

# The Effectiveness of Interactive Learning Multimedia with a Contextual Approach to Student's Understanding Mathematical Concepts

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## ABSTRACT

The purpose of this study is to determine the effectiveness of the use of interactive learning multimedia products on the understanding of mathematical concepts, especially the angle measurement material for fourth grade elementary school students. This study used a quasi-experimental research design with a nonequivalent comparison-group design. The data collection technique used was a written test technique involving 60 students. The research data were tested using the t-test. The results showed that the use of interactive multimedia learning had a positive effect on the understanding of mathematical concepts, especially the angle measurement material for fourth grade elementary school students. The t-test results show a significance value of  $< 0.05$  so that  $H_0$  is rejected and  $H_a$  is accepted, which means that the use of interactive multimedia learning with a contextual approach is effective in improving students' conceptual understanding.

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## 1. INTRODUCTION

Understanding is one of the most important characteristics related to achieving educational goals (Mwakapenda, 2004). Related by Widyastuti & Pujiastuti (2014: 184) that students who already have a good understanding of concepts can be better trained to be able to develop logical thinking skills and be able to solve everyday problems. Agreeing with this, Booker (2004) also stated that understanding mathematical concepts in elementary school is the most basic thing that students must have, so that later they can be used as a foundation for the development of advanced mathematical concepts. Thus, understanding concepts for elementary school students should be done correctly so that they can know the function of mathematics in everyday life correctly and effectively. Jerome Bruner (Suherman, 2003: 43) also states that learning mathematics will be successful if students are directed to understanding the

concept of a material. Thus, the implementation of learning should be able to help students to have a good understanding of concepts in order to achieve good mathematics learning achievement.

The quality of education can be seen from the evaluation results, both at the local, national and international levels. Trends in International Mathematics and Science Study (TIMSS) is a study initiated by the International Association for the evaluation of Educational Achievement (IEA) which is carried out regularly every 4 years in order to compare student achievement in Mathematics and Science for class IV and class VIII in several countries in the world. The first survey was conducted in 1999 and the last time was in 2019. For the survey results in 2019, Indonesia did not participate on this occasion. As for the results of the 2015 TIMSS survey (Mullis, Martin, Foy, & Hooper, 2015) it was found that Indonesian students obtained a math score of 397, which is ranked 44th out of 49 countries, and is included in the lower ranking. So it can be seen that students' mathematics learning achievement in Indonesia is still low and lagging behind other countries. In addition, based on data on the results of the National Standard School Examination for elementary schools in the city of Yogyakarta in 2019, it was found that the average value of mathematics subjects was lower than other subjects.

The use of learning media has a great influence on the effectiveness of learning. In the current era, technology is growing rapidly and is used in various fields, as well as in the field of education. Therefore, it is necessary to use learning media that utilizes technology as a supporting medium for teaching. Jenlink (2019: 1) states that teachers need to focus on the use of media and digital technology because they can motivate students in learning and also increase participation and connection in the learning environment in the classroom. One of the learning media that can be used in learning mathematics is interactive learning multimedia with a contextual approach. She & Chen (2009: 1297) state that multimedia offers great potential as a powerful learning technology to enhance human learning. In addition, Cairncross & Mannion (2010: 156) also states that multimedia has the potential to create a quality learning environment. Various media elements, user control to receive information, and interactivity can be used to improve the learning process through the creation of an integrated learning environment. Various media elements such as text, images, sound, animation, and video can be used to inform the message and users can learn at a time and place that is convenient for them.

Interactive learning multimedia can be designed by connecting subject matter with students' daily lives or is contextual. According to Lotulung, Ibrahim, & Tumurang (2018: 40) states that the learning process that connects the material with students' real-world situations will encourage students to make connections between the knowledge they have and the environment around them. In order to create meaningful learning, students need to be given the opportunity to do, try, and experience for themselves so that students are not only passive listeners who only receive all the information provided by the teacher. Selvianiresa & Prabawanto (2017: 2) also explain that in mathematics lessons there are indirect concepts, so a process is needed to interpret these concepts. Students can learn these abstract mathematical concepts through various real activities, where learning is directly related to students' daily lives. Therefore, it would be better if interactive learning multimedia contained learning steps with a contextual approach so that the learning process became more meaningful for students. Therefore, interactive learning multimedia with a contextual approach can be an alternative media for learning mathematics.

Surjono (2017: 2-3) states that interactive learning multimedia is a combination of various media such as text, images, sound, graphics, animation, video, and others that are designed synergistically and integrated using technology in the form of computers or the like to help students understand the subject matter in order to achieve certain learning objectives. The content in this interactive learning multimedia contains competencies, materials, simple games, practice questions, summaries, references, and developer profiles. In addition, the content in interactive learning multimedia contains several components of contextual learning, including constructivism, inquiry, questioning, community learning, modeling, reflection, and authentic assessment. This interactive learning multimedia display combines several media such as text, images, audio, animation, video, and navigation buttons that are designed to be attractive and communicative.

The interactive learning multimedia product with a contextual approach has been tested based on materials and media. Product feasibility assessment is carried out by material experts and media experts. Furthermore, field trials were conducted to determine the responses of teachers and students. Based on the results of material validation, a total score of 83 was obtained in the appropriate category, and the results of media validation obtained a total score of 100 in the appropriate category. While the results of the teacher's response questionnaire obtained a score of 87.5 with a very decent category, and for student responses a score of 35.87 was obtained with a very decent category. The results of the product testing became a reference in this study to determine the effectiveness of interactive multimedia learning with a contextual approach to improving the understanding of mathematics concepts for fourth grade elementary school students.

Research by Novitasari (2016: 8-18) also revealed that the use of interactive multimedia in learning mathematics can improve students' mathematical concept understanding abilities. In line with this research, Shi (2017) also revealed in his research that learning using multimedia assistance is more effective than traditional methods, where students gain faster learning by obtaining higher average scores on English subject matter. In addition, it was also found that students took longer to remember the material. The same thing is also in the form of Li (2016) in his research which results that learning that utilizes multimedia technology can increase student motivation and retention. In addition, students' understanding of learning using multimedia assistance in learning is higher than conventional learning.

Based on this background, research questions can be formulated: How is the effectiveness of interactive learning multimedia with a contextual approach to understanding mathematics concepts for fourth grade elementary school students? The purpose of this study was to determine the effectiveness of the use of interactive learning multimedia with a contextual approach to understanding the mathematical concepts of fourth grade elementary school students.

## 2. METHODS

This study uses an experimental research model with a quasi-experimental research design. This design was chosen because the researcher was not able to strictly control the influence of external variables that affect the implementation of the experiment. There are two forms of quasi-experimental design, one of which is the non-equivalent comparison-group design which was chosen as the design in this study. In this study, the experimental class and the control class were used to determine the effect of using media on students' conceptual understanding. Where the experimental class uses interactive multimedia learning with a contextual approach and the control class uses textbooks. The following is a description of the nonequivalent comparison-group design according to Johnson & Christensen (2014: 360):

**Table 1.** Design nonequivalent comparison-group design

	Pretest measure	Treatment	Posttest measure
Experimental Group	O <sub>1</sub>	X <sub>1</sub>	O <sub>2</sub>
Control Group	O <sub>3</sub>	X <sub>2</sub>	O <sub>4</sub>

### Explanation

X<sub>1</sub> : Learning activities using interactive learning multimedia with a contextual approach in the experimental class

X<sub>2</sub> : Learning activities using math textbooks

O<sub>1</sub> : Experimental class pretest results

O<sub>2</sub> : Experimental class posttest results

O<sub>3</sub> : Control class pretest results

O<sub>4</sub> : Control class posttest results

This research was conducted in March of the 2018/2019 academic year. The subjects used were 58 fourth grade elementary school students in Kotagede District, namely SD Negeri Rejowinangun 1 as the experimental class and SD Negeri Rejowinangun 3 as the control class which were selected based on random sampling technique. The data collection technique used is using a written test to measure the ability to understand concepts. The data collection instrument was in the form of pretest and posttest question sheets. The questions developed are in the form of questions that include indicators of the ability to understand concepts from Permendikbud Number 58 of 2014 namely: (1) Restate the concepts that have been studied. (2) Give examples and not examples of a general concept or principle. (3) Classify objects according to certain properties according to the requirements in accordance with the concept. (4) Presenting concepts in various forms of mathematical representation in the form of tables, graphs, diagrams, pictures, and so on. (5) Compare and contrast concepts. (6) Giving a guess or description of a thing based on the pattern obtained. (7) Linking concepts in mathematics and outside mathematics.

The data analysis used is inferential statistics. This is so that the research sample data can be analyzed and the results can be generalized. The data were analyzed using the standard N-gain test to determine the effectiveness of interactive multimedia learning on understanding concepts in the experimental class and control class. While the t-test analysis with a significance of 0.05 using IBM Statistics SPSS 26 software, was used to determine the difference in increasing understanding of concepts between the experimental and control classes. To calculate the N-gain using the formula according to Hake (1998: 65), that is:

$$g = \frac{\text{skor posttest} - \text{skor pretest}}{\text{skor maksimal} - \text{skor peretest}}$$

The gain score results obtained are then presented based on the following table:

**Table 2.** Gain score category

Interval	Effectiveness Category
$(g) \geq 0,7$	Hight
$0,7 > (g) \geq 0,3$	Currently
$(g) < 0,3$	Low

Meanwhile, the effectiveness hypothesis test using the t-test was analyzed using the help of the IBM SPSS program, which was seen from the independent sample t-test and paired sample t-test. The initial step to perform the t test is to perform a prerequisite test which includes a normality test and a homogeneity test. The normality test of concept understanding data was carried out using the Kolmogorov-Smirnov test on the IBM SPSS Statistics 26 program. The data was declared to be normally distributed if the significance value was 0.05. While the homogeneity test was carried out using the Levene test. The data is declared homogeneous if the significance value 0.05. Furthermore, after the data is normally distributed and homogeneous, the t-test can be performed.

Independent t-test was used to test whether there were significant differences between two different sample groups (Nurgiantoro, Gunawan, & Marzuki, 2012: 182). The hypotheses tested for the concept understanding ability variable are as follows.

$$H_0 : (\mu_{E1}) = (\mu_{K1})$$

(There is no difference in the ability to understand concepts between students who take part in learning activities using interactive multimedia learning with a contextual approach compared to students who do not use interactive multimedia learning with a contextual approach).

$$H_a : (\mu_{E1}) \neq (\mu_{K1})$$

(There is a difference in the ability to understand concepts between students who take part in learning activities using interactive multimedia learning with a contextual approach compared to students who do not use interactive multimedia learning with a contextual approach).

Explanation:

$\mu_{E1}$  : Average score of experimental class concept understanding

$\mu_{K1}$  : Average score of control class concept understanding

Criteria for acceptance and rejection of  $H_0$  at a significance level of 0.05 is if the significance (2-tailed)  $> \alpha$  (0.05) then  $H_0$  is accepted, if the significance (2-tailed)  $< \alpha$  (0.05) then  $H_0$  is rejected. (Trihendradi, 2013: 116)

While the paired t-test is used to test whether there is a significant difference in one group of sample subjects before and after being given treatment (Nurgiantoro et al., 2012: 188). The hypotheses tested for the concept understanding ability variable are as follows.

$$H_0 : (\mu_{E1 \text{ pretest}}) = (\mu_{E1 \text{ posttest}})$$

(There is no difference in students' ability to understand concepts before and after participating in learning using multimedia learning with a contextual approach).

$$H_a : (\mu_{E1 \text{ pretest}}) \neq (\mu_{E1 \text{ posttest}})$$

(There are differences in the ability to understand concepts in students before and after participating in learning using multimedia learning with a contextual approach).

Explanation:

$\mu_{E1 \text{ pretest}}$  : The average pretest score for understanding the concept of the experimental class

$\mu_{E1 \text{ posttest}}$  : The average post-test score for understanding the concept of the experimental class

Criteria for acceptance and rejection of  $H_0$  at a significance level of 0.05, namely if the significance (2-tailed)  $> \alpha$  (0.05) then  $H_0$  is accepted, if the significance (2-tailed)  $< \alpha$  (0.05) then  $H_0$  is rejected. (Trihendradi, 2013: 119)

### 3. FINDINGS AND DISCUSSION

#### Results of Data Analysis with N-Gain

The results of the ability to understand concepts between the experimental class and the control class in this study showed different results before and after using interactive multimedia learning. The following is a summary of the results of the value of understanding the concept.

**Table 3.** Pretest and posttest value data

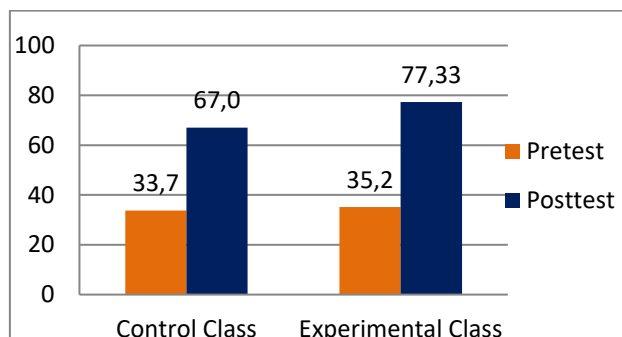
No.	Class	Average Value		Gain	Criteria
		Pretest	Posttest		
1.	Control	33,7	67,0	0,5	Currently
2.	Experiment	35,3	77,33	0,67	Currently

Based on the table, it can be seen that the average value of the pretest of understanding the concept of students in the control class is 33.7. After the pretest was carried out, the learning activities took place as usual by using the textbooks provided at the school. During three meetings of learning mathematics on the material of measuring angles, then a posttest was carried out and the students' average score was 67.0. This shows that students in the control class experienced an increase in the ability to understand concepts with a gain of 0.5 which is included in the moderate criteria.

The average value of concept understanding in the experimental class is 35.2. After conducting the pretest, students in the experimental class received treatment through the use of interactive multimedia learning with a contextual approach. During the use of interactive learning multimedia for 3 meetings, then students in the experimental class were given a posttest and obtained an average score of 77.33. This shows that students in the experimental class experienced an increase in the ability to understand

concepts with a gain value of 0.67 which is included in the moderate criteria. So it can be seen that the N gain in the experimental class is greater than the control class.

The following is a diagram showing the comparison of increasing the ability to understand concepts based on the calculation of values in the control and experimental classes.



**Figure 1.** Comparison diagram of concept understanding test results

Based on the diagram, it can be stated that the ability to understand concepts in the control class students has a lower increase when compared to the increase in concept understanding in the experimental class. This can be seen through the results of the increase in the control class which has increased by 33.3 with a gain of 0.5. While in the experimental class there was an increase of 42.13 with a gain of 0.67.

So it can be stated that students' understanding of concepts in the experimental class has increased higher than the control class. Based on this, it can be seen that interactive learning multimedia with a contextual approach can be declared effective to improve students' understanding of concepts. This is also in accordance with the results of research from Shi (2017) which states that learning using multimedia assistance is more effective than traditional methods, where students accept learning faster with higher average scores. In addition, students also take longer to remember the material. In addition, research from Alkhasawneh (2016) also shows that student achievement in classes that use multimedia learning assistance is higher than classes that do not use multimedia in learning mathematics. The use of multimedia in learning also provides a strong positive attitude towards the implementation of learning.

#### Product Effectiveness Data Analysis Results with T-test

The first step to perform the t test is to perform a prerequisite test which includes a normality test and a homogeneity test. Based on the normality test, it states that the data distribution is normally distributed using the Kolmogorov-Smirnov, with a significance value of 0.05. The following are the results of the normality test.

**Table 4.** Normality test Results

Class	Condition	Significance	Condition
Control	<i>Pretest</i>	0.152	Normal
	<i>Posttest</i>	0.057	Normal
Experiment	<i>Pretest</i>	0.200	Normal
	<i>Posttest</i>	0,200	Normal

Furthermore, to test the homogeneity of the data, the Levene test was carried out, based on the results of the data obtained a significance value of  $> 0.05$ , which means that the data has the same variance or is homogeneous. The following are the results of the homogeneity test.

**Table 5.** Homogeneity test results

Class	Condition	Significance	Condition
Control	<i>Pretest</i>	0,157	Homogeneous data
Experiment	<i>Pretest</i>		Homogeneous data
Control	<i>Posttest</i>	0.266	Homogeneous data
Experiment	<i>Posttest</i>		Homogeneous data

Furthermore, for the results of the Independent sample t-test, the following results were obtained.

**Table 6.** Independent t-test results

Class	Condition	Significance	Condition
Control	<i>Posttest</i>	0,000	There is a
Experiment	<i>Posttest</i>		difference

Based on the results of the independent t-test, it can be seen that the significance value is  $< 0.05$ , so  $H_0$  is rejected and  $H_a$  is accepted. Therefore, it can be concluded that there are differences in conceptual understanding between control class students and experimental class students who use interactive multimedia learning with a contextual approach in mathematics learning activities. Research from Shah & Khan (2015) also found that the experimental group, which used multimedia in learning, showed more positive achievements and attitudes than the control group, which did not use multimedia in learning.

Furthermore, for the results of the paired samples t-test, the following results were obtained.

**Table 7.** Paired t-test results

Class	Condition	Significance	Condition
Experiment	<i>Pretest</i>	0.000	There is a difference
	<i>Posttest</i>		

Based on the results of the paired t-test, it can be seen that the significance value is  $0.05$ , so  $H_0$  is rejected and  $H_a$  is accepted. Therefore, it can be concluded that there are differences in students' understanding of concepts in the experimental class before and after using interactive multimedia learning with a contextual approach in mathematics learning activities.

The results showed that interactive learning multimedia with a contextual approach was found to be effective in increasing conceptual understanding. This is obtained from the results of the test of understanding the concept that is seen from the average value and gain. The average value of pretest and posttest in the experimental class is higher than the control class. In the experimental class, the posttest average value was higher than the pretest value, namely  $77.33 > 35.2$  with an increase of  $42.13$  and a gain value of  $0.67$  which was included in the medium category. While in the control class, the posttest average value was indeed higher than the pretest value, namely  $67.0 > 33.7$  with an increase of  $33.3$  and the gain value of  $0.5$  was included in the medium category. However, the gain in the control class is smaller than the experimental class.

In addition, the results of the independent t-test also showed that there was a difference in posttest scores between the experimental class students who used interactive multimedia learning and the control class students who did not use interactive learning multimedia, with a significance value ( $p$ ) < 0.05, which was 0.000. Paired t-test results also showed that there were differences in students' understanding of concepts before and after using interactive multimedia learning with a significance value of < 0.05, which was 0.000.

Based on these results, it can be seen that interactive multimedia learning with a contextual approach can improve students' understanding of concepts, especially on angle measurement material in fourth grade elementary school. This is in line with research conducted by Novitasari (2015) which states that learning mathematics with interactive multimedia can improve students' understanding of mathematical concepts. Research from (Arham & Dwiningsih, 2016) also resulted in the finding that learning using interactive multimedia learning was effective as a learning medium in terms of student learning outcomes.

#### 4. CONCLUSION

Based on the results of the research that has been described, namely from the results of data analysis with N-gain and t-test, it can be concluded that interactive learning multimedia with a contextual approach is effective for improving understanding of mathematical concepts, especially on angle measurement material in grade IV elementary school. The use of interactive learning multimedia is flexible and can provide convenience for students to study independently and at any time. It is hoped that the results of this study can be considered for other researchers to be able to develop interactive learning multimedia products with a contextual approach

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