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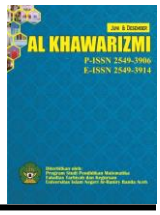

THE INFLUENCE OF SELF-DIRECTED LEARNING ASSISTED BY MODULES ON MATHEMATICAL LITERACY IN TERMS OF STUDENTS' LEARNING INDEPENDENCE

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Abstrak

This research aims to see the effect of self-directed learning assisted by modules on students' mathematical literacy based on students' learning independence. The experimental design used in this research is factorial experimental. The population in this study were all tenth-grade students at MA Plus Walisongo Kotabumi. The samples in this study were students of class X MIA 1 as the experimental and students of class X MIA 2 as the control class for each class of 32 students. The data were subjected to analysis using a two-way ANOVA test. The findings in this research are: 1) there is an influence of self-directed learning assisted by modules on students' mathematical literacy; 2) there is an influence of high, medium and low learning independence categories on students' mathematical literacy; 3) there is an interaction between self-directed learning assisted by modules, and the category of independent learning on students' mathematical literacy

INTRODUCTION

Education is one of the important foundations for the progress of the nation to develop skills that keep pace with increasingly sophisticated developments (Janah, Suyitno, and Rosyida 2019). Education is a very basic thing in moving the cultural sector to create something creative and innovative, as well as making the nation's life intelligent and responsible (Dharma et al. 2020). Mathematics education is one of the subjects that makes a positive contribution to achieving an intelligent and useful society at every level of education. Mathematics is one of the subjects taught from elementary level to university level (Ananda

et al. 2022). Mathematics is able to develop the ability to think, discuss and give opinions, as well as contribute to solving problems that exist in life and in the world of work (Anggraeni, Muryaningsih, and Ernawati 2020). Mathematics is considered a very helpful instrument in solving problems in other branches of research because of its significant contribution to technological and scientific progress (Nastiti Khairun Nisa 2023). One of the characteristics of the 21st century is news and information that is easily accessible. Various information in society ranging from social, political, economic, health information and others certainly requires good analytical skills to understand the meaning contained therein. This information is usually presented in the form of tables, charts, graphs and cannot be separated from numbers (Fevi Rahmadeni, Anisya Septiana 2023). Mathematics is closely related to mathematical literacy. An individual's ability to create, apply, and understand mathematics in a number of contexts is determined by their ability to think mathematically and use concepts, methods, and facts to describe, explain, or predict phenomena or events (Ananda et al. 2022).

Mathematical literacy is the ability of students to understand and apply various mathematical applications, such as facts, principles, manipulation and problem solving in everyday life, both past and present (Naufal and Amalia 2022). Mathematical literacy is one component of using mathematical concepts and applying them in everyday situations. Mathematical literacy helps people to identify and understand the role of mathematics in the world, and to make the judgments and decisions necessary in the lives of constructive, engaged, and reflective citizens (E Salsabila, W Rahayu, S A Kharis 2019). Skills in mathematical literacy are very important, not only for solving mathematical problems but also for solving problems in everyday life. By having high mathematical literacy skills, it is hoped that students will be able to answer long-form questions or story questions, where many students still experience difficulties in solving these problems (M Sakinah 2021). Students' mastery of mathematics will increase and be competitive through activities based on mathematical literacy. One way to increase students' mastery of mathematical literacy is by solving literacy-based questions. Mathematical literacy is the capacity to identify the role of mathematics, reason mathematically in varied contexts and solve everyday mathematical problems constructively (Riyatuljannah and Fatonah 2021). It is important to note that the process of learning mathematics should not only make students proficient in counting but also practice the skills of understanding, reasoning, solving problems, and applying concepts and other things in everyday life.

Mathematical literacy is important and needed in students' lives, but this is not in line with research conducted by PISA to determine students' mathematical literacy abilities. The mathematical literacy of students in Indonesia is still low, seen from research conducted by programme for international students assessment (PISA) (Purwanti, Mutrofin, and Alfarisi 2021). Based on the results of the PISA study published by the OECD in the mathematics domain which assesses students' mathematical literacy, it shows that serious efforts are needed so that Indonesia's average score is better than the average score of other participants (Prastyo 2020). This means that the ability of students in Indonesia to solve problems that require the ability to analyze, give reasons, communicate effectively, solve and interpret problems in various situations is still low.

Low mathematical literacy was also found at MA Plus Walisongo Kotabumi. Based on an interview with a mathematics educator at MA Plus Walisongo Kotabumi, he stated that

students' mathematical literacy was still not good. Students cannot yet interpret the information obtained. The thought process in the mind that occurs when students are solving problems will be influenced by various kinds of obstacles so that each student has different abilities in dealing with problems (Ridha Yuniara, Saminan, Zainal Abidin 2023). The results of observations carried out by researchers show that students' mathematical literacy is still low. Mathematical literacy is one of the abilities that students must develop and possess to improve learning outcomes. Students in Indonesia still really need the ability to translate everyday problems into formal mathematical forms for solving them (Khaerunisak, Kartono, Isti Hidayah 2017).

One of the affective aspects that must be considered is students' learning independence. The higher the learning independence of students, the higher their mathematics learning outcomes will be. Vice versa, the lower the learning independence of students, the lower the learning outcomes will be (Riyanti 2021). Learning independence in question is the ability of students to self-regulate independently in the learning process to achieve a goal. Students with better self-regulation skills usually learn more and produce higher levels of academic satisfaction. Independent learning can improve students' academic achievement in mathematics, one of which is mathematical literacy skills (Tasekeb, Wardono, and Mulyono 2019).

Previous research also stated that learning independence has a significant influence, and has a positive influence on students' mathematics learning outcomes (Ratna Puspita Indah 2021). This means that the higher the student's learning independence, the higher the student's mathematics learning outcomes, and vice versa (Riyanti 2021). The absence of independent learning in students will result in various kinds of behavioral problems, for example shyness, lack of enthusiasm for school, and bad study habits. Individuals who have high learning independence tend to learn better, are able to interact, play, and manage their learning effectively; save time in completing them, manage studying and time efficiently, and get high scores in science (Fahmy, Wardono, and Masrukan 2018). Therefore, students' independence in learning mathematics needs to be increased again, so that every indicator of learning independence can be achieved well (Rahayu and Aini 2021).

Another factor in students' low mathematical literacy in the material is students' lack of independence in learning so that in solving the questions given they still depend on explanations from educators and are less active in discovering their own knowledge. Then the learning model used plays a very important role in shaping students' mathematical literacy so that it is better. One of the independent learning methods that can increase students' learning independence and mathematical literacy is self-directed learning. Self-directed learning is one type of learning that can be applied to develop mathematical literacy. Current developments in information and technology give students hope to take more initiative in their own learning (Liu et al. 2018).

Self-directed learning is increasing knowledge, skills, achievement and individual development starting with one's own initiative using one's own learning planning and doing it oneself, realizing one's own learning needs in achieving learning goals by creating one's own learning strategies and assessing one's own learning outcomes (Abubakar and Arshad 2015). According to Holec & Chamot there are four stages of independent learning as a syntax, namely planning, implementing, monitoring and evaluating (Zamnah and Ruswana 2018). Independent learning referred to in this case is independent learning that can be done

individually or in groups. On the other hand, there is a close relationship between independent learning and the ability to self-regulate independently (Kocdar et al. 2018). So a person's self-regulation ability to achieve learning goals is needed to achieve independent learning goals efficiently.

The effectiveness of learning should not only be determined by the learning model used, but the use of appropriate media will be able to maximize learning outcomes. The important role of learning media in the development of students' stimulus abilities in cognitive thinking (Kocdar et al., 2018). One of the media used to help self-directed learning to improve mathematical literacy is a module. Students will be helped in studying the material they will study using modules (Indriyani, 2019). The modules are structured systematically and interestingly so that students can use them to gain knowledge, control the problem solving process, understand problems, and examine and generalize problems independently (Fathonah et al., 2019). Students can learn independently according to the instructions contained in the module, educators as facilitators who guide and direct all activities in the learning process to follow the module instructions, so that learning activities are more effective and interactive through the discussion process (Sari Asih, 2021).

There are several previous research results that are relevant to this research, namely: 1) Mathematical literacy and critical thinking play an important role in facing the 21st century (Janah et al. 2019). The novelty of this research is that it will be seen whether there is an influence of self-directed learning assisted by modules on mathematical literacy on student learning independence; 2) There is a significant influence of independent learning on mathematics learning outcomes (Ratna Puspita Indah 2021). Learning independence has a positive influence on mathematics learning outcomes. Therefore, to improve student learning outcomes, it is necessary to increase student learning independence. The most recent research that has been carried out is that in this research we want to see the influence of self-directed learning assisted by modules on mathematical literacy on student learning independence; 3) Self-directed learning can help students to carry out independent learning and be able to solve problems independently (Loyens, Magda, and Rikers 2008). The most recent research that has been carried out is that this research uses a module to look at mathematical literacy and will be reviewed with students' learning independence. Based on the description above, research will be conducted that focuses on the influence of self-directed learning assisted by modules on mathematical literacy in terms of student learning independence.

RESEARCH METHODS

Research Type

This research is a quantitative research. Quantitative research was used to determine the effect of self-directed learning assisted by modules on mathematical literacy in terms of students' learning independence. Quantitative methods are used for research on certain populations or samples, collecting data using research instruments, analyzing quantitative/statistical data, with the aim of testing predetermined hypotheses. The experimental design used in this research is factorial experimental in Table 1.

Table 1
Factorial Experimental Design

Learning Model (A_i)	Students' Learning Independence		
	High (B_1)	Medium (B_2)	Low (B_3)
Self-Directed Learning Assisted By Modules Class (A_1)	(A_1B_1)	(A_1B_2)	(A_1B_3)
Discovery Learning Class (A_2)	(A_2B_1)	(A_2B_2)	(A_2B_3)

Research Time and Place of

This research was carried out at MA Plus Walisongo Kotabumi. The research was conducted within 1 month, namely 1 - 31 May 2023.

Research Population and Sample

The population in this study were all tenth grade students at MA Plus Walisongo Kotabumi. The samples in this study were students of class X MIA 1 as the self-directed learning assisted by modules class (experiment) with a total of 32 students and students of class X MIA 2 as the Discovery Learning class (control) with a total of 32 students. The sample in this study was taken by simple random sampling.

Procedure

Students are given test questions with indicators of mathematical literacy to obtain initial data before being given useful treatment to see whether the two classes have the same abilities. If both classes have the same abilities, then the research can be continued by giving different treatment to the experimental and control classes. Then, researchers provided treatment with self-directed learning assisted by modules in the experimental class and Discovery Learning in the control class. Each class was given treatment for 4 meetings. After the learning is complete, a mathematical literacy posttest and a student learning independence questionnaire are given.

Data Sources, Instruments and Data Collection Techniques

This research data was taken from MA Plus Walisongo Kotabumi. The instruments used were mathematical literacy test and questions student learning independence questionnaire. The data collection technique in this research uses a mathematical literacy test in the form of description questions and a learning independence questionnaire.

Data Analysis Technique

Quantitative data analysis in this research consists of initial data analysis and posttest which can be seen as follows. Initial data analysis in this study used mathematical literacy test scores before being given treatment which included normality tests, homogeneity tests, and average similarity tests. Posttest analysis, after being given treatment in the self-directed learning class assisted by modules and the Discovery Learning class, will then be given a posttest mathematical literacy test. Before testing the hypothesis, prerequisite tests will be carried out on the posttest obtained, namely the normality test and homogeneity test. If the data obtained is normally distributed and comes from a homogeneous population, an influence test will be carried out using two-way analysis of variace (ANOVA) tests.

RESEARCH RESULTS AND DISCUSSION

Research Results

Table 2 shows the results of the initial data normality test using the Kolmogorov-Smirnov[a] test.

Table 2
Kolmogorov-Smirnov[a] Initial Data Normality

	Statistic	df	Sig.
MIA 1	.154	32	.053
MIA 2	.149	32	.067

Based on the results of the Kolmogorov-Smirnov normality test. The value obtained is $Sig = 0{,}053 > 0{,}05$ for pretest for class X MIA 1 and $Sig = 0{,}067 > 0{,}05$ for pretest for class X MIA 2. This means that H_0 is accepted. It can be concluded that both samples come from a normally distributed population.

Table 3
Homogeneity Test Results from Initial Data with Levene's Test

Statistic	Pretest Score
$p - Value$	0,385
$Homogeneity$	$p - Value > 0{,}05$
Conclusion	Homogeneous

Based on the results of the homogeneity test using Levene's test, the value $Sig = 0{,}385 > 0{,}05$ was obtained. This means H_0 is accepted. It can be concluded that the variance of the two samples is the same.

Table 4
Average Similarity Test Using The Independent Sample T-Test

		t-test for Equality of Means				
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Initial Data	Equal variances assumed	.724	62	.472	1.0344	1.4293
	Equal variances not assumed	.724	59.931	.472	1.0344	1.4293

Based on the results of the average similarity test using the Independent Sample T-Test. The value obtained is $Sig = 0{,}472 > 0{,}05$. This means that H_0 is accepted, meaning there is no difference in the average or the two samples have the same ability. Because both classes have the same abilities, the research can be continued by giving different treatments to the experimental and control classes.

After being given self-directed learning treatment assisted by modules for the experimental class and Discovery Learning for the control class, students will be given a posttest. Then the posttest results will be tested again for normality and homogeneity.

Table 5
Kolmogorov-Smirnov[a] Posttest Normality

	Statistic	Df	Sig.	Criteria	Conclusion
Self-directed learning	.136	32	.141	Sig.> α	Normal Distribution
Discovery learning	.149	32	.068	Sig.> α	Normal Distribution

Based on the results of the Kolmogorov Smirnov normality test calculations in the mathematical literacy posttest, a value of sig = 0,141 was obtained in the self-directed learning class so that $sig. > \alpha$, while in the Discovery learning class the value of sig = 0.068 was obtained so that sig.>α. So it can be concluded that the data for both classes is normally distributed.

Table 6
Homogeneity Test Results from Posttest with Levene's Test

Statistic	Pretest Score
$p - Value$	0.172
Homogeneity	$p - Value > 0{,}05$
Conclusion	Homogeneous

Based on the results of homogeneity test calculations using Levene's test in the table, the value of sig = 0.172 is obtained so that sig>α. So it can be concluded that the variance of the self-directed learning class is the same as the discovery learning class or is homogeneous.

Table 7
Description of Posttest Score Data

Treatment	N	Range	Min	Max	Mean
Self-directed Learning	32	19	65.50	84.50	76.93
Discovery Learning	32	22.60	63.10	85.70	72.47

Table 7 shows that the class using the Self-directed Learning got a mean value of 76.93, while the class that used the Discovery Learning got a mean value of 72.47. The highest mean value was obtained in the class with the Self-directed Learning.

Table 8
Description of Learning Independence

Mathematical Literacy	Learning Independence Category	Mean
Self-directed Learning	High	80.19
	Medium	77.68
	Low	69.65
Discovery Learning	High	79.64
	Medium	70.60
	Low	65.63

Table 8 shows that classes that use Self-directed Learning in the high learning independence category get an average score of 80.19, medium get an average score of 77.68, low get an

average score of 69.65. While the class that used Discovery Learning in the high learning independence category got an average score of 79.64, medium got an average score of 70.60, low got an average score of 65.63.

After carrying out the prerequisite tests, namely posttest normality and homogeneity as shown in table 5 and table 6, the results showed that the requirements for normality and homogeneity of the data had been met so it was feasible to carry out further analysis to test the hypothesis. The results of the two-way ANOVA interaction test obtained (ANOVA 2 × 3) follow.

Table 9
Two-Way Anova Test Results

Variant Source	Sig.	Criteria	Conclusion
Treatment	0.00	$Sig. < 0.05$	H_{0A} is rejected
Learning Independence	0.00	$Sig. < 0.05$	H_{0B} is rejected
Treatment * Learning Independence	0.01	$Sig. < 0.05$	H_{0AB} is rejected

Based on calculations using IBM Statistics SPSS 26, the results obtained are: 1) sig value. 0.00 < 0.05 then the H_{0A} is rejected so there is an influence of self-directed learning assisted by modules on students' mathematical literacy. 2) sig value. 0.00 < 0.05 then H_{0B} is rejected so there is an influence of high, medium and low learning independence categories on students' mathematical literacy. 3) sig value. 0.00 < 0.05 then H_{0AB} is rejected so that there is an interaction between self-directed learning assisted by modules and the category of independent learning on students' mathematical literacy.

After obtaining the results, it turns out that there is a significant interaction between self-directed learning assisted by modules and the category of independent learning on students' mathematical literacy, so further testing will be carried out using the Post Hoc test. The results obtained can be seen in Table 10 below.

Table 10
Post Hoc Test Results

Post Hoc		Sig.	Criteria	Conclusion
A_1B_1	A_1B_2	0.64	$Sig. > 0.05$	H_0 is accepted
	A_1B_3	0.00	$Sig. < 0.05$	H_0 is rejected
A_1B_2	A_1B_3	0.00	$Sig. < 0.05$	H_0 is rejected

This further test serves to determine the comparison between the third groups obtained. The results obtained after students were given self-directed learning treatment assisted by the module were: 1) there was no difference in mathematical literacy between those who had high learning independence (B_1) and those who had medium learning independence (B_2). This was confirmed by the Sig value. 0.64 > 0.05 ; 2) there is a difference in mathematical literacy between those who have high learning independence (B_1) and those who have low learning independence (B_3). This is confirmed by the Sig value. 0.00 < 0.05 ; 3) there is a difference in mathematical literacy between those who have medium learning independence (B_2) and those who have low learning independence (B_3). This is confirmed by the Sig value. 0.00 < 0.05.

Discussion

Researchers are very interested in Self Directed learning. Because, independent learning that can increase students' learning independence and mathematical literacy is one of the self-directed learning. Independent learning referred to in this case is independent learning that can be done individually or in groups. The effectiveness of learning should not only be determined by the learning model used, but the use of appropriate media will be able to maximize learning outcomes. The important role of learning media in the development of students' stimulus abilities in cognitive thinking (Indriyani 2019). One of the media used to help self-directed learning to improve mathematical literacy is a module. Students can improve their mathematical literacy through a series of materials and a series of activities that direct students to discover their own knowledge and through the questions contained in the module. Apart from the learning model and the media used, affective aspects also need to be considered, such as learning independence. The higher the learning independence of students, the higher their mathematics learning outcomes will be. Vice versa, the lower the learning independence of students, the lower the learning outcomes will be (Riyanti 2021). So this research is different from previous research, where this research will focus on looking at the influence of self-directed learning with the help of modules on learning independence. Review of students' learning independence.

The learning process is an activity that reflects educational value. The findings from the results of this research are: 1) there is an influence of self-directed learning assisted by modules on students' mathematical literacy, where students who were treated using self-directed learning assisted by modules had higher scores than students who were treated using discovery learning. This result is also in line with previous research where the average test score for the experimental class was better than the control class (Indriyani 2019). Self-directed learning is a form of learning that can improve mathematical literacy. Current developments in information and technology give students hope to take more initiative in their own learning (Fathonah, Mariani, and Sukestiyarno 2019); 2) there is an influence of high, medium and low learning independence categories on students' mathematical literacy. Learning independence is one of the intellectual references for students (Sari Asih 2021). The higher the learning independence of students, the higher their mathematics learning outcomes will be. Vice versa, the lower the learning independence of students, the lower the learning outcomes will be (Witri Lestari 2018); 3) there is an interaction between self-directed learning assisted by modules and the category of independent learning on students' mathematical literacy. Self-directed learning is increasing knowledge, skills, achievement and individual development starting with one's own initiative using one's own learning planning and doing it oneself, realizing one's own learning needs in achieving learning goals by creating one's own learning strategies and assessing one's own learning outcomes (Dian Nafisa, Sukestiyarno 2021). On the other hand, there is a close relationship between independent learning and the ability to self-regulate independently (Amaliyah, Sukestiyarno, and Asikin 2021). One of the learning models that is closely related to independent learning and developing students' mathematical literacy skills is self-directed learning (S.Sirate and Ramadhana 2017).

After obtaining the results, namely that there was a significant interaction between self-directed learning assisted by modules and the independent learning category on students' mathematical literacy, then a further test was carried out, namely the Post Hoc test.

This further test serves to determine the comparison between the third groups obtained. The results obtained after students were given self-directed learning treatment assisted by the module were: 1) there was no difference in mathematical literacy between those who had high learning independence and those who had medium learning independence; 2) there is a difference in mathematical literacy between those who have high learning independence and those who have low learning independence; 3) there is a difference in mathematical literacy between those who have medium learning independence and those who have low learning independence. One of the affective aspects that is closely related to mathematical literacy skills is students' learning independence. Learning independence significantly influences mathematical literacy skills (Chuseri, Anjarini, and Purwoko 2021). Students' independence in learning mathematics needs to be increased again, so that every indicator of learning independence can be achieved well (Rahayu and Aini 2021).

Based on the explanation above, the learning model used plays a very important role in learning outcomes such as self-directed learning. The learning model will be better if there is a role for learning media, one of which is modules. With the learning model and media used, it is necessary to pay more attention to the affective aspects of students, especially learning independence. It turns out that the learning model and media used, namely assisted self-directed learning modules, have an effect on mathematical literacy. The affective aspect of independent learning also influences mathematical literacy. Self-directed learning assisted by modules and the independent learning category also interact with mathematical literacy. This research has obtained results, and has described its findings. Where, no one has done this research before.

CONCLUSION

Based on the results of the study, it can be concluded that: 1) there is an influence of self-directed learning assisted by modules on students' mathematical literacy; 2) there is an influence of high, medium and low learning independence categories on students' mathematical literacy; 3) there is an interaction between self-directed learning assisted by modules and the category of independent learning on students' mathematical literacy.

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