

ASSESSING THE IMPACT OF FLIPPED CLASSROOM ON MATH COMPREHENSION IN PRIMARY SCHOOL STUDENTS

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Abstract

This study aims to evaluate the effectiveness of the Flipped Classroom learning model in improving the understanding of mathematical concepts in elementary school students. Using a quasi-experimental design with a pre-test and post-test nonequivalent control group design, data were collected from 50 sixth graders of an elementary school. The Flipped Classroom model is compared to conventional teaching methods, with students' understanding of mathematical concepts as dependent variables. Results showed significant improvements in both groups, signaling the positive impact of both teaching methods on student understanding. However, no significant differences were observed between the two methods. The study emphasizes the importance of considering a variety of factors, including technology skills, parental support, and cultural context, in choosing the right teaching method. While the Flipped Classroom offers an innovative approach, conventional methods remain relevant in specific contexts. Recommendations for future research include the use of larger samples and considering additional factors that affect learning outcomes. Overall, the research contributes to an understanding of effective teaching practices in basic mathematics education, providing valuable insights for educators and policymakers.

Kata Kunci: flipped classroom learning; understanding math concepts; elementary school.

Abstrak

Penelitian ini bertujuan untuk mengevaluasi efektivitas model pembelajaran Flipped Classroom dalam meningkatkan pemahaman konsep matematika pada siswa sekolah dasar. Menggunakan desain kuasi-eksperimental dengan pre-test post-test nonequivalent control group design, data dikumpulkan dari 50 siswa kelas enam sebuah sekolah dasar. Model Flipped Classroom dibandingkan dengan metode pengajaran konvensional, dengan pemahaman konsep matematika siswa sebagai variabel terikat. Hasil menunjukkan peningkatan yang signifikan pada kedua kelompok, menandakan dampak positif dari kedua metode pengajaran terhadap pemahaman siswa. Namun, tidak ada perbedaan signifikan yang diamati antara kedua metode tersebut. Studi ini menekankan pentingnya mempertimbangkan berbagai faktor, termasuk keterampilan teknologi, dukungan orang tua, dan konteks budaya, dalam memilih metode pengajaran yang tepat. Sementara Flipped Classroom menawarkan pendekatan inovatif, metode konvensional tetap relevan dalam konteks tertentu. Rekomendasi untuk penelitian mendatang termasuk penggunaan sampel yang lebih besar dan mempertimbangkan faktor tambahan yang memengaruhi hasil pembelajaran. Secara keseluruhan, penelitian ini berkontribusi pada pemahaman praktik pengajaran yang efektif dalam pendidikan matematika dasar, memberikan wawasan berharga bagi pendidik dan pembuat kebijakan.

Kata Kunci: pembelajaran flipped classroom; pemahaman konsep matematika; sekolah dasar.

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Introduction

Mathematics education at the primary school level has an undeniable role in forming a strong foundation for the understanding of more complex mathematical concepts at higher levels (R. Amelia et al., 2022). It is important for mathematics education at the primary school level to provide a supportive learning environment, as well as an effective teaching approach to

help students gain a solid understanding of the basic concepts of mathematics (Atiaturrahmaniah et al., 2022) With this strong foundation, students will be better prepared to explore and understand more complex mathematical concepts in the future, which is important for their ability to face academic challenges and the professionals they will face (Nur & Nugraha, 2023) (W. Amelia et al., 2022) Therefore, it is important to ensure that students have a solid understanding of mathematical concepts from an early age so that they can become competent learners and face future challenges (Ginanjari, 2019)

Although the importance of understanding mathematical concepts has been widely recognized, there are still significant problems in achieving this goal in the primary school environment. One of the main problems faced is the low level of understanding among students of the mathematical concepts taught (Suendarti & Liberna, 2021). Factors such as improper curriculum, ineffective teaching methods, and lack of educational resources can also be challenging. Comprehensive efforts from various parties, including schools, teachers, parents, and other related parties, are needed to overcome these problems by implementing innovative teaching strategies, ongoing teacher training, and emotional and psychological support for students (Efendi & Sholeh, 2023) This is important to create a learning environment that supports and stimulates positive mathematical development for all students. Many students have difficulty understanding mathematical concepts in depth, which can hinder their ability to apply those concepts in different contexts or to solve problems related to mathematics in real life (Laswadi, 2023)

The level of interest in learning mathematics is also an issue that needs attention. For some students, mathematics may seem difficult or boring, which can result in them losing interest in learning this subject (Laswadi, 2021) Lack of interest in learning can hinder students' motivation to invest the time and effort required to understand mathematical concepts well (Aisyah, 2023) Therefore, it is important to find a learning approach that can increase students' interest and motivate them to learn mathematics more actively and effectively.

In addition, with the development of technology and educational advancements, the emergence of various new learning models offers the potential to improve the understanding of mathematical concepts in elementary school students (Nur & Nugraha, 2023) One of the increasingly popular learning models is the Flipped Classroom, where students learn material independently outside the classroom through videos or online materials, while the time in class is used for discussion, collaboration, and application of concepts in deeper activities (Rahman, 2022)). Flipped Classroom offers a different approach to learning, allowing students to access learning materials independently at home, while providing opportunities to deepen their understanding through direct interaction with teachers and classmates in the classroom (Wiarsihi et al., 2021) By using class time for discussion, collaboration, and application of concepts in deeper contexts, this model can increase student engagement and facilitate more active and student-oriented learning (Syafi'i, 2023) It can also allow teachers to provide individualized assistance to students who need more support in understanding the material. Thus, Flipped Classroom offers the potential to improve learning effectiveness and student academic outcomes (Mujiono, 2021) Although this learning model is promising, it is not yet clear to what extent it is effective in improving the understanding of mathematical concepts in elementary school students. Therefore, this study aims to evaluate the effectiveness of the Flipped Classroom learning model in improving the understanding of mathematical concepts at the elementary school level. Thus, this research is expected to provide valuable insights for education

practitioners in their efforts to improve the quality of mathematics learning in elementary schools.

The study of mathematics education has been the focus of extensive research over the past few decades. Several previous studies have made valuable contributions to understanding learning strategies that are effective in improving the understanding of mathematical concepts in elementary school students. Previous research has identified various effective learning strategies, such as Cooperative Learning, Inquiry-Based Learning, and other learning models, which have been shown to improve the understanding of mathematical concepts in elementary school students (Widiya & Radia, 2023). However, there are still many challenges and areas that need to be explored further to improve mathematics learning at this level. Current studies continue to explore the potential of new learning models, the integration of technology in mathematics learning, and the psychological and social factors that influence student understanding and achievement in mathematics. Thus, these studies become an important foundation for the development of more effective and inclusive mathematics education in the future. For example, research by Smith et al. (2019) highlights the importance of applying active learning models in mathematics learning and found that models such as Cooperative Learning and Inquiry-Based Learning can improve the understanding of mathematical concepts in students (Indah & Nuraeni, 2021).

Previous research has provided valuable insights into the effectiveness of the Flipped Classroom learning model in the context of primary school mathematics education. Fatmiyati and Juandi (2023) conducted a study evaluating the impact of the Flipped Classroom model on the understanding of mathematical concepts in elementary school students (Fatmiyati & Juandi, 2023). Their findings show a significant improvement in the understanding of the material compared to conventional methods. A meta-analysis by Edy Nurtamam (2023) also concluded that the Flipped Classroom approach consistently improves the math achievement of elementary school students (Edy Nurtamam et al., 2023). In addition, Simanjuntak (2021) conducted a study that highlighted that Flipped Learning positively affects students' mathematics performance (Simanjuntak et al., 2021). A case study by Nurkhasanah (2021) shows that the application of Flipped Classroom can increase student engagement and their understanding of mathematical concepts (Nurkhasanah, 2021). Finally, Ashari and Basuki (2021) conducted a meta-analysis that highlighted the influence of Flipped Classrooms not only on students' math achievement but also on their attitudes towards mathematics learning (Ashari & Basuki, 2021). As such, this past research provides strong support for further exploring the effectiveness of the Flipped Classroom in improving primary school students' mathematical comprehension.

Although previous research has provided valuable insights into learning strategies that can improve the understanding of mathematical concepts in elementary school students, there is still a research void in evaluating the effectiveness of flipped classroom learning models in this context. Flipped classrooms provide an approach that allows personalization of learning (Kristanto, 2020), increases student engagement (Maemunah, 2019), allows the application of concepts in real contexts (Clarisa et al., 2020), and provides more immediate feedback, making it an effective solution in improving the understanding of mathematical concepts in elementary school students (Imawati et al., 2022).

This study aims to provide empirical evidence that can provide a better understanding of the extent to which this learning model can be an effective alternative in the context of mathematics learning at the primary school level. This research is expected to make a significant

contribution to understanding the effectiveness of the Flipped Classroom learning model in improving the understanding of mathematical concepts in elementary school students.

Research Methods

The study used a quasi-experimental design with a pre-test post-test nonequivalent control group design. In this study, data were collected before and after the intervention without randomization in the assignment of subjects to experimental and control groups. The population of this study was students of SD Negeri Girikulon with a sample of 50 grade 6 students who were randomly selected to be part of the experimental group and control group. The independent variable in this study is the Flipped Classroom learning model vs. conventional methods, while the dependent variable is students' understanding of mathematical concepts. The research instruments used include tests of understanding mathematical concepts before and after the intervention, as well as classroom observation to pay attention to interactions between teachers and students during the learning process.

The research procedure begins with an initial test to assess students' initial understanding of mathematical concepts before the intervention. Then, the intervention is carried out using the selected learning model, which can include the application of Flipped Classroom or conventional methods. After the intervention, a final test is conducted to assess the student's final understanding of mathematical concepts. Data from the initial test and the final test were analyzed using appropriate statistical methods to evaluate the differences between the two measurements and determine the effectiveness of the applied learning model.

This research was conducted by observing the principles of research ethics and obtaining permission from the authorized agency before starting the research.

Results and Discussion

Table 1. Table of Research Results using Quasi-Experimental Design with Pre-test Post-test Nonequivalent Control Group Design.

Group	Before the Intervention	After the Intervention	Difference
Experiment	75	82	7
Control	72	78	6

Table 1 presents data on students' average scores in understanding mathematical concepts before and after the intervention, as well as the difference in scores between the two measurement times for both groups in the study. It provides a direct picture of the impact of the intervention on the understanding of mathematical concepts in students in both groups, as well as allowing comparisons between experimental and control groups.

Table 2. Table of Independent and Dependent Variables in Research.

Independent Variables	Learning Model
Experimental Group	Flipped Classroom
Control Group	Conventional Method
Variable Dependencies	Understanding of Students' Mathematical Concepts

Table 2 illustrates how the Flipped Classroom learning model and Conventional Method were used as independent variables, while students' understanding of mathematical concepts was used as dependent variables in this study.

Table 3. Research Instrument Table.

Research Instruments	Description
Test of comprehension of mathematical concepts before intervention	A written test that measures students' understanding of mathematical concepts before the intervention.
Test of comprehension of mathematical concepts after intervention	A written test that measures students' understanding of mathematical concepts after the intervention.
Class Observation	Direct observation by researchers to observe the interaction between teachers and students during the learning process

Table 3 provides an overview of the research instruments used in the study, including tests of understanding mathematical concepts before and after the intervention, as well as classroom observations to observe interactions between teachers and students during the learning process.

Table 4. Class Observation Table.

Waktu	Aktivitas	Interaksi Guru-Siswa
08:00 - 08:10	Preheating	The teacher begins the lesson with open-ended questions that stimulate students' thinking. Students actively participate and share their ideas with the teacher.
08:10 - 08:30	Concept explanation	Teachers use learning videos to explain math concepts clearly. Students listen attentively and follow directions well.
08:30 - 08:50	Group discussions	Students work in small groups to apply the concepts learned in real problems. Teachers supervise and provide guidance when needed, encouraging collaboration among students.
08:50 - 09:00	Cover	The teacher summarizes today's learning and gives positive feedback to the students. Students seem motivated and eager to continue learning.

Table 4 reflects the interaction between teachers and students during various learning activities, from the initial warm-up to the conclusion of the lesson. These classroom observations provide a deeper understanding of how the Flipped Classroom learning model is applied in the context of elementary school math learning, and how those interactions affect students' learning experiences.

Table 5. Research Procedure Table.

Research Steps	Description
Initial Test	Provide tests of understanding mathematical concepts to all participants before the intervention is carried out
Interviews	Provide learning with appropriate models to experimental and control groups.
Final Test	Provide tests of understanding mathematical concepts to all participants after the intervention is carried out.

Data Analysis	Analyze the collected data using appropriate statistical methods to test the differences in understanding of mathematical concepts between the two groups.
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Table 5 provides an overview of the steps taken in the study, ranging from initial tests to assess initial understanding of mathematical concepts, interventions with appropriate learning models, final tests to assess understanding after intervention, and data analysis to test differences between the two groups. It was emphasized that this research was carried out by taking into account the principles of research ethics and having obtained permission from the competent authority before starting the research.

The results showed that both groups, the experimental group who received learning with the Flipped Classroom model and the control group who received learning with conventional methods, experienced a significant improvement in the understanding of mathematical concepts after the intervention. Analysis of the data showed that there was no significant difference between the two groups in improved understanding of mathematical concepts.

These results provide insight into the effectiveness of the Flipped Classroom learning model in the context of mathematics education in elementary schools. Although there were no significant differences compared to conventional methods in this study, Flipped Classroom remains a valuable learning option to consider in curriculum development and mathematics teaching practice. Classroom observations highlight the important role of teachers in supporting the learning process and implementation of learning models. Continuous evaluation of learning practices is also key to improving student learning outcomes in the future (Rambung et al., 2023). Taking these findings into account, the study provides valuable insights for education practitioners in the development of effective and relevant learning strategies to meet student needs.

In discussing the results of this study, it is important to evaluate the findings that have been revealed thoroughly. The results showed that both the experimental group that received learning with the Flipped Classroom model and the control group that received learning with conventional methods experienced a significant increase in the understanding of mathematical concepts after the intervention. Although there was no significant difference between the two groups in the improvement, it showed that both learning models had a positive impact on improving the understanding of mathematical concepts in elementary school students.

However, although the Flipped Classroom does not show significant advantages compared to conventional methods in this study (Cevikbas & Kaiser, 2022) this learning model remains a valuable alternative to consider in curriculum development and mathematics teaching practice. The study had some limitations, including limited sample size and individual variability in students' abilities, so these findings need to be carefully considered in a broader context (Lu et al., 2023).

Flipped Classroom is a pedagogical approach where direct teaching moves from group learning spaces to individual learning spaces, and the resulting group space is transformed into a dynamic and interactive learning environment where educators guide students as they apply concepts and engage creatively in the subject matter (Laupichler et al., 2022).

The practical implication of this research is the need to consider various factors in choosing the learning model that best suits student needs and the learning context (Septianti & Afiani, 2020). Recommendations for follow-up research include conducting research with larger sample sizes and paying attention to other factors that might influence learning outcomes, such

as student motivation, learning styles, and parental involvement. Overall, the results of this study provide valuable insights into the effectiveness of learning models in improving the understanding of mathematical concepts in primary school students, as well as highlighting the importance of further research development to gain a deeper and holistic understanding.

In discussing the results of this study, it is important to consider relevant findings from related literature studies. Previous studies have shown that the flipped classroom learning model can improve student engagement and their learning outcomes in math. However, the success of this model is also influenced by factors such as students' level of technological skills and parental support. In addition, research highlights the importance of considering students' social and cultural context in choosing appropriate learning models. This shows that conventional learning methods are still relevant in some contexts, especially when considering aspects of students' culture and environment (Putra & Pratama, 2023). Thus, the integration of findings from this literature study enriches the discussion of research results and emphasizes complexity in choosing the right learning model.

Conclusion

Based on the results of research and related discussions, it can be concluded that both learning models, Flipped Classroom and conventional methods, have a significant impact on improving the understanding of mathematical concepts in elementary school students. While there are no significant differences between the two models in improving understanding of mathematical concepts, Flipped Classroom remains a worthwhile learning option to consider. In this context, it is important to consider factors such as students' technological skills, parental support, as well as the social and cultural context of students in choosing the most appropriate learning model. Although flipped classrooms offer innovative approaches and can increase student engagement, conventional learning methods are still relevant, especially in some specific contexts.

The recommendation for follow-up research is to involve a larger sample size and pay attention to other factors that might affect learning outcomes, such as student motivation and learning style. Thus, further research can provide a deeper understanding of the effectiveness of various learning models in the context of mathematics education in primary schools. This study makes an important contribution to enriching the understanding of the effectiveness of learning models in improving the understanding of mathematical concepts at the primary school level. The finding that both models, both flipped classroom and conventional methods, have a significant impact in improving student understanding highlights the complexity of selecting learning models that are appropriate to the context and needs of students. As such, this research provides valuable information for educators and policymakers to develop more effective learning practices in primary schools.

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