THE EFFECT OF IMPROVE METHOD ON MATEMATICAL UNDERSTANDING ABLILITY AND SELF-DEVELOPMENT

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Mathematical concepts must not only be understood or memorized in order for students to learn them effectively. Learners will more easily achieve learning objectives if they have a strong ability to understand mathematical concepts. However, in reality, researchers found that there are still many students who have difficulty in understanding the mathematical concepts taught by teachers during their education. This hampers the learning process because it causes the teacher to have to repeat the material continuously. The research method used was a pseudo-experiment with a 2x2 factorial design with level-based treatment. The data analysis technique used two-way ANOVA. The results of this study are as follows: 1) Overall mathematical understanding ability of students taught with IMPROVE method is higher than students taught with conventional method; 2) There is an interaction between learning method and PAM on mathematical understanding ability; 3) For students with high PAM, the mathematical comprehension ability of students taught with IMPROVE method is higher than that of students taught with conventional method; 4) For students with low PAM, the mathematical comprehension ability of students taught with IMPROVE method is higher than that of students taught with conventional method. For students with low PAM, the mathematical comprehension ability of students taught with IMPROVE method is lower than students taught with conventional method; 5) Self-development of students taught with IMPROVE learning method is higher than students taught with conventional method.

A. INTRODUCTION

After making observations, researchers focused on directing students to be able to understand the concept of a subject rather than just remembering mathematical formulas or concepts. Mathematical concepts must not only be understood or memorized so that students can learn them effectively. Learners are easier to achieve learning objectives if they have a strong ability to understand mathematical concepts. To be able to understand and remember the concept of the next material must first understand the concept of the previous material. Thus it is expected that students can understand mathematical concepts well. The National Committee of Instructors of Science (NCTM, 2000) in a diary on standards and measures in school arithmetic states inquire about has set up the significance of conceptual understanding aptitudes in learning science "Investigate has positively built up the vital part of conceptual understanding within the learning of science". Permendikbud No. 37 of 2018 which has been submitted by NCTM states that it is contained in the core

competencies, so the content of mathematics learning is appropriate for educators to direct students to be able to see good mathematical concepts. However, from several studies that have been conducted in various regions in Indonesia, it appears that the ability of students to understand numerical concepts is still relatively low. This is in accordance with research (Hidayah & Lisdawati, 2014)(Rosita, 2018) which found that there are still many students who have difficulty understanding the mathematical concepts taught by teachers during their education. This hampers the learning process because it causes the teacher to have to constantly repeat the material.

In line with (Karim & Nurrahmah, 2018) although teachers have made every effort to ensure that students are able to understand mathematics as expected, these symptoms still exist. The mathematical prior knowledge of students also contributes greatly to the understanding ability of students, it is often found during the teaching and learning process that students who have high category mathematical prior knowledge are easy to master the lesson / material. While students who are classified as having a low category have difficulty understanding the material, in accordance with research conducted (Alan & Afriansyah, 2017) this is influenced by the learning methods used by the teacher when teaching. To achieve mathematics learning objectives optimally, you can use alternative methods according to (Kurnia Astuti, 2016), one of which is the Make strides strategy which is an acronym for "Presenting Metacognitive Addressing, Practicing, Checking on, and Diminishing Troubles Getting Dominance, Confirmation, Improvement and, Medicinal". A learning method that introduces concepts that are considered new to students, by providing metacognitive questions in students' learning activities, solving problems given by the teacher. In accordance with research (Soleha, 2017) Learners are given the opportunity to verify the correctness of their understanding and evaluate what they have learned so as to enrich their knowledge. This learning is very supportive in developing students' mathematical understanding skills.

In recent years, researchers have investigated not only cognitive aspects but also affective aspects that affect learners' attitudes. According to (Mohanty et al., 2016), one of these aspects is self-development, which is expected to have an impact on students' perceptions of their mathematical abilities. (Aryana et al., 2022) suggests that *self- development* is an important decision maker for decision making, for example perseverance in utilizing different challenges, and confidence in making the right steps at each step. The importance of using the IMPROVE method applied to the learning process and it is felt that it will be very effective and efficient so that students can improve their mathematical understanding abilities and *self-development* in learning, this can also make students easily understand further learning material. Reinforcement of material is very important in the learning

process so that students are able to build the concept of knowledge they have by honing the ability of understanding and *self-development* in students. Based on what has been described above, mathematical understanding ability, student *self-development* and IMPROVE method are needed to influence learning outcomes. To find out more clearly, the author tried to conduct research with the title of the effect of the IMPROVE learning model on students' mathematical understanding ability and *self-development* at SMP Negeri 6 in Serang City.

B. RESEARCH METHOD

This research was conducted using the *quasi-experiment* method. This method is used because it is impossible for researchers to fully control the variables that affect the course of experimental research. (Arikunto, 2012) states that in quasi-experiments subjects are not arbitrarily assembled. But the analyst acknowledges the condition of the subject because it is, meaning that it isn't conceivable to require investigate subjects from the existing populace, since the subjects (understudies) have actually shaped in one bunch (one course). The population of this study were VIII grade students at SMPN 6 Serang City in the 2023/2024 school year, consisting of 4 classes. The sample selection process used *purposive sampling* technique with 2 (two) classrooms selected with a total of 72 students, with each classroom consisting of 36 people. Specifically, class VIII.H was designated as the experimental group, receiving instruction through the IMPROVE learning method. In contrast, class VIII.I served as the control group, which used conventional learning methods. (Sugiyono, 2011) argues that this research is in accordance with the research design *Nonequivalent Group Posttest-Only Design* is a design in which there are two groups each selected randomly. The experimental group was treated with *IMPROVE* learning and the control group was not treated, meaning that conventional learning was used at the school.

This study used a *factorial design* 2 x 2 *treatment by level* in this study there were four research variables, namely two dependent variables, two variables(Sugiyono, 2011)(Sugiyono, 2011) states that the variable that is affected or becomes the result of the independent variable is called the "dependent variable", namely the mathematical understanding ability of students and *self-development* in this study. A variable that affects or becomes the root cause of the dependent variable is called the "independent variable", namely the *IMPROVE* learning method and the conventional learning method used by the school. In this study, there is one active variable and one predictor variable which is the independent variable in this study. *IMPROVE* learning approach (A_1) and conventional learning model (A_2) are the active variables in this study. In this study, Prior Mathematics Knowledge (PAM) serves as the predictor variable. High prior

mathematical knowledge (B_1) and low prior mathematical knowledge (B_2) are two categories of students' prior mathematical knowledge. Table.3.1 shows the relationship between learning and mathematics prior knowledge with mathematical understanding ability.

Table. 1 Research design with 2 x 2 factorial (the relationship between learning methods and PAM on mathematical understanding ability)

	PAM (B)	**Learning method (A)**	
		Methods *IMPROVE* (A_1)	**Methods conventional (A_2)**
PAM	High (B_1)	A1 B1	A2 B1
	Low (B_2)	A1 B2	A2 B2

Researchers also want to discuss the relationship between learning methods and students' *self-improvement*. In this study, students who were treated with the *IMPROVE* method ($_{C1}$) and students who were treated with conventional methods ($_{C2}$).

Table. 2 Research design with 2x1 factorial (IMPROVE method relationship to *self-development*)

Learning method	
IMPROVE Method ($_{C1}$)	Conventional method ($_{C2}$)
C1	C2

This design will look at the effect of learning methods on mathematical understanding ability and *self-development of* students, namely:

1) First effect ($_{A1}$ and $_{A2}$)
   The difference in mathematical understanding ability given the IMPROVE learningmethod with students given conventional learning methods.
2) Effect of interaction (A$\times$ B)
   The interaction effect between learning method and PAM on mathematical comprehension ability.
3) Simple effect
   a) Differences in mathematical understanding ability of students who were givenIMPROVE learning method and conventional learning method with high PAM (A1B1 and A2 B1).
   b) Differences in mathematical understanding ability of students who were givenIMPROVE learning method and conventional learning method with low PAM (A1 B2 and A2 B2).
4) Second effect ($_{C1}$ and $_{C2}$)
   Differences in *self-development of* students who are given IMPROVE learning methods with students who are given conventional learning methods.

Data were collected using a description instrument consisting of a

Mathematical Prior Knowledge (PAM) test in the form of multiple choice questions, a mathematical understanding ability test in the form of a description test and a *self-development* questionnaire in the form of a statement. This instrument was previously validated by 7 experts in the field of mathematics, namely 2 lecturers, 3 peers and 2 mathematics teachers. Furthermore, it was tested on students from different schools who had previously received the same material. To validate the instrument, validity test and reliability test were conducted. The instrument was considered valid based on the validity test ($p < 0.05$). The underlying purpose of this hypothesis is to ascertain whether there is an effect of IMPROVE learning method on comprehension ability and *self-development*.

C. RESULTS AND DISCUSSION

1. Analysis of Mathematical Prior Knowledge (PAM) Score

Data on mathematical prior knowledge (PAM) was obtained through a test of students' mathematical prior knowledge, which was given before the learning treatment in this study. The mean PAM before treatment is not too much different, namely the IMPROVE learning group of 10.47 and the conventional learning group of 8.86. The variance of the IMPROVE learning method group was 11.285 while the conventional learning group was 6.066. The next step is to conduct a prerequisite test, namely the normality test. The results of the normality test using the *Kolmogorov-Smirnov* test can be seen in table. 3:

Table.3 PAM Normality Test based on IMPROVE and Conventional Learning

		Method IMPROVE	Method conventional
N		36	36
Normal Parametersa,b	Mean	10,47	8,86
	Std. Deviation	3,359	2,463
Most Extreme Differences	Absolute	,142	,127
	Positive	,142	,127
	Negative	-,107	-,095
Test Statistic		,142	,127
Asymp. Sig. (2-tailed)		,066c	,148c

Table 3 appears that the in general likelihood esteem (sig. 0.066 > sig. 0.05) within the Make strides strategy and the likelihood esteem (sig. 0.148 > sig. 0.05) within the customary strategy. At that point test the homogeneity of fluctuation of PAM scores of understudies from two learning bunches with Levene test. Generally, the likelihood esteem (sig. 0.104 > sig. 0.05) for each learning gather with PAM is more than the noteworthiness level (α) of 0.05. This demonstrates that the invalid speculation (H0)

is acknowledged. Hence, the change of the two bunches is homogeneous. An balance test was conducted utilizing the Autonomous Test to decide whether there was a distinction within the implies of the two bunches (between understudies some time recently getting Progress and ordinary learning strategies). Sig esteem. (2-tailed) 0.027 is less than 0.05, at that point H0 is acknowledged, meaning that there's no distinction within the normal of the two exploratory and control classes. Based on these midpoints, the two Move forward learning strategy bunches and the routine learning strategy bunch unmistakably have no distinction. This shows that the invalid speculation (H0) is acknowledged.

The conclusion from the test was that the sample used in this study started with relatively similar PAM conditions for all categories so that the PAM groups could be compared. The sample has provided complete data in accordance with the research needs. The distribution of samples is presented in Table 4 based on the PAM category (high and low).

Table. 4 Distribution of KPM Research Samples based on high and low PAM

PAM (B)	Learning Method (A)	
	IMPROVE Method (A1)	**Conventional Method (A2)**
High ((B1)	($_{A1B1}$) 18 learners	($_{A2B1}$) 18 students
Low (B2)	($_{A1B2}$) 18 students	($_{A2B2}$) 18 students

Based on Table 4, the distribution of PAM samples in the high and low Pam categories is the same. This happens because as follows: (1) the PAM test instrumentused the same test designed by the researcher; (2) the time of the PAM test was not notified in advance so that the students were not ready to face the PAM test. Research samples that have been classified based on PAM categories (high and low). In this chapter, the results of the research data analysis of each test and its discussion are presented.

2. Analysis of Mathematical Comprehension Ability Score by Learningand PAM

Details of data on students' mathematical understanding ability (KPM) based on descriptive statistics consist of KPM test mean, and standard deviation (Sd) based on learning methods and mathematical prior knowledge (PAM). Shows each level of mathematical prior knowledge (PAM). In the low category PAM, the group of students who followed IMPROVE learning had an average of 80.28 and students who followed conventional learning had an average of 68.89. Furthermore, in the low category of PAM, the group of learners who get IMPROVE learning and conventional learning have an average KPM test of 65.56 and 64.72.

The results of the normality test of mathematical understanding ability (KPM) data for students based on the learning model and PAM with the *Kolmogorov-*

Smirnov Z test can be briefly presented in Table 5 as follows.

Table 5 Normality Test of KRM Data by Learning Method and High PAM

		IMPROVE Method	ConventionalMethod
N		18	18
Normal Parametersa,b	Mean	80,28	68,89
	Std. Deviation	9,151	9,785
Most Extreme Differences	Absolute	,155	,154
	Positive	,123	,154
	Negative	-,155	-,123
Test Statistic		,155	,154
Asymp. Sig. (2-tailed)		,200c,d	,200c,d

Table 6 Normality Test of KRM Data by Learning Methodand Low PAM

		IMPROVE Method	ConventionalMethod
N		18	18
Normal Parametersa,b	Mean	65,56	64,72
	Std. Deviation	10,966	9,773
Most Extreme Differences	Absolute	,258	,178
	Positive	,120	,101
	Negative	-,258	-,178
Test Statistic		,258	,178
Asymp. Sig. (2-tailed)		,073c	,136c

In the normality test for high PAM category learning, namely IMPROVE learning has sig. = 0.200 > sig. = 0.05 and in conventional learning has sig. = 0.200 > sig. = 0.05, this shows that both data are normally distributed or accept H_0 so it is feasible to use for further tests. In the normality test for low PAM category learning, namely IMPROVE learning has sig. = 0.073 > sig. = 0.05 and in conventional learning has sig. = 0.136 > sig. = 0.05, this shows that both data are normally distributed or accept H_0 so it is feasible to use for further tests. KPM homogeneity test results based on learning methods. Shows that the data of mathematical understanding ability of the two groups of IMPROVE learning method on high category PAM has a sig value. 0.863 > sig. 0.05 then H0 is accepted. Then the learning method group.

The conventional PAM in the high category has a sig value. 0.935 > sig. 0.05 then H_0 is accepted. To determine whether there is a difference in the improvement of students' mathematical understanding ability (KPM) between students who get the IMPROVE learning method and the convention learning method for high and low category PAM, the *Two-Way* ANOVA test is

conducted.

Table 7 *Two-Way* ANOVA Test Results of KRM based on learning model and PAM

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2779,167a	3	926,389	9,375	,000
Intercept	351401,389	1	351401,389	3556,141	,000
METHODS	672,222	1	672,222	6,803	,011
PAM	1605,556	1	1605,556	16,248	,000
METHOD * PAM	501,389	1	501,389	5,074	,028
Error	6719,444	68	98,815		
Total	360900,000	72			
Corrected Total	9498,611	71			

Based on Table 7, the results of the *Two-Way* ANOVA calculation with the help of SPSS.21.0 above show that the *sig* value. 0.028 is less than 0.050. This means that the null hypothesis *H0 is* rejected. Based on the data in Table 5.14 page 90, it can be seen that the interaction factor between the learning method and PAM causes an interaction. This can be seen in the interaction factor between PAM and learning methods obtained Sig = 0.028 <0.05 at the 5% significance level. This means that there is a very significant interaction between the factors of learning methods and mathematical prior knowledge onmathematical understanding ability.

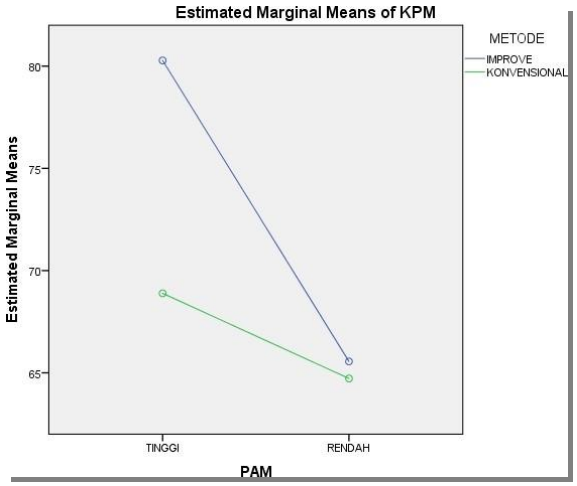

Figure 1 The interaction between learning methods and PAM on mathematical understanding ability (KPM)

Based on Figure 1, high PAM benefits the most with the IMPROVE method when compared to students who have low PAM. The interaction between learning strategies and scientific earlier information on scientific understanding capacity can be visualized with a chart.

3. Analysis of Statistical Description of *Self-Development* (SD) of Students in Learning Mathematics

Details of *Self-Development* data of students obtained from SD questionnaire of students. Shows the data of filling out the questionnaire *Self-Development of* students in the group that uses the IMPROVE learning method has a mean, which is 113.78 and the class treated with conventional learning methods has a mean of 106.19. The variance of the IMPROVE learning group is 135.778 in the conventional learning group which is 172.847.

The results of the normality test of the data for filling out the *self-development* questionnaire of students between those given the IMPROVE learning method treatment and those given the conventional learning method treatment using SPSS.21.0 with the *Kolmogorov-smirnov* Z test are briefly presented in Table 8 as follows.

		IMPROVE	Konvensional
N		36	36
Normal Parametersa,b	Mean	113,78	106,19
	Std. Deviation	11,652	13,147
Most Extreme Differences	Absolute	,125	,142
	Positive	,125	,142
	Negative	-,090	-,064
Test Statistic		,125	,142
Asymp. Sig. (2-tailed)		,170c	,063c

Table 8 Data Analysis of Normality Test of *Self-Development*

Whereas the comes about of the typicality test of students' self-development information on customary learning strategies appear the by and large likelihood esteem (sig.0,063) since it is more than the importance level (α) of 0,05. This implies that the H0 speculation is acknowledged. Homogeneity test analysis of students' *self-development* data from generative learning model groups and conventional learning models has a *sig.0.530* value more than sig. 0.05, so the H0 hypothesis is accepted.

To determine whether there is a difference in *self-development* between students who get IMPROVE learning methods and conventional learning methods, statistical tests are carried out using *independent tests* or *t-tests*. Shows the *Fcount* value of 0.019 and the probability (*sig.*) is less than 0, 05. This means that the null hypothesis (*H0*) is rejected, the difference in *self-development*

can also be seen. Through the results of the t-test calculation so as to get t count = 2, 397 $\geq$ 1.993 = *t* table at the significance level (α) of and with degrees of freedom (*dk*) = 72 so that H_0 is accepted.

D. DISCUSSION

Based on the fourth hypothesis testing that the mathematical understanding ability of students with low PAM who get the IMPROVE method is lower than students who get the conventional method. But in fact, *H0* is accepted, which means that there is no significant difference for groups of students with low PAM who are taught the IMPROVE method or those taught by conventional methods. In line with (Yuliani et al., 2018) low PAM student groups tend to give up easily in working on mathematical understanding ability tests. This is because groups of students who have low PAM are not used to working on mathematical understanding ability test questions, they prefer to work on procedural problems. Furthermore, students with low PAM are students who have low comprehension skills.

This causes students who have low PAM who are treated with the IMPROVE method to be no different from students who have low PAM in students who are treated with conventional methods. The IMPROVE method is a learning model based on the theory of constructivism. Learning on constructivism requires students to be able to construct their knowledge by means of group discussion activities, students construct their knowledge from the concepts they already have to form new concepts learned, so that the IMPROVE learning model pays great attention to the initial knowledge of students. This is in line with the opinion (Hidayah & Lisdawati, 2014) that learning in constructivism is not an activity of exchanging information from instructors to understudies, but or maybe an action that permits understudies to construct their claim information, discover something valuable for themselves and be able to specific their possess thoughts or thoughts. Discussion activities are dominated by students with high PAM, while students with low PAM are only silent listening to the opinions and ideas of students who have high PAM. In agreement with (Rosita, 2018) explains that achievement differences are very prominent in group discussions, students with low achievement are relatively passive in discussion activities. However, because the teacher has a very high target to improve mathematical understanding ability, so in the learning process the teacher forms a heterogeneous group. Teachers form groups in which each group has a group leader who is fully responsible during discussion activities.

Students who have high PAM are elected as group leaders, all members are required to be active in discussion activities, so that during the discussion students with high PAM explain the material being studied to students with low PAM and students who have low PAM must be more active in asking students who have high PAM. According to

(Surrey, 1985) these activities cause students with low PAM to only ask questions to students with high PAM. Listening and receiving material from their friends, sharing knowledge and experiences can help learners with low PAM understand the subject matter easily. The activity is the same as the conventional method, students with low PAM only receive the material that students learn from the teacher. The difference is that students who get the IMPROVE method get knowledge from activities that exchange information between discussion groups or group friends and students who get an expository learning model get explanations from the teacher. Based on this exposure, there is no difference in the mathematical understanding ability of students with low initial ability who get the IMPROVE method and students who get conventional methods.

E. CONCLUSION

Based on the comes about of inquire about and discourse in Chapter IV with respect to the impact of scientific understanding capacity and self-development of understudies, between understudies who get learning with the Make strides strategy and understudies who get learning with ordinary strategies. Moving on from the comes about of theory testing and dialog of the inquire about that has been depicted, the taking after conclusions can be gotten:

1. The mathematical understanding ability of students who were treated using the IMPROVE learning method was higher than students who were treated using conventional learning methods.
2. There is an interaction effect between learning methods and PAM on students' mathematical understanding ability.
3. The mathematical understanding ability of students who were treated using the IMPROVE learning method was higher than students who were treated using conventional learning methods for students who had high PAM.
4. Self-development among students treated with IMPROVE learning method is higher than students treated with conventional learning method.

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