.
Pair 1	Pre-test & Post-test	20	.295	.206

Table 2 shows the correlation results between two paired samples: pre-test and post-test. Based on the table, the correlation value is obtained, namely 0.295, and the

significance value, namely $0.206 >$ probability value, namely 0.05 . So, there is no correlation/relationship between the pre-test and post-test.

The impact of implementing the Flipped Classroom model with the SRL strategy on learning outcomes is analyzed in Table 3. The significance value (2-tailed) is $0.000 < 0.05$, leading to the rejection of H_0 and acceptance of H_a . This means there is an average difference of 23.5 in learning outcomes between the pre-test and post-test due to the impact of the Flipped Classroom model with the SRL strategy.

Tabel 3. Paired Sample Test Results

		Paired Differences					t	df	Sig. (2-tailed)
		Mean/ Rerata	Standar Deviasi	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-23.500	10.273	2.297	-28.308	-18.692	-10.231	19	.000

The flipped classroom is a form of Blended learning (Sonia, 2022). Blended learning is effective in the 21st century (Puspitarini, 2022). Blended learning is learning with face-to-face interaction in class and online. A flipped classroom combines synchronous and asynchronous learning (Suardipa et al., 2022). Synchronous learning is offline learning in the classroom in real-time, where students and educators interact with each other and receive direct feedback. Asynchronous learning is independent learning outside of class, where material can be obtained through media on digital platforms. Students can study material or ask questions through the digital platform but need direct feedback (Sunarto et al., 2023).

In this research, students received material in the form of e-books/files/videos which were shared via Whatsapp Group. They are also given a Semester Learning Plan (RPS) and a college contract so they know what they will study at meetings 1-14. Face-to-face learning is carried out according to the lecture schedule and online learning is carried out before and after lectures with flexible times during one semester. The concept of implementing learning activities used by the researchers in Flipped Classroom learning is as shown in Figure 1 below, demonstrating the practical application of these methods (Wulandari, 2020b).

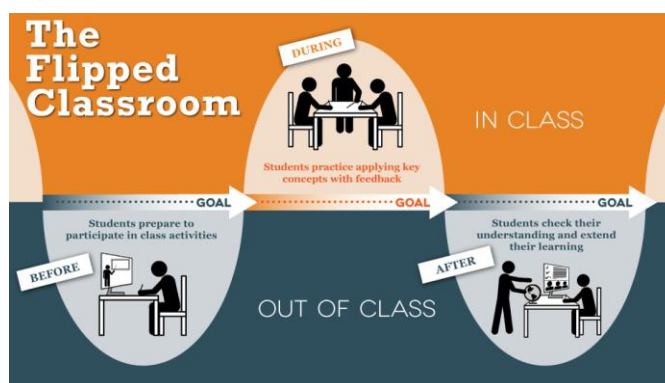


Figure 1. Concept for Implementing the Flipped Classroom Model

In independent learning, students must have a strategy to achieve learning objectives and maximize learning outcomes. Independent learning can also improve

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skills in a series of learning activity processes (Oishi, 2020). Self Regulated Learning (SRL) is the strategy for learning independently. SRL significantly impacts students, such as students who can get to know themselves, socialize with the environment, feel more confident, organize their learning strategies, and have increased motivation (Ayu & Meutia, 2020).

Researchers apply the Flipped Classroom model with the SRL strategy with the hope that student learning outcomes can be maximized and learning outside the classroom can run well. The implementation of the Flipped Classroom learning model with the SRL strategy in this research was carried out in stages as shown in Table 4 below, and the results showed a significant improvement in student engagement and understanding of the material.

Table 4. Flipped Classroom Model with SRL Strategy

No.	<i>Flipped Classroom Model</i>	SRL Strategy	Indicator
1.	Before Class starts (outside of class)	Planning	<ul style="list-style-type: none"> ➤ Determining goals ➤ Determining learning strategy ➤ Controlling yourself in preparation for studying ➤ An obligation to pass the course
2.	During class (in class)	Performance	<ul style="list-style-type: none"> ➤ Carrying out learning activities ➤ Controlling over emotions and motivation ➤ Applying cognitive and metacognitive strategies
3.	After class ends (outside of class)	Self Reflection	<ul style="list-style-type: none"> ➤ Self-evaluation of learning outcomes ➤ Determining strategies to overcome failure

In the flipped classroom approach, educators ensure that students learn the material before class starts. In this step, it is hoped that students will be able to remember and understand the material discussed in class. This principle allows the class to focus more on analysis activities and the application of the material. Students must apply their knowledge in various in-depth learning activities during class. Discussions, group projects, or case studies may be part of the learning strategies. The goal is to ensure that students understand the concepts and can apply them in relevant contexts.

After class ends, students are not just passive recipients of knowledge. They are expected to evaluate their understanding and complete the assignments given. At this stage, they play an active role in creating deeper understanding through applying concepts in real situations or through creative tasks. In the flipped classroom approach, learning is not confined to class hours. It involves students in the entire learning cycle, starting from pre-class, during class, to post-class. This comprehensive approach creates a holistic learning experience and encourages their active involvement in the learning process.

So, learning activities in the Flipped Classroom model are related to Bloom's Taxonomy in the realm of cognitive abilities, starting from C1 (remembering) to C6 (Creating). The relationship between Flipped Classroom and Bloom's Taxonomy is depicted in Figure 2 below (Wulandari, 2020a).

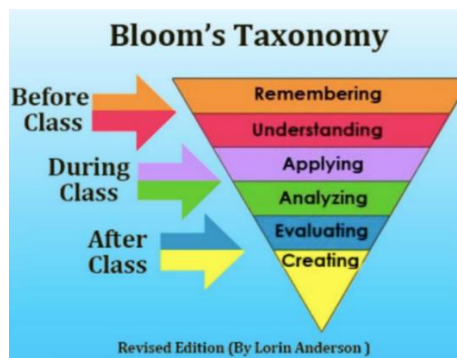


Figure 2. The relationship between the Flipped Classroom Model and Bloom's Taxonomy

According to Benjamin S. Bloom, learning outcomes can be grouped into three types, namely cognitive/knowledge, affective/attitude, and psychomotor (Mahmudi et al., 2022) revised Bloom's Taxonomy in cognitive groups starting from the ability to remember (C1) to create (C6) (Nafiati, 2021). Based on research results, flipped classroom learning can encourage students to develop abilities in this cognitive domain. Flipped Classroom learning impacts cognitive learning outcomes based on the revised Bloom's Taxonomy. Apart from that, Flipped Classroom learning also has a positive impact on learning motivation (Zheng et al., 2020), student satisfaction (Låg, 2019), positive evaluation (Colomo-magaña et al., 2020), and increasing independence and social skills (Jdaitawi, 2019).

External and internal factors impact students' learning outcomes. An example of an external factor is the application of a learning model. Meanwhile, internal factors are closely related to students' abilities. Students can organize themselves to learn, one of which is influenced by SRL (Arsyad et al., 2022). Based on the results of learning with SRL, students can manage their own time, change their learning environment, situation, and conditions, increase their knowledge insight from various learning sources, and become more independent and not dependent on studying with educators in the class.

Learning outcomes are hoped to be maximized if external and internal factors are maximized. So, in this research, these two factors were applied. Based on the results of this research, it was found that interaction between educators and students increased, and they became more active in asking questions in class, especially regarding material they did not understand. Apart from that, they are competent in understanding the material, analyzing the questions, applying the material to the questions, and solving problems. This is also closely related to learning outcomes in the post-test average score, namely 76.50. If concluded, there is an increase in cognitive learning outcomes.

Cognitive learning outcomes that can be improved and optimized are in the C1 (Remembering) - C5 (Evaluating) domain, while C6 (Creating) is still less than optimal. Level C6 (Creating) is where students process and combine the information obtained to formulate theories or equations into a structure that performs a specific function. Usually, C6-level questions are identical to Olympic questions. Student's difficulties in solving problems are due to several factors. Namely, students have not mastered the material well, are not able to apply the material in everyday life

(Purwanti, 2020), and have not practiced enough HOT questions (Nurwahidah et al., 2019).

Conclusion

Based on the research results, it can be concluded that applying the Flipped Classroom model with the SRL strategy impacts cognitive learning outcomes. The mean difference between the pre-test and post-test is 23.5, where the pre-test mean is $53.00 < \text{post-test } 76.50$. This shows that the impact of the Flipped Classroom model with the SRL strategy is efficacious in improving student learning outcomes, which is reflected in the increase in the average value of cognitive learning outcomes. Applying the Flipped Classroom model with the SRL strategy can create a self-regulating experience related to learning strategies, linking concepts to everyday life, deepening the material, and increasing activeness during the learning process. The Flipped Classroom model with the SRL strategy is suitable for optimizing limited time in class and training students to manage their time well.

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