



The effect of the use of interactive multimedia in mathematics learning on motivation and learning outcomes

Sarah Rachma Tushyfa¹, Khusnul Laely², Septiyati Purwandari³

^{1,2,3} Elementary School Teacher Education, Faculty of Education, Universitas Muhammadiyah Magelang

Correspondence: srhrachmatshyfa@email.com

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ABSTRACT

This study aims to determine the effect of using interactive multimedia in mathematics learning on students' motivation and learning outcomes in grade V of SD negeri Magelang 7. The research employed a quasi-experimental method with a one-group pretest-posttest design involving 27 students. Research instruments consisted of a learning motivation questionnaire with 30 items and a multiple-choice learning achievement test. Data were analyzed using paired sample t-test. The results showed that the average learning motivation score increased from 71.19 (pre-test) to 77.85 (post-test), while the average learning outcomes improved from 56.26 (pre-test) to 71.85 (post-test). The paired sample t-test indicated a significance value of $0.000 < 0.05$, confirming that interactive multimedia had a significant effect on improving students' learning motivation and achievement in mathematics. These findings suggest that interactive multimedia can serve as an effective alternative medium to enhance the quality of mathematics learning in elementary schools.



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INTRODUCTION

Mathematics is one of the subjects that plays an important role in shaping logical, systematic, critical, and creative thinking skills (Ramlah et al., 2022). These abilities are indispensable for students to face the development of science and technology in the modern era (Nahdi, 2019). But mathematics learning in elementary schools still faces various problems. The results of the Programme for International Student Assessment (PISA) survey show that the achievement of mathematical literacy of Indonesian students is still below the average of OECD countries (Oktaviani et al., 2022). This condition indicates the need to improve the quality of mathematics learning from the elementary school level. Efforts to improve the quality of mathematics learning need to be focused on developing strategies that are able to foster students' interest, concept understanding, and thinking skills (Ansya et al., 2023).

The results of initial observations at SD Negeri Magelang 7 show that some grade V students still have difficulties in understanding mathematical concepts. They tend to be passive, lack enthusiasm for learning, and experience obstacles in solving problems. This has an impact on low motivation and achievement of student learning outcomes. One of the reasons is the use of monotonous learning methods, where teachers use more lecture methods and conventional media (Susilo et al., 2024). Learning motivation plays an important role in increasing student participation and responsibility for the learning process (Hanaris, 2023). As a result, students are less actively involved in the learning process and learning becomes less meaningful. The application of innovative learning media is able to increase students' motivation and interest in learning, especially in subjects that are considered difficult such as mathematics (Mustika R, 2021).

Learning motivation is an important factor that affects student success. Students with high motivation tend to have a greater desire to participate in learning and achieve good achievement (Ferdy Fahrurrazi & Sri Setia Putra Jayawardaya, 2024). On the other hand, learning outcomes are a picture of students' achievements after participating in the learning process both in the cognitive, affective, and psychomotor domains (Mohammad Awad AlAfnan, 2025). Therefore, efforts to increase motivation as well as learning outcomes need to be carried out systematically through learning media innovation, one of which is the application of interactive learning technology. This can create a more engaging learning atmosphere and actively increase student engagement (Sufa, 2023).

One of the innovations that can be used is interactive multimedia. This media is capable of combining text, images, audio, video (Susilo et al., 2024), as well as animations that are presented in an interesting and interactive way. Thus, interactive multimedia can stimulate attention, strengthen memory, and foster student engagement in learning. Another advantage is that this media can be operated flexibly according to the needs of students so that it allows for more effective and fun learning (Sufa, 2023).

Various previous studies have proven the effectiveness of interactive multimedia in improving the quality of learning (Ali et al., 2025) shows that interactive multimedia can increase student engagement as well as deepen understanding of concepts. The integration of digital technology is able to support independent learning and increase students' intrinsic motivation (Setianawati et al., 2023). Research by Vercellotti (2018) also highlights the importance of interactive approaches in learning to encourage more optimal learning outcomes. Next, Hakim and Windayana (2016) revealed that the use of multimedia in collaborative learning has been proven to enrich students' learning experiences.

Although these various studies have shown a positive influence on the use of interactive multimedia, its application in mathematics learning at the elementary school level, especially in SD Negeri Magelang 7 is still limited in research. In fact, school conditions show the need for innovative strategies to improve student motivation and learning outcomes. Therefore, this study was conducted to analyze the influence of the use of interactive multimedia in mathematics learning on the motivation and learning outcomes of grade V students of SD Negeri Magelang 7.

RESEARCH METHODS

The research method explains the approach and procedure used in this study. This section contains the research design, subjects or participants, instruments used, data collection procedures and data analysis techniques applied.

Research Design

This study uses an experimental method with a one-group pretest-posttest design. This design was chosen because it is suitable for determining the effect of treatment on the same group. Through this design, it can be known to what extent the treatment in the form of the use of interactive multimedia affects learning motivation and student learning outcomes. The research was carried out at SD Negeri Magelang 7 in the even semester of the 2024/2025 school year.

Research Sample

The subjects of the study were all grade V students of SD Negeri Magelang 7 with a total of 27 students. The sampling technique uses saturated sampling, namely all members of the population are used as research samples because the number is relatively small. In this way, the results of the study are expected to represent the actual conditions in the class without any reduction in the number of respondents.

Collecting Data

Data collection was carried out in two stages, namely before treatment (pre-test) and after treatment (post-test). Learning motivation data was obtained through a questionnaire containing 30 statements with a Likert scale, including aspects of willingness to learn, motivation for needs, ideals, awards, interesting activities, and learning environment. The learning outcome data is obtained through a multiple-choice test designed to measure students' understanding of mathematical concepts.

Before being used, both instruments have gone through a content validity test by experts (expert judgment) and a reliability test using Cronbach's Alpha formula. Instruments that have been declared valid and reliable are then given to students. The pre-test is conducted to obtain an overview of the initial condition of student motivation and learning outcomes. Furthermore, students were given treatment in the form of learning with interactive multimedia based on powerpoint. After the treatment is completed, students are given a post-test with the same instrument to measure the same changes to measure changes in learning motivation and learning outcomes.

Data Analysis

The data obtained was analyzed through two stages. First, descriptive analysis is used to calculate the average score, percentage, and distribution of motivation scores and student learning outcomes. The results of the analysis were used to provide an overview of motivational conditions and learning outcomes before and after treatment.

Both inferential analyses were carried out using the paired sample t-test. This test aims to find out whether there is a significant difference between the results of the pre-test and post-test in both motivation and student learning outcomes. The test was carried out with the help of SPSS software version 25 at a significant level of 0.05. If the significance value is less than 0.05, it can be concluded that the use of interactive multimedia has a significant effect on student motivation and learning outcomes.

RESULTS

This section presents the results of research on the effect of the use of interactive multimedia in mathematics learning on the motivation and learning outcomes of grade V students of SD Negeri Magelang 7. The data analyzed included the results of the learning motivation questionnaire and learning outcome tests both in the pretest and posttest stages. In addition, an inferential test was carried out using a paired sample t-test to determine the significance of the difference between before and after treatment.

Learning Motivation

A descriptive analysis of student learning motivation can be seen in Table 1. Based on Table 1, it is known that students' learning motivation has increased after being treated with interactive multimedia learning. The average learning motivation score increased from 71.19 during the pre-test to 77.85 in the post-test. The lowest also increased from 63 to 68. Meanwhile, the highest score increased from 77 to 84. This shows that the use of interactive multimedia can encourage students to be more motivated in participating in mathematics learning.

Table 1. Descriptive Statistic of Students' Motivation

<i>Variabel</i>	<i>N</i>	<i>Min</i>	<i>Max</i>	<i>Mean</i>
Pre-test	27	63	77	71,19
Post-test	27	68	84	77,85

Learning Outcomes

Descriptive analysis of student learning outcomes is shown in Table 2. From Table 2, student learning outcomes have also improved. The average pre-test score of 56.26 increased to 71.85 in the post-test. The lowest value that was originally 44 increased to 59 and the high value that was previously 67 increased to 85. This confirms that interactive multimedia not only affects motivation but also improves students' understanding of the material.

Table 2. Descriptive Statistic of Students' Learning Outcomes

<i>Variabel</i>	<i>N</i>	<i>Min</i>	<i>Max</i>	<i>Mean</i>
Pre-test	27	44	67	56,25
Post-test	27	59	85	71,85

Paired Sample t-test results

Paired sample t-test to ensure increased motivation and learning outcomes. The results can be seen in Table 3. Table 3 shows that both motivation and student learning outcomes have a significance value of 0.000 (<0.05). Thus, there is a significant difference between pre-test and post-test scores both in motivation and student learning outcomes. This means that the use of interactive multimedia has a significant effect on increasing the motivation and learning outcomes of mathematics students in grade V.

Table 3. Paired Sample T-Test Results

		<i>T</i>	<i>Df</i>	<i>Sig. (2-tailed)</i>
Pair 1	Pre-test – Post-test (Learning Motivation)	-9.665	27	.000
Pair 1	Pre-test – Post-test (Learning Outcomes)	-10.630	27	.000

Overall, the results of this study prove that learning with interactive multimedia based on powerpoint is able to create a more interesting learning atmosphere to increase student involvement in learning while improving academic achievement. The results of the comparison of the average pretest and posttest scores, both motivation and student learning outcomes, are shown in figure 1.

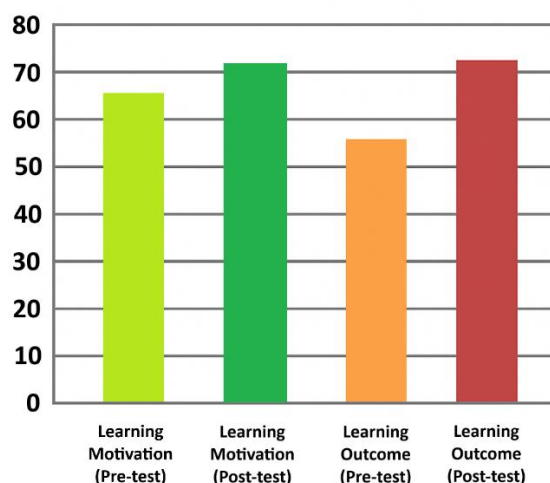


Figure 1. Comparison of Average Pre-test and Post-test of Students' Motivation and Learning Outcomes

There was a clear increase, namely learning motivation increased from 71.19 to 77.85, while learning outcomes increased from 56.25 to 71.85. The improvement of both shows that the use of interactive multimedia in mathematics learning can have a positive impact on students' affective and cognitive aspects.

These findings not only provide empirical evidence on the effectiveness of interactive multimedia but also serve as an important basis for further analysis in the discussion. In the next section, these results will be linked to relevant theories as well as previous researchers to strengthen understanding of the contribution of interactive multimedia to improving student motivation and learning outcomes.

DISCUSSION

The results showed that students' motivation to learn increased after participating in learning with interactive multimedia. The average motivation score increased from 71.19 in the pretest to 77.85 in the posttest. This increase shows that the use of interesting learning media can foster students' interest and involvement in learning mathematics. This is in line with Mustika R (2021) which states that motivation is an important driving factor in learning activities. Without motivation, students will not have the energy and drive to achieve optimal achievement (Emda, 2017).

In line with the *Cognitive Theory of Multimedia Learning* in Mayer (2024) that multimedia-based learning is designed according to the work of the human brain so that it can improve the quality of the thinking process and learning outcomes. According to Rodríguez et al. (2017), interactive multimedia can optimize the learning process through a combination of text, images, audio, and animations to make it easier for students to understand the material and improve their collaboration skills. This is also supported by So et al. (2019) who found that digital multimedia is able to create a more meaningful and interactive learning experience, especially in learning that requires conceptual visualization. In line with Olsson et al. (2015) that learning improvement can be achieved through the use of interesting and varied learning media. Meanwhile, learning outcomes reflect the level of achievement of students after participating in the learning process.

In addition to motivation, the results of the study also showed an increase in students' mathematics learning outcomes. The average pre-test score of 56.26 increased to 71.85 in the post-test. This improvement shows that interactive multimedia not only encourages motivation but also helps students achieve a better understanding of concepts. Nurmawati et al. (2020) emphasizing that learning media functions to clarify the presentation of messages and information so that the learning process becomes more effective and learning outcomes increase. Rahman et al. (2024) found that interaction-based media can improve students' understanding through more active learning. This is in line with Chiu and Churchill (2015) that the use of interactive learning technology can increase the effectiveness of the learning process and help students understand concepts more deeply through interesting visualizations.

The findings of this study are reinforced by Depita (2024) which shows that the use of computer-based interactive media can increase student engagement as well as student learning outcomes. Similar findings were also reported by Deliany et al. (2019) and Ali et al. (2025) which confirms that interactive multimedia-based learning can foster interest in learning and significantly improve academic achievement. Thus, the results of this study confirm that interactive multimedia plays an important role in improving the quality of mathematics learning in elementary schools both in terms of motivation and academic achievement (Hoerunnisa et al., 2019; Nurmawati et al., 2020).

However, this study has some limitations. First, the study was only conducted in one class with a limited number of samples, so the results could not be generalized widely. Second, the time to implement the research is relatively short, so it has not been able to describe the long-term impact of the use of interactive multimedia. Therefore, further research is recommended to involve a larger sample and use a more robust experimental design, for example by involving a control group to reinforce the findings. Overall, these findings have important implications for elementary school teachers to utilize interactive multimedia as an alternative learning strategy. Through the presentation of more interesting and interactive materials, teachers can increase student engagement, motivate students, and help achieve optimal learning outcomes (Khotimah & Hidayat, 2022).

CONCLUSION

Based on the results of the study, it can be concluded that the use of interactive multimedia in mathematics learning has a positive effect on the motivation and learning outcomes of grade V students of SD Negeri Magelang 7. The average learning motivation score increased from 71.19 in the pre-test to 77.85 in the post-test, while the average learning outcome increased from 56.26 to 71.85. The results of the paired sample t-test showed a significance value of 0.000 (<0.05) so that there was a significant difference between the pretest and posttest scores.

The increase in motivation and learning outcomes shows that interactive multimedia can create a more interesting learning process, encourage student involvement and make it easier to understand mathematical concepts. Thus, elementary school teachers are advised to utilize interactive multimedia as an alternative learning strategy to improve the quality of the learning process and outcomes.

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