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The Effect of Blended Learning on Metacognitive Awareness, Self-Efficacy, Learning Independence, and Learning Achievement of Senior High School/MA Students

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Abstract: The purpose of this study is to find out whether there is an influence of blended learning on metacognitive awareness, self-efficacy, student learning independence, and student learning achievement and to find out whether blended learning is superior to scientific learning in mathematics learning in the aspects of metacognitive awareness, self efficacy, student learning independence, and student learning achievement. This research is a pseudo-experimental research with the population of all students in grade XI MAN 2 Wonosobo for the 2023/2024 school year. Of the ten existing classes, two classes were selected by purposive sampling, namely classes XI - 3 and XI - 4. From the two selected classes, then randomly selected so that class XI - 4 was obtained as an experimental class, namely the class that received blended learning and class XI - 3 as a control class that received mathematics learning with scientific learning and vector subjects. The instruments used to collect data are in the form of student learning achievement test questions and questionnaires on metacognitive awareness, self-efficacy, and student learning independence. Validity is determined by the consideration of the validator who concludes that the instrument used in this study is valid. Meanwhile, Cronbach's alpha of all variables in this study showed reliable values. To see if there is an effect of blended learning on metacognitive awareness, self-efficacy, learning independence and student learning achievement after research treatment is carried out in both the experimental and control classes, the T2 hotteling statistical test is used. Meanwhile, to see the advantages of scientific learning with blended learning methods compared to scientific from the perspective of metacognitive awareness, self-efficacy, learning independence and student learning achievement from both classes, univariate t test statistics were used. The results of the study showed that :(1) there was an effect of blended learning on metacognitive awareness, self-efficacy, learning independence, and student achievement simultaneously; (2) scientific blended learning is not superior to scientific in terms of metacognitive awareness, self-efficacy, and learning independence of high school/MA students; (3) scientific blended learning is superior to scientific in terms of learning achievement of high school/MA students.

Keywords: Blended, Learning, Independence, Metacognitive, Self-Efficacy.

1. INTRODUCTION

Education is also one of the aspects affected by the Covid-19 pandemic. The Covid-19 outbreak prompted the Government to issue a learning policy from face-to-face or offline learning to online learning which had never been carried out simultaneously before for all elements of education, namely students, teachers and parents (Yang, Y., et al., 2020) . The COVID-19 pandemic has drastically changed the global education landscape, forcing institutions to adopt distance learning methods to ensure the continuity of the teaching and learning process.

Garrison and Vaughan (2008) emphasize that blended learning not only provides opportunities for students to learn independently but also enriches interaction and collaboration in face-to-face contexts. This becomes very relevant post-pandemic, where students need to

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adapt to a more hybrid way of learning. Means et al. (2010) shows that the blended learning approach tends to produce better learning outcomes than traditional or online learning alone. There is another learning model, namely hybrid learning. Hybrid learning is a learning model that integrates various learning methods, both online and offline, with an emphasis on a more flexible and adaptive learning experience.

In 2022, the world will finally witness the end of the COVID19 pandemic which has changed almost all aspects of life, including the education sector. One method that continues to be used and developed is blended learning, which has been proven to provide flexibility and effectiveness in supporting the teaching and learning process in times of crisis. Thus, this research is important to explore the effectiveness of learning using blended learning after the COVID-19 pandemic, considering the potential of this model in improving the quality of education and students' adaptability to dynamic learning situations. Limited infrastructure and technological readiness are also major concerns in implementing blended learning in various educational institutions.

Albert Bandura (1997) stated that self-efficacy will influence academic achievement. Students with low self-efficacy in carrying out certain tasks will tend to avoid tasks that they consider difficult and unable to be completed. In mathematics subjects, students cannot avoid the tasks that must be completed as a form of responsibility as students. Students are required to be able to complete all assignments well as a reflection and evaluation of students' mastery of the material that has been taught.

In Utami's (2017) research, the self-efficacy of middle school students in Ciamis was in moderate condition. This is reinforced by the findings of Sukoco and Mahmudi (2016) who stated that students felt insecure and even afraid if asked by the teacher to explain the answers they obtained, students felt afraid if the answer was wrong, and students also felt afraid if they could not communicate the results they obtained clearly. thorough and accurate in front of his friends.

In research by Yuan et al, (2020) the blended learning method can increase students' metacognitive awareness. Yuan further explained that the blended learning method has a rapid increase in metacognitive awareness compared to the usual Problem Based Learning method so that blended learning is one of the key factors in increasing students' metacognitive awareness. So this research will use learning using the Blended learning method.

Blended learning also affects mathematics learning achievement. Research conducted by Ya-Wen Lin, Chih-Lung Tseng and Po-Jui Chiang (2016) stated that blended learning provided benefits to junior high school students in the experimental group not only from their

learning achievements, but also from their attitudes towards mathematics. The students gave a positive response in learning mathematics using the Moodle platform after blended learning.

Theoretically and empirically, the research results that have been presented show that blended learning has a positive impact on several students' abilities. Therefore, this research aims to determine the effect of blended learning on metacognitive awareness, self-efficacy, learning independence, and learning achievement of high school/MA students in the post-Covid-19 pandemic period.

2. METHODOLOGY

This research is quantitative research using a quasi experimental design. This design uses assessments from nonrandom participants in two independent samples. The selection of participants was appropriate (not random) because of the limitations of the researcher's intervention on the class structure that had been formed by the school. The researcher only chose two classes from all the classes in the school. Researchers will use two class samples consisting of an experimental class that will be given blended learning and a control class that will be given face-to-face learning with scientific learning.

The research design used was pretest and posttest in the quasi experimental design. In this design, tests are carried out before and after treatment is given. The results of the test are calculated and concluded based on appropriate data analysis techniques. Interpretation of the results takes the form of explaining the effects of treatment in a multivariate and univariate manner.

Table 1. Research Design Table

Class Experiment	*Pretest*	Scientific learning with Blended Learning	*Posttest*
Control Class	*Pretest*	Ordinary scientific learning	*Posttest*

Next, the following is table 2 which contains the differences between the research designs for ordinary scientific learning and scientific learning with blended learning carried out in this research.

Table 2. Differences between regular scientific learning and scientific learning with blended learning

Aspects	Scientific Learning	Scientific Learning with Blended Learning
The role of the teacher	Facilitator who guides students in scientific process	Facilitators who direct learning both in class and online, provide materials and activities via digital platforms.
Student Roles	Active in the learning process in class	Active in both learning environments, responsible for online learning and classroom interactions in face-to-face learning.
Method Learning	Using a discussion approach	Uses a combination of face-to-face and online methods, including discussions, videos, and digital assignments.
Method Learning	At a minimum, use only when relevant to activities in class	Very high, using online learning platforms, digital collaboration tools, and multimedia learning resources
Interaction	Live interaction and group discussions, emphasis on collaboration and teamwork.	Face-to-face and online interactions, including discussion forums, video conferencing, and digital collaboration.
Flexibility of time and place	Limited to class schedule	Very flexible, allowing students to study anytime and anywhere with internet access.

This research was carried out at MAN 2 Wonosobo in Wonosobo Regency. The research time is from 2 to 30 May 2024, academic year 2023/2024, even semester. The population of this research is all MAN 2 Wonosobo students in the even semester of the 2023/2024 academic year. Researchers used cluster sampling techniques in determining the research sample. There are two classes that are the research samples, namely classes XI - 3 and XI - 4. Classes XI - 3 are given regular scientific learning while classes XI - 4 are given scientific learning with blended learning.

The data collection technique chosen was to use two types, namely test and non-test. Tests are used to collect data on student learning achievements, while non-tests (in the form of questionnaires) are used to collect data related to students' metacognive awareness, self-efficacy and learning independence in class.

The data analysis technique was carried out using descriptive analysis, used to describe the pretest results before implementing blended learning and describing the posttest results after implementing blended learning. Then, this analysis is used to describe the effect of mathematics learning with blended learning on metacognitive awareness, self-efficacy, learning independence and student learning achievement.

3. RESULT AND DISCUSSION

Research Results

a) Description of research results

The research was carried out from May 2 2024 to May 30 2024 in classes XI - 3 and classes XI - 4 with the topic of discussion being vectors. The learning schedule in these two classes is carried out on Mondays and Thursdays. In this research, the experimental class used Blended Learning, while the control class used scientific learning.

The average implementation of the experimental class which used blended learning with scientific learning was 87.25%, while the control class which used scientific learning had an average implementation of 84.5%. Table 16 below is a breakdown of the average percentage of learning implementation.

Table 3. Average learning implementation

Meeting	Percentage			
	Experimental Class		Control Class	
	Activity Teacher	Activity Student	Activity Teacher	Activity Student
Meeting 1	88 %	88 %	88 %	88 %
Meeting 2	85 %	85 %	85 %	85 %
Meeting 3	88 %	88 %	77 %	77 %
Meeting 4	88 %	88 %	88 %	88 %
Average	87,25 %	87,25%	84,5 %	84,5 %

b) Description of Metacognitive Awareness, Self Efficacy, Learning Independence, and Learning Achievement

Data for metacognitive awareness, self-efficacy, learning independence, and learning outcomes are described thoroughly using descriptive statistical analysis, including minimum value, maximum value, average, mode, median, and standard deviation.

Table 4. Statistical Data for Research Variables

Class	Parameter	MA		SE		LI		LI	
		Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Experiment	Minimum	92	94	32	27	46	48	53,33	20
	Maximum	161	145	73	65	85	82	100	93,33
	Average	130,3	123,3	52	50,94	67,33	64,64	84,27	53,74
	Median	134	125	50	50	66	65	86,67	53,33
	Std deviasi	18,49	13,58	9,94	7,72	10.07	7.63	13,16	18,02
Control	Minimum	87	83	30	30	50	47	0	33.3
	Maximum	173	175	74	70	86	89	100	100
	Average	126,4	125,8	52,03	48,06	64,33	62,42	81,21	73,74
	Median	126	122	52	50	64	61	86,67	80
	Std deviasi	20,06	19,11	8,86	9,30	9,08	8,72	20,03	14,61

Information:

MA : *Metacognitive awareness*

SE : *Self Efficacy*

LI : Learning Independence

LA : Learning Achievement

c) Assumption Test

Testing uses the R-Studio statistical test assistance application. Based on the Henze-Zirkler test, the results of the experimental class normality test had a p-value of 0.08849209. Then the normality test results for the control class have a p-value of 0.0688102.

Based on the Henz-Zirkler test, it can be seen that the p value is greater than 0.05, so H0 is accepted, meaning the sample comes from a population with a multivariate normal distribution. All dependent variables in the experimental class and control class follow a normal distribution in each group.

The homogeneity test is used to determine whether the variance of a population group is homogeneous or not. Test $box's\ M$ for the homogeneity matrix of the covariance matrix using R-Studo.

Table 5. Box's M test results

Test	Statistics	p-value
$box's\ M$	X^2 =12.351	0.2622

From the M box test, it is obtained that $X2$ = 12.351 and p-value = 0.2622> 0.05, so H0 is accepted, meaning that the assumption of homogeneity of the covariance matrix is met.

The Manova assumption test on the data in this study has been fulfilled, then pretest data analysis is carried out using the Manova test. This test was carried out to find out whether the two students in the experimental class and control class had the same abilities. Testing this hypothesis uses Hotteling's $T2$. The interpretation of Hotteling's $T2$ is that if the p-value <0.05 then H0 is rejected, and it can be concluded that the two groups are significantly different. Testing using the Rstudio application.

Tabel 6. Hasil uji *Hotteling's T^2*

Uji	Statistik	p-value
Hotteling's T^2	X^2 = 2.6161	0.624

Based on the results of Hotteling's $T2$, the value obtained is $T2$ = 2.6161 with a p-value = 0.624. The p-value is greater than 0.05 which indicates that H0 is accepted, meaning that there is no significant average difference between metacognitive awareness, self-efficacy, learning independence and student learning outcomes in the experimental class and the control class. There is no difference indicating that students in the experimental class and students in the control class have the same abilities.

d) Data Analysis After Treatment

Experimental class multivariate normality test using HenzeZirkler. Testing the Henze-Zirkler test uses the RStudio statistical test assistance application. The test results show that the p-value is 0.07054423. The results of the control class multivariate normality test have a p-value of 0.2458614.

From the results of the Henze-Zirkler test, it was found that each experimental class and control class had a p-value of 0.07054423 and 0.2458614, where both p-values were greater than 0.05, so H0 was accepted, meaning the sample came from a distributed population. multivariate normal. The univariate normality test used in the experimental class and control class was the Shapiro-Wilk test.

Table 7 Recapitulation of post-test normality test results

Class	Variabel	P-Value	Assumption of Normality
Experiment	*metacognitive awareness*	0.08065	Fulfilled
	self efficacy	0.1047	Fulfilled
	learning independence	0.9944	Fulfilled
	learning achievement	0.3072	Fulfilled
Control	*metacognitive awareness*	0.5911	Fulfilled
	self efficacy	0.5869	Fulfilled
	learning independence	0.1741	Fulfilled
	learning achievement	0.5911	Fulfilled

The homogeneity test is used to determine whether the variance of the sample group is homogeneous or not. Test $box's\ M$ for the homogeneity matrix of the covariance matrix using R-Studio.

Table 8. Box's M homogeneity test results

Uji	Statistik	p-value
$box's\ M$	$X^2 = 14.553$	0.1492

The homogeneity test is used to determine whether the variance of the sample group is homogeneous or not. Test $box's\ M$ for the homogeneity matrix of the covariance matrix using R-Studio.

Table 9. Hotteling's $T2$ posttest results

Uji	Statistik	p-value
Hotteling's T^2	$X^2 = 26{,}567$	2,432e-05

Based on the results of Hotteling's *T*2, the value obtained is *T*2 = 26.567 with a p-value = 2.432e-05. The p-value is smaller than 0.05, which indicates that H0 is rejected, meaning that there is a significant average difference between metacognitive awareness, self-efficacy, learning independence and student learning outcomes in the experimental class and the control class.

After knowing that blended learning as a whole has a significant influence on metacognitive awareness, self-efficacy, learning independence and student learning outcomes, the next step is to find out whether there is an influence of blended learning on each variable.

Table 10. Results of the t test for two independent samples on blended learning

Variabel	t-value	*P-Value*
metacognitive awareness	0,60869	0,5449
self efficacy	-1,3675	0,1762
learning independence	-1,096	0,2772
learning achievement	4,9508	5,678e-06

It can be seen that blended learning has no effect on students' metacognitive awareness because the p-value = 0.4172 > 0.05 means that H0 is accepted, so blended learning has no effect on students' metacognitive awareness. The p-value of the student self-efficacy variable is 0.1678 which has a value higher than 0.05 and H0 is accepted, which means learning using blended learning has no effect on student self-efficacy. The learning independence variable has a p-value of 0.1101 which is greater than 0.05, which means that H0 is accepted so that blended learning does not have a significant influence on student learning independence. Blended learning is superior in terms of student achievement because it has a p-value of 5.678e-06 which is smaller than 0.05 so H0 is rejected.

Research Discussion

Even though blended learning has been widely applied and studied, the results of this research show that the application of this learning method does not have a significant impact on increasing students' metacognitive awareness. Because based on the research results, it was found that the p-value was 0.5449 which was greater than 0.05, which means H0 was accepted. These findings are in line with studies conducted by Hyytinen et al. (2021), who indicated that

the relationship between deep learning approaches and metacognitive awareness is not always visible in blended learning environments. In addition, Nikolopoulou and Zacharis (2023) found that students' uncertainty regarding group work in blended learning can hinder the development of their metacognitive awareness. One of the reasons blended learning does not have a significant impact on students' metacognitive awareness is that not all blended learning implementations are managed with the same quality. According to Halverson et al. (2014), differences in curriculum design, material quality, and evaluation methods can influence learning outcomes

The results of this research also show that the blended learning method does not have a significant impact on increasing student self-efficacy. This is in line with findings from previous research which stated that changes in learning methods were not always associated with increasing students' self-confidence in their abilities. For example, research by Kintu et al. (2017) found that there was no significant change in the self-efficacy of students who participated in a blended learning program. These findings emphasize the need for additional or different approaches to effectively increase student self-efficacy in blended learning environments.

This research also shows that blended learning does not affect student learning independence. In line with research which shows that in blended learning there is no substantial difference in students' ability to learn independently compared to traditional learning (Kiviniemi, 2014). In this research, it was stated that student characteristics such as motivation, discipline and time management skills greatly influence learning independence.

According to Shahid, the effectiveness of blended learning really depends on how learning materials and activities are designed and implemented. Designs that are less than optimal or do not suit student needs can hinder the development of student independence and learning achievement. In this case the researcher realized that the research design carried out by the researcher had shortcomings so that it became one of the factors in the research results which caused blended learning to not have a significant influence on learning independence and student achievement.

Furthermore, blended learning shows a significant influence on student learning achievement. In line with research by Means et al. (2010), students who take part in learning using the blended learning method show better learning outcomes compared to students who only study using traditional methods. Apart from that, blended learning also increases students' access to various digital learning resources that are not limited to the material provided in class. This allows students to dig deeper into knowledge and strengthen their understanding of the

material being taught. Furthermore, research by Graham (2006) shows that in blended learning environments, students are often faced with situations that require them to use technology to complete their assignments, which in turn improves their digital skills.

4. CONCLUSION

Based on the research results that have been explained, it shows that there is an influence of blended learning on metacognitive awareness, self-efficacy, learning independence and student learning achievement simultaneously, but the application of blended learning does not show a significant increase in the aspects of metacognitive awareness, self-efficacy, independence. student learning and student learning achievement. This research was carried out in less than optimal conditions because it was not possible to carry out online learning via an online platform outside of class hours because there were 12 students or almost half of the students in the experimental class who lived in dormitories or Islamic boarding schools which did not allow them to bring cellphones, so to Only some students can participate in online learning outside KBM hours. Even though this research was carried out in conditions that were not optimal, the results were still quite good.

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