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Implementation of Mathematics Instructional Multimedia for Students' Self-Regulated Learning

Nela Akmalia, Rusijono Rusijono, Fajar Arianto
Faculty of Educational Technology, State University of Surabaya
***Corresponding Author e-mail: nela.21010@mhs.unesa.ac.id**

Abstract: *In learning mathematics, fostering the affective domain requires self-regulated learning which will then form a strong tendency which is called a mathematical disposition. To increase student self-regulated learning, teachers can modify learning, one of which is through the use of learning multimedia. This research is a quantitative study using quasi-experimental methods and the research design used is a static group comparison. The subjects of this study were class VII students at MTs Bilingual Muslimat NU Sidoarjo. Students were divided into two groups: the experimental group consisted of 31 people and the control group consisted of 31 people. Based on the results of data analysis and discussion of research results, it can be concluded that the application of interactive multimedia mathematics affects students' self-regulated learning. This is evidenced by the results of the t-test which shows a mean difference value of 5.968, which means that the average self-regulated learning of students is higher when using multimedia learning than not using it. The Sig (2-tailed) value of 0.012 indicates that Ha is accepted and Ho is rejected*

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Introduction

Technology and science in the 21st century are developing very rapidly. Because of the sophistication of this technology, various information and knowledge can be accessed quickly by anyone, anytime and anywhere. The more advances in technology and science development, the paradigm regarding education and other aspects will change. For example, innovations in the field of education that utilize technology continue to be made and developed. This will lead to increasingly tight and open competition in education and technology globally. To face this global competition, proper preparation, and superior and qualified human resources are needed. The characteristics of quality individuals are being able to be independent, willing, and capable (Dinata, Rahzianta, & Zainuddin: 2016). This opinion is in line with UUD No. 20 of 2003 article 3 functions to develop the potential of students to become people of faith and piety, have a noble character, are healthy, knowledgeable, intelligent, creative and independent, democratic and responsible.

Efforts can be made in forming independent and capable individuals by training and forming students to develop their self-regulated learning (Asyhari & Sa'adah, 2022). Self-regulated learning is the ability and confidence to learn by not depending on others and being responsible for achieving the expected goals (Yuliati & Saputra: 2020, 143). Furthermore,

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Kizilcec, Pérez-Sanagustín & Maldonado (2017) explained that students with higher self-regulated learning are more aware of their strengths and weaknesses, and are more likely to look for opportunities to acquire new knowledge and skills. Self-regulating students can be characterized by their ability to initiate metacognitive, cognitive, affective, motivational, and behavioral processes to realize their learning goals. Self-regulated learning has also been conceptualized as a constellation of actions (eg monitoring, directing, regulating) carried out in achieving learning goals or a specific set of processes sequenced by students to control their internal and external weaknesses (Ben-Eliyahu & Bernacki, 2015). Self-regulated learning allows students to have the initiative to keep on learning both at school with friends and teachers as well as self-study using available resources. Independent learning refers to the willingness and ability of students to learn with or without the help of other parties because they are aware of and know the importance of learning for themselves. In learning mathematics, coaching in the affective domain requires self-regulated learning which will then form a strong tendency called a mathematical disposition, namely a strong desire, awareness, and dedication in students to think and act positively (Purnamasari & Herman, 2016).

The basis of knowledge behind various scientific disciplines and the development of modern technology is mathematics (Fatmawati & Ekawati, 2016). Mathematics as a science that is obtained from the results of human thinking or reasoning, makes its application different at every level of school. The higher the school level, the more influential the learning objectives (Lusiana, Armiati & Yerizon, 2022). Mathematics is not limited to calculation lessons but mathematics is also the knowledge that is around us, when mathematics is implemented in everyday life, thinking patterns will be more rational and critical because the problems are considered facts (Istianah, Wiryokusumo & Leksono, 2020). Suherman (2003) states that mathematics is a language that uses terms that are defined carefully, clearly, and accurately, with symbolic and solid representations, more in the form of symbolic language regarding ideas than regarding sounds. As an educator, the biggest goal in the world of education is to educate the nation's children. So the ability of regulated learning cells is needed in learning mathematics. To increase student self-regulated learning, teachers can modify learning so that they can increase student self-regulated learning. One of them is multimedia learning.

Learning with multimedia is a combination of various media or file formats in the form of text, images or vectors, graphics, sound, animation, and video interactions that have been packaged into a digital or computerized file whose function is to convey messages to the public and can be controlled as freely as possible. Mayer (2009) defines multimedia as a tool for presenting material in more than one format (for example in words and pictures). Multimedia can be said as a medium that has enormous potential in helping the success of the learning process. The basic objective of the need for multimedia learning is to increase the effectiveness and efficiency of the learning process (Ratini, 2011). Multimedia is suitable for students in the 2000s who are more interested in delivering creative and up-to-date material because they are the millennial generation or generation Z where technology is increasingly developing.

In the multimedia principle, people can learn more deeply when they receive explanations in words and pictures rather than words alone (Mayer, 2002). This principle is in line with the view of sensory modality, which states that multimedia means two or more sensory systems in which the learner is involved. Multimedia focuses on sensory receptors that learners use to understand incoming material (eg eyes and ears). In this regard, the

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principle of multimedia signaling states that students engage in deeper learning when key steps in the narrative are signaled rather than not signaled. Signals cue learners as to what words and pictures need attention and allow their organization. That is, linguistic elements need to be associated with several visual stimuli to help students store new linguistic elements in their long-term memory (Matus, 2018).

Adinugraha (2018) states that learning multimedia functions as a means to facilitate learning. Multimedia as an inseparable part of the teaching and learning process aims to facilitate students in achieving educational goals and learning objectives in general. With learning media, it is hoped that students can be involved in learning activities both physically, mentally, emotionally, and socially (Nulhakim, Susanto & Husain, 2022). This condition can stimulate an increase in student self-regulated learning. This is in line with the opinion of Arsyad, (2011) who argues that the use of learning media in the teaching and learning process can generate new desires and interests, generate motivation and stimulate learning activities, and even bring psychological influences on students. This is in line with research on the use of learning multimedia for high school class X students which shows that learning multimedia can improve student self-regulated learning (Handayani, 2015). Other research on the development of interactive science learning multimedia on the human skeleton and muscle material shows that learning multimedia can significantly improve student self-regulated learning (Adhitama, 2015). This research is also supported by Rusman's opinion (2013) that learning using websites can encourage students to be more active and independent in learning. This shows that the use of learning multimedia is effective for developing students' self-regulated learning. Based on the previous explanation, the purpose of this study was to determine the effect of implementing multimedia mathematics on students' self-regulated learning.

Research Method

This research is quantitative research using a quasi-experiment design (Quasi-Experimental Design). The research design used in this study was a static group comparison design involving two class groups, namely the control class and the experimental class.

Table 1. Static Group Comparison Research Design

Group	Perlakuan	*Posttest*
Experiment	X	O_1
Control	-	O_2

The subjects of this study were students at MTs Bilingual Muslimat NU Sidoarjo, to be precise, students of class VII, totaling 62 people. Students were divided into two groups: the experimental group consisted of 31 people and the control group consisted of 31 people. Sampling was done by purposive random sampling technique.

The instrument used is a self-regulated learning questionnaire referring to the questionnaire used by Onah & Sinclair (2017).

Table 2. Self-Regulated Learning Questionnaire

No	Dimension	Item
1	*Goal setting*	I know what I will achieve in this study
		I have set aside time to study the material being taught
		I have high standards for what I do in this course

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		I have set targets for everything I want to achieve in this lesson
		My involvement in this study is important
		I know the goal I want to achieve at the end of this lesson
2	*Task strategy*	I work strategically by prioritizing tasks that will help me achieve my study goals
		I prepare myself by reading the material that will be taught during the lesson
		I set a study agenda
		I am ready to overcome any challenging task in this study
3	*Time management*	I plan to use my time for my study purposes
		I find good times to study so I won't be distracted
4	*Environment structuring*	I choose my study place to avoid distractions
		I'm looking for a comfortable place to study
		I choose the right place to work to study effectively
5	*Help seeker*	I plan to use the opportunities provided to get support from peers and teachers
		I plan to participate in discussion forums to get the most out of learning
6	*Self-evaluation*	While engaged in this study, I will reflect on my studies in each material
		I will be proactive in engaging and reviewing the progress of my chosen learning outcomes

Hypothesis testing was carried out using the t-test. The formulation of the hypothesis in this study is

Ho = There is no effect of implementing multimedia mathematics learning on students' self-regulated learning

Ha = There is an effect of implementing multimedia mathematics learning on students' self-regulated learning

Before conducting the t-test, the researcher first made sure that the data obtained was normal by carrying out the normality test. Then, the researcher also ensures that the data obtained has a homogeneous variance or comes from a homogeneous population by carrying out a homogeneity test.

Result and Discussion

Result

The normality test was performed with the Kolmogorov-Smirnov test. The Sig (2-tailed) value obtained from the calculation results > α level of 5% or Sig (2-tailed) > 0.05, then the student's self-regulated learning data is declared normal. Conversely, the value of Sig (2-tailed) < 0.05 so the data is not normal. The normality test is carried out using the normality test result approach related to self-regulated learning (experiments and controls).

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Table 3. Normality Test Results

	Factor	Statistic	df	Sig.
SRL	Eksperiment	,117	31	,200*
	control	,124	31	,200*

Based on Table 3. It can be seen that the results of the normality test related to student self-regulated learning data (experiments and controls) store a value of Sig (2-tailed) = 0.200. Because the Sig (2-tailed) value is 0.200 > 0.05 so that it can be stated as a whole the data related to student self-regulated learning (experimental and control) normal dissemination.

The homogeneity test is carried out to show two or more groups of sample data that have been taken from populations that have the same variance. In other words, the homogeneity test is carried out to determine whether the data set under study have the same characteristics or not.

Table 4. Homogeneity Test Results

		Levene Statistic	df1	df2	Sig.
SRL	Based on Mean	1,059	1	60	,308
	Based on Median	,940	1	60	,336
	Based on the Median and with adjusted df	,940	1	56,743	,336
	Based on trimmed mean	,973	1	60	,328

Based on Table 3, the results of the student self-regulated learning data homogeneity test (experimental and control) store a value of Sig (2-tailed) = 0.308. Because the Sig (2-tailed) value is 0.308 > 0.05 so that it can be stated as a whole the data related to student self-regulated learning data (experimental and control) holds homogeneous variance or is from a homogeneous population.

The T-test is a statistical method used to test whether there is a significant difference between two groups or populations. In this study, the t-test compared the self-regulated learning data of students in the experimental group and the control group.

Table 5. t-test results

		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
SRL	Equal variances assumed	2,579	60	,012	5,968	2,314	1,338	10,597

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Based on Table 5, it is known that the mean difference is 5.968, which means that the experimental class has a higher average value of 5.968 than the control class. So students who use learning multimedia have higher self-regulated learning than students who do not use learning multimedia. In addition, it was found that the value of Sig (2-tailed) = 0.012. Due to the Sig (2-tailed) value of 0.012 <0.05, it can be stated that Ha is accepted and Ho is rejected. It can be concluded that in this research the alternative hypothesis (Ha) is accepted. With this, it can be proven that there is an effect of implementing multimedia mathematics learning on students' self-regulated learning.

Discussion

Self-regulated learning is one of the important abilities students have. Based on the results of the research that has been done, the implementation of multimedia can be one of the efforts that teachers can make to improve self-regulated learning. The implementation of mathematical multimedia that has been carried out by researchers provides space for students to operate multimedia independently. This condition is one of the causes of increasing the ability of self-regulated learning in students. This is the opinion of Enmufida, Jupri, and Yulianti (2021). All three mentioned that the use of learning multimedia that provides space for students to utilize and operate it independently opens opportunities for them to carry out self-regulation. Self-regulation carried out can be an exercise in improving self-regulated learning. This opinion is also corroborated by Hadi and Sovitriana (2019) who state that two conditions determine the formation of student self-regulated learning, namely: 1) social sources, such as family, parents, teachers who provide direction, model and regulate student behavior, and 2) opportunity to practice self-regulated learning, students who are constantly regulated directly by parents or teachers cannot build their skills in learning independently because of the weak opportunities they have, so it is necessary to create conditions that can support students to bring out their maximum abilities independently

Two factors influence student self-regulated learning, namely internal and external factors. Factors from within the student are student habits, physiological conditions, and psychological. Meanwhile, factors that come from outside are the environment, both at school, at home, and in the community (Purnamasari & Herman, 2016). When these two factors are conditioned as well as possible, a significant increase in student self-regulated learning will result. One that can be conditioned by the teacher is external factors, especially the school environment. The use of multimedia learning in mathematics material provides a new atmosphere for students that it will make the learning atmosphere more conducive and more interesting. In addition, from internal factors, learning multimedia can foster student learning motivation so that it can influence student psychology so that it is more prepared and more conducive to receiving learning (Oktaviandri, 2023). This condition can be a trigger for increasing student self-regulated learning.

Conclusion

Based on the results of data analysis and discussion of research results, it can be concluded that the application of interactive multimedia mathematics affects student self-regulated learning. This is evidenced by the results of the t-test which shows a mean difference value of 5.968, which means that the average self-regulated learning of students is higher when using multimedia learning than not using it. The Sig (2-tailed) value of 0.012 indicates that Ha is accepted and Ho is rejected.

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Recommendation

Educators are advised to use mathematics learning multimedia to increase student self-regulated learning.

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