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IMPROVING STUDENT'S MATHEMATIC REFLECTIVE THINKING ABILITY THROUGH THE IMPROVE LEARNING MODEL

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Abstract

Several studies show that the learning process with a metacognitive approach helps students develop their reflective thinking skills. One of the IMPROVE syntaxes is asking metacognitive questions. This study aims to describe the influence of the IMPROVE learning model on students' mathematical reflective thinking abilities. For this reason, this study uses a quantitative approach with descriptive analysis techniques after comparing two groups of data according to the non-equivalent control group design. The study involved several students of class X IPA at MAN 3 Serang City as a population consisting of two study groups as samples. The data collection technique uses the Mathematical Reflective Thinking Ability Test (KBRM) instrument which contains six indicators. The application of the IMPROVE learning model, based on the results of the study, was proven to have a positive and significant influence on increasing students' mathematical reflective thinking skills. Also, the mathematical reflective thinking ability of students who apply the IMPROVE learning model is in the fairly good category, while the mathematical reflective thinking ability of students who apply ordinary learning is in the poor category. The achievement of each indicator of students' mathematical reflective thinking skills who apply IMPROVE learning is in the good category on 2 question indicators, fairly good category on 2 question indicators and not a good category on 2 question indicators out of a total of 6 indicators of mathematical reflective thinking ability questions.

Keywords: thinking ability, mathematical reflective, IMPROVE learning model

INTRODUCTION

PISA is a program to measure the ability of 15-year-old school students in literacy, mathematics, and science at an international level (Hewi and Shaleh, 2020). This study is conducted every three years, starting in 1997 (Aditomo and Faridz, 2018) and the last time it was held in 2018 (Leksmono, 2019). Indonesia began to fully participate in this program in 2000 (Pratiwi, 2019). From the results of the 2018 PISA survey for mathematics ability itself, it was reported that the average ability score of Indonesian students was 379 with an international average score of 500 (Hewi and Shaleh, 2020); (Kemendikbud, 2019). With this score, Indonesia was ranked 73rd out of 79 countries participating in the study (OECD, 2019). In addition, the average score is in the category of level 1, which means that Indonesia is still below the minimum competency level for the PISA assessment (Schleicher, 2019).

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PISA defines mathematical literacy as an ability to formularize, use, and associate mathematics in many situations, involves mathematical reasoning and applying mathematical concepts, structured steps, facts and tools to illustrate, explain and predict an event (OECD, 2019). In its report, the Ministry of Education and Culture's Balitbang Education Assessment Centre stated that more than 70% of students in Indonesia have not reached the minimum level of mathematics competence. This means that when faced with situations that require problem-solving skills using mathematics, many of our students still encounter difficulties (Kemendikbud, 2019). Some experts state that mathematical activity places problem-solving at the centre (Noer, 2011). For this reason, schools are asked to present problem-solving as an inseparable part of the mathematics learning process, from the beginning to the end of learning (Khaeroni, 2021).

Along with making students understand the material, learning mathematics in schools also has another objective. There are other main objectives such as mathematical reasoning ability, mathematical communication, mathematical connection, mathematical representation and mathematical problem-solving (Hafriani, 2021), as well as certain behaviours that students must acquire after they study mathematics (Ariawan and Nufus, 2017). Problem-solving ability is a fundamental ability that needs to be trained (Achsin, 2016) so that students can find solutions to a problem in everyday life (Mulyati, 2016) by using their thinking skills (Cahyono, 2016).

Reflective thinking ability is a thinking skill which plays a fundamental role when students are faced with problem-solving situations (Wahyuni, Arthamevia, and Haryo, 2018) which includes critical thinking and creative thinking skills (Anugraheni, 2020). To solve a problem, Polya (in Khaeroni) introduces four stages of problem-solving. The first is understanding the problem. The second is planning a settlement strategy. The third is implementing the strategy, and the fourth is conducting a review (Khaeroni, 2021). Furthermore, in planning the strategy itself, Polya (Billstein, Libeskind, and Lott, 1993) identifies a general strategy (heuristic) that can be used to solve a problem, one of which is *Looking Back*. At this stage, students get the opportunity to think reflectively, which is to intentionally learn from experience about what has been done and what can still be done in solving problems (Sabandar, 2013).

Reflective thinking has an important role as a means of thinking to solve mathematical problems (Ramadhani and Aini, 2019). Reflective thinking provides opportunities for students to learn to think about the best strategies in achieving learning goals (Karli, 2018). The reflective thinking process is recommended by Chee and San (Suharna, 2018) to guess and use their imagination in solving problems (Arief, 2019). The process of reflective thinking occurs when a person always doubts the answers that have been obtained (Suharna, 2018). 26 Reflective thinking is a process of analysing, evaluating, motivating, and exploring deep meaning (Guroll, 2011). 26 Reflective thinking is a cognitive ability that directs students to solve a problem along with problem-solving.

Students need to develop two types of abilities, namely: mathematical reflective thinking and problem-solving skills. Another fact is that mathematical problem-solving skills are influenced by mathematical reflective thinking skills (Syadid and Sutiarso, 2021). However, in learning activities, Nindiasari stated that some teachers are rarely developed the ability to think mathematically reflective (Nindiasari, 2011). Furthermore, in the preliminary study, it was also stated that in teaching teachers are not accustomed to developing the thinking skills of their students. This can be confirmed from the learning process, where the teacher only provides final formulas (products) in explaining a mathematical concept, while students are not invited to think about how to obtain the mathematical concept. When faced with questions that contain indicators of mathematical reflective thinking, Nindiasari said that no less than 59% of students have not shown quench outcome (Nindiasari, 2011).

At the other research, Nindiasari also stated that the metacognitive approach gave the greatest contribution compared to the role of ordinary learning in achieving and improving 34 students' mathematical reflective thinking skills (Nindiasari, Kusumah, Sumarmo, and Sabandar, 2014). In the metacognitive approach, students are made aware to control and monitor their thinking processes through asking questions about problem understanding; building connections between new knowledge and prior knowledge; using problem-solving strategies; and evaluating their thinking processes and solutions (Nindiasari et al., 2014).

The IMPROVE is one of learning model which the syntax includes steps to ask metacognitive questions that help students develop and utilize their thinking skills. The IMPROVE learning model is an active student learning model that was first designed by Mevarech and Kramarski (Tety Septiani, 2018). IMPROVE itself is an abbreviation of the syntax, which is **I**ntroducing new concept, **M**etacognitive questioning, **P**racticing, **R**eviewing and **R**educe difficulty, **O**btaining mastery, **V**erification, and **E**nrichment.

1. *Introducing New Concepts*

The teacher plays a role as a facilitator by guiding students to find concepts independently, this is characterized by the teacher not giving away the final result of a concept. The teacher guides students to find a concept by asking questions that lead to the discovery of a concept, it is hoped that students' understanding of a concept can last a long time because students actively participate in finding and understanding new concepts.

2. *Metacognitive questioning*. The teacher asks metacognitive questions to students, namely:
   a. **Comprehension question**s encourage students to describe a concept in their own words and try to understand the meaning of a concept. Examples of understanding questions that can be given to students are "*what is the relationship between logarithms and exponents*?", "*What is the difference in the form of* ${}^{a}\log b$?" *and* ${}^{a^m}\log b^n$?", "*what is unique about the form* ${}^{a}\log b \,.\, {}^{b}\log c = c$? ".
   b. **Connection questions** encourage students to see similarities and differences in a concept/problem. As for examples of connection questions, namely: "*Look at the following example of the logarithmic form: what is the difference in the form* ${}^{a}log\ b^n$ *and* ${}^{a^m}log\ b^n$?. "*Consider the following forms:* ${}^{2}\log 2 = 1$ *and* ${}^{5}\log 5 = 1$. *What are the similarities and differences between the two logarithmic forms, explain and explain why? What logarithmic properties can be deduced from these two forms?"*
   c. **Strategy questions** encourage students to consider the appropriate strategy in solving the given problem and include reasons for choosing the strategy. An example of a strategy question is: "*Given that* ${}^{5}log\ 3 = a$ *and* ${}^{3}log\ 2 = b$. *How to convert* ${}^{6}log\ 25$ *in term a and b?"*
   d. **Reflection questions** are questions that drive students to inquire themselves about the completion process. As for examples of reflection questions, such as: "*What are the difficulties encountered in solving the problem of graphing logarithmic functions?*"

3. *Practising*. At this stage, students are divided into small groups with heterogeneous student abilities and are given worksheets to be completed in groups. Student's practise solving problems given by the teacher. This is very useful to improve mastery of the material and hone students' skills in group discussions.
4. *Reviewing and reducing difficulties.* If when understanding the material or answering questions students face difficulty, then at this step the teacher reviews and discusses these difficulties, the teacher can carry out this stage through class discussion, then the teacher provides solutions to answer the difficulties faced by students.
5. *Obtaining mastery*. To see the mastery of student material individually or as a whole, the teacher gives a test according to the material that has been studied.
6. *Verification*. The test results obtained in the previous stage can be used to identify anyone who has and has not understood or mastered the material presented.
7. *Enrichment*. If there is a student who has not to understand the material, the teacher responds by giving repetition or improvement activities.

The thing that distinguishes the IMPROVE learning model from other learning models is the provision of metacognitive questions to students with the aim that students can optimize their thinking skills in finding solutions to a problem. The existence of discussions in small heterogeneous groups allows the emergence of discussion, debate, and mutual assistance in finding solutions to a given problem. And there is a verification and enrichment stage that helps teachers identify students who are still having difficulties in learning and helps students by providing repetitions so that students better understand the material presented.

In 2018, Watulingas conducted an experiment which showed that the IMPROVE learning model affected student learning outcomes (Watulingas and Janna, 2018). Research carried out by Lestari stated that students who were given learning using a metacognitive approach showed an improvement in critical thinking skills compared to students who were given expository learning (Lestari, Nindiasari, and Fatah, 2019). Furthermore, Yanti and Cahyani reported more specific research results, namely that the IMPROVE approach was proven to be better in terms of improving mathematical representation abilities compared to the PBL model, the same results were also shown in students' metacognitive abilities (Yanti and Cahyani, 2019). Based on these research studies, the purpose of this study is to determine the influence of implementing the IMPROVE learning model on increasing students' mathematical reflective thinking skills.

METHODS

Quantitative approach with descriptive quantitative analysis techniques was used in this research. The type used is Quasi-Experimental with a Non-equivalent Control Group Research Design where the research sample is not chosen randomly. This quantitative method was conducted to determine the effect of implementing the IMPROVE learning model on increasing students' mathematical reflective thinking skills. The design of this research can be displayed as follows (Sugiyono, 2016).

O_1	X	O_2
O_3		O_4

Figure 1. The Research Design

Description:

O_1 & O_3	=	The average value of the students' mathematical reflective thinking ability test before being given treatment
O_2	=	The average value of the students' mathematical reflective thinking ability test after being given treatment
O_4	=	The average value of the mathematical reflective thinking ability test of students who were not given treatment
X	=	Applying treatment in the form of implementing the IMPROVE learning model

This research was carried out at MAN 2 Serang City in the Odd Semester of the 2021/2022 Academic Year with a population of students in class X IPA which was divided into two existing classes, namely X IPA 1 as many as 36 people and X IPA 2 as many as 32 people. The class that received treatment in the form of the implementation of the IMPROVE learning model was called the experimental class, while the class that did not receive treatment or the class that received the usual learning done by the teacher (scientific) was called the control class. The determination of the experimental and control classes was carried out after giving the treatment.

The instrument used in this research is the Mathematical Reflective Thinking Ability (KBRM) test on the Logarithmic Properties of class X Science which is given through pre-test and post-test in the experimental class and control class. Before the KBRM test instrument was used, this instrument had gone through the stages of construct validation, readability testing, and testing the instrument in a class that had received material on Logarithmic Properties.

Construct validation was done by consulting the KBRM test instrument and asking for expert opinion (*judgment expert*) about the suitability of the items with indicators of students' mathematical reflective thinking skills through the KBRM Test Validation Sheet. The construct validator in this study was a lecturer at the University of Sultan Ageng Tirtayasa, Dr Hepsi Nindiasari, S.Pd., M.Pd. After going through the construct validation stage by the expert, this instrument was given to a small group of students consisting of 5 students of class XII science who had already received material on the properties of logarithms to do a readability test. This small group was asked to read every word on the KBRM test instrument questions and to give an assessment of the aspects of readability by filling out a readability test questionnaire. This legibility test questionnaire uses a Likert scale with a score of 1. Very Poor, 2. Less, 3. Good, 4. Very Good. Furthermore, this score is analysed by looking for an average rating that represents different levels of ability. The average value was changed to qualitative based on the conversion guidelines into a 4 scale value based on the highest score, lowest score, number of classes and intervals as shown in the following table (Widoyoko, 2012).

Table 1. Conversion of readability test scores

Range	Category
$3.25 < X \leq 4$	Very good
$2.50 < X \leq 3.25$	Good
$1.75 < X \leq 2.50$	Less
$X \leq 1.75$	Very Poor

The next step is to test the KBRM test instrument to obtain the level of validity and reliability of the instrument. After going through the above steps, the KBRM instrument was revised to be used in research. The KBRM test instrument used consists of 6 description questions with indicators of students' mathematical reflective thinking skills adapted from Nindiasari, namely (Nindiasari et al., 2014): (1) can interpret a case based on the mathematical concepts involved, (2) can identify concepts or mathematical formulas involved in mathematical problems that are not simple, (3) can evaluate/check the truth of an argument based on the concepts/properties used, (4) can draw analogies from two similar cases, (5) can analyse and clarify questions and answers, (6) can distinguish between relevant and irrelevant data. Here are some examples of the Mathematical Reflective Thinking Ability Test items used in this study.

1. Given $\frac{\log x\sqrt{x} + \log\sqrt{y} + \log xy^2}{\log xy}$. How to solve the above problem? Provide an explanation accompanied by the concept used.
2. If ${}^{a}\log 3 = {}^{b}\log 27$ with $a > 0, b > 0, a \neq 1, b \neq 1$, confirm if ${}^{a}\log b = 3$? Outline your answer?
3. If ${}^{8}\log b = 2$ dan ${}^{4}\log d = 1$, the relation between b and d is $b = 3d$. Check the data above. Which data is not correct?

The data analysis technique was to perform a normality test and a homogeneity test, followed by a comparison test of two independent samples to see the average difference between the experimental class and the control class using SPSS 20 software. To strengthen the results of quantitative research, qualitative analysis was then carried out by describing students' mathematical reflective thinking skills who applied the IMPROVE learning model to support and strengthen quantitative data analysis. Qualitative data were obtained from the categorization of the average pre-test and post-test scores as well as the acquisition of scores on each indicator of the KBRM test question which was grouped based on the predicate interval for the SMA level education unit as follows (Kemdikbud, 2017):

Table 2. Criteria for Mathematical Ability Level

Range	KBRM Qualification
85 < N ≤ 100	Very Good
70 < N ≤ 85	Good
55 < N ≤ 70	Pretty Good
N ≤ 55	Poor

Validity Test, Readability Test, and Instrument Trial

The KBRM test instrument validation sheet was given to experts for consultation and expert opinion was asked about the suitability of the instrument with indicators of students' mathematical reflective thinking abilities. The results of the construct validation assessment provided by the expert are as follows:

This instrument is suitable for use because all indicators of mathematical reflective thinking ability are contained in the instrument questions. The form of the questions is consistent and the answers and rubrics are appropriate.

The expert assessment given in this construct validation shows that the KBRM test instrument is following the indicators used and is suitable for use in research. The results of the KBRM test readability test questionnaire is presented as follow:

Table 3. Readability Test Results of KBRM Test Instruments

Statement	Average score
Clarity of instructions for working on questions	3.2
Clarity of the meaning of the question	3.4
Editorial sentence questions are easy to understand	2.8
Tables/Graphs/Images presented can be understood	3.4
Possible questions can be done	1.2
Average	**2.8**
Criteria	**GOOD**

From the 5 students' readability test results, an average score of 2.8 was obtained which was come under the "Good" category. Thus, the KBRM test instrument has good quality in terms of readability. The test results of the KBRM test instrument were given to students of class XII IPA 1 MAN 2 Serang City, totalling 26 people. The validity score was determined by correlating between score item and total scores using the Product Moment Correlation with the provision that if $r_{count} > r_{table}$ then the item was valid. The correlation between X and Y is defined as:

$$r_{xy} = \frac{n\sum x_i y_i - \left(\sum x_i\right)\left(\sum y_i\right)}{\sqrt{\left(n\sum x_i^2 - \left(\sum x_i\right)^2\right)\left(n\sum y_i^2 - \left(\sum y_i\right)^2\right)}} \text{ (Sugiyono, 2015)}$$

By using the above formula, the results of the validity of the KBRM test item test items are obtained as follows.

Table 4. The Validity of KBRM Test Instruments

Item No	r_{count}	Decision
1	0.599	Valid
2	0.800	Valid
3	0.511	Valid
4	0.791	Valid
5	0.549	Valid
6	0.759	Valid

According to the test result, it can be concluded that the KBRM test instrument is valid. Furthermore, the reliability of the instrument is calculated using Spearman Brown with the condition that if $r_i > r_{tabel}$. The formula used is:

$$r_i = \frac{2r_b}{1 + r_b} \quad \text{(Sugiyono, 2015)}$$

Which:

r_i = instrument internal reliability

r_b = product-moment correlation between the first and second halves

By using the above formula, it is obtained that $r_i = 0.635 > r_{table} = 0.404$. Thus, the KBRM test instrument is also reliable. So the instrument can be used as data collection instrument in the study.

RESULTS AND DISCUSSION

This research was conducted to determine the influence of implementing the IMPROVE learning model on improving students' mathematical reflective thinking skills, and to describe students' mathematical reflective thinking skills through the application of the IMPROVE learning model. The results obtained from this stage are as follows.

Pre-test Result Data Analysis

Comparative testing requires that the two groups being compared have the same initial ability. Therefore, the purpose of this step was to determine the initial conditions of the ability of the two groups. If the ability of the two classes is the same or there is no significant difference, then the two classes can be used as subjects in the study. However, if there are a difference in ability, the research design changes by involving one group only. The first is to determine the normality distribution of each data.

Table 5. Pre-test Normality Test Results

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
X IPA-1	.347	36	.000	.668	36	.000
X IPA-2	.368	32	.000	.631	32	.000

Since the number of samples is small (less than 50 people), then the Shapiro-Wilk column will be considered. Because the *Sig* or p_{value} for both classes is less than 0.05, the data distribution of these two data groups is **not normally distributed**. For that, no homogeneity test is needed. Furthermore, the comparative test between these two data groups was a non-parametric comparation of two independent samples using the Mann Whitney U test. The results are presented as follow.

Table 6. Pre-Test Comparative Test Result

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Nilai is the same across categories of Kelompok	Independent-Samples Mann-Whitney U Test	.970	Retain the null hypothesis

The comparative test hypothesis used is:
H_0: there is no significant difference in the average value of the two classes
H_1: there is a significant difference in the average value of the two classes

Since the value of *Sig* or p_{value} = 0.970 > 0.05, then H_0 is accepted. That is, both data come from classes with the same ability so that they can be involved as the experimental and control classes. The experimental and control classes were determined using a simple random sampling technique. Class X IPA 2 was chosen as the experimental class and X IPA 1 as the control class.

Post-test Result Data Analysis

The first step of the analysis is to check whether the data is normally distributed or No. The results for the normality test using the Shapiro-Wilk method are as follow.

Table 7. Post-test Data Normality Test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
X IPA-1 (Control Class)	.122	36	.197	.960	36	.209
X IPA-2 (Experimental Class)	.096	32	.200*	.970	32	.509

Since the value of *sig*. (p_{value}) of both data are 0.209 and 0.509, which means p_{value}s' are greater than 0.05, so that the data are said to be normally distributed. Next is to check the homogeneity test, using Levene's test. The results are as follow.

Table 8. Results of Post-test Homogeneity Test

Levene Statistic	df1	df2	Sig.
1.145	1	66	.288

The above table shows the results of the homogeneity test with *Sig* (p_{value}) is 0.288 that is greater than 0.05, which means that the variance of the two groups is the same or is called homogeneous. Then the second assumption, namely homogeneity, has been fulfilled. Furthermore, a comparative test of two independent samples was carried out using parametric statistical techniques with a t-test using SPSS 20 based on the significance value (2-tailed) which measured whether there was an average difference in the subjects tested.

Table 9. Post Test Comparative Test Table with t-Test

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Score	Equal variances assumed	1.145	.288	-2.955	66	.004	-15.91146	5.38460	-26.66215	-5.16077
	Equal variances not assumed			-2.966	65.782	.004	-15.91146	5.36473	-26.62315	-5.19976

The post-test comparative test hypotheses used are:
H_0: there is no significant difference in the average value of the two classes
H_1: there is a significant difference in the average value of the two classes

The *Sig* or p_{value} obtained through the t-test is 0.004, which is less than 0.05. Then the decision is to reject H_0 or H_1 is accepted. That is, there is a significant difference in the post-test scores between the experimental and the control class.

The difference between the average pre-test and post-test scores between the experimental class and the control class is as follows.

Table 10. Average Pre-Test and Post-Test scores

Class	Pre-Test	Post-Test
X IPA 1 (Control Class)	6,57	40,35
X IPA 2 (Experimental Class)	6,26	55,08

From the table above, the average post-test score for the experimental class is higher than the control class. So, it can be shown that the use of the IMPROVE learning model has a significant effect on students' mathematical reflective thinking abilities.

Discussion

To support and enhance the research results that were analysed quantitatively, the research results were also analysed qualitatively. This qualitative analysis aims to describe students' mathematical reflective thinking skills through the application of the IMPROVE learning model. The categorization of pre-test and post-test scores for the experimental class and the control class is presented in the following table to see the level of students' mathematical reflective thinking abilities.

Table 11. Categories of Students' Ability

Sample	Pre-tes		Pos-test	
	Average	Category	Average	Category
X IPA 1 (Control Class)	6,57	Poor	40,35	Poor
X IPA 2 (Experimental Class)	6,26	Poor	55,08	Pretty good

The table above shows that the initial mathematical reflective thinking ability of the experimental class and control class students is in the poor category because the pre-test is given before the students get the material being tested. After students in both classes carried out learning on the Logarithmic Properties material through the IMPROVE learning model in the experimental class and Scientific learning in the control class, the results obtained increased in mathematical reflective thinking skills which were included in the pretty good category for the experimental class and still in the poor category for the control class.

The results of the comparative test show that the implementation of the IMPROVE learning model has a positive and significant influence on students' mathematical reflective thinking abilities. Table 11 also shows that the average KBRM post-test score of experimental class students is higher than that of the control class. The analysis of the achievement of the KBRM post-test results on each indicator based on the assessment rubric used is presented as follows.

Table 12. Analysis of the Achievement of Each Indicator

Indicators of Students' Mathematical Reflective Thinking Ability	Quest. No.	The average score of each indicator	Ideal score for each indicator	Average Value of Each Indicator	Category
Able to interpret a case based on the mathematical concepts involved	1	3,1	6	51,56	Poor
Able to identify mathematical concepts or formulas involved in math problems that are not simple	2	3,6	6	60,42	Pretty good
Able to evaluate/check the truth of an argument based on the concept/nature used	3	4,4	6	72,92	Good
Able to draw an analogy from two similar cases	4	2,5	10	25	Poor
Able to analyse and clarify questions, and answers	5	3,9	6	66,15	Pretty good
Able to distinguish between relevant and irrelevant data	6	4,5	6	74,48	Good
Total		**22,03**	**40**	**55,08**	Pretty good

Based on the analysis of the objective of the KBRM test results on the first indicator, an average score of 51.56 was obtained which is fall under the poor category. The average achievement in the second indicator is 60.42 which is fall under the fairly good category. The achievement of the third indicator reached an average of 72.92 which is fall under the good category. While the objective of the fourth indicator, namely being able to make analogies from two similar cases, is the value with the lowest average among other indicators of mathematical reflective thinking ability, which is 25 which is fall under the poor category. The average objective on the fifth indicator reached 66.15 which is fall under the fairly good category. The last indicator, which can distinguish between relevant and irrelevant data, reaches the highest average among other indicators of 74.48 and in the good category.

Judging from the objective of each indicator of mathematical reflective thinking ability, the results of the KBRM test showed that students had reached a good category on question no. 3 and no. 6 with indicators of evaluating/checking the truth of an argument based on the concept/nature used; and indicators can distinguish between relevant and irrelevant data. In the implementation of the IMPROVE learning model, there is one syntax that provides metacognitive questions to students, through giving these metacognitive questions students are trained to think and confirm the validity of an argument based on the concepts used, and students are trained to distinguish between relevant and irrelevant data.

Students achieve a fairly good ability on questions no. 2 and no. 5 with indicators that can identify mathematical concepts or formulas involved in math problems that are not simple, and on indicators can analyse and clarify questions and answers. One of the syntaxes in the IMPROVE learning model is practising (practice), at this stage students practice in groups in solving problems given through Worksheets (LK). This is very useful for increasing mastery of the material and honing students' abilities that make a positive contribution to students' ability to identify concepts or formulas involved in complex math problems and students' ability to analyse and clarify questions and answers.

While question no. 1 and 4 with indicators can interpret a case based on the mathematical concepts involved; and can draw an analogy from two similar cases of achieving mathematical reflective thinking skills which are categorized as poor. Students still have difficulty in these two indicators of mathematical reflective ability. Many students have difficulty in interpreting a case of logarithmic properties in everyday life, this is indicated by many students who leave their answers blank in question no. 1. Students also have difficulty in drawing analogies from some cases or problems with the given logarithmic properties. Students still do not understand finding similarities in the concepts used in solving the given problem.

Overall, students' mathematical reflective thinking skills who apply the IMPROVE learning model have abilities in the fairly good category. This is supported by the syntax steps in the IMPROVE learning model that help students hone their higher-order thinking skills, including students' mathematical reflective thinking skills. Although the results achieved by students have not achieved good abilities, because students are not familiar with questions that require high-level skills such as mathematical reflective thinking skills.

CONCLUSION

Based on the findings and discussion, it is concluded that the application of the IMPROVE learning model has a better effect than ordinary learning (Scientific) in increasing students' mathematical reflective thinking skills on logarithmic properties in class X science. The average result of the Reflective Mathematical Thinking Ability test of students in the class that applied the IMPROVE learning model was higher than the ability of the students in the class of students who applied the ordinary (Scientific) learning model. In general, the description of students' mathematical reflective thinking skills in classes that apply the IMPROVE learning model is in the fairly good category, while the mathematical reflective thinking abilities of students who apply ordinary learning are in the poor category. Of the 6 indicators of mathematical reflective thinking ability given to students through the post-test, it can be described that the mathematical reflective thinking ability of students in classes that apply the IMPROVE learning model is in the good category on 2 indicators, fairly good category on 2 indicators and poor category. good on 2 question indicators.

Based on the research results obtained, the researcher proposes several suggestions for teachers to carry out learning that encourages students to think and develop certain mathematical abilities that fall into the category of higher-order thinking skills through innovative learning models that are adapted to mathematics learning materials. The innovative learning model that can be chosen is the IMPROVE learning model which in its syntax there are stages of metacognitive questions that can stimulate and develop students' mathematical reflective thinking skills. Teachers can also choose other innovative learning models to develop higher thinking skills in mathematics.

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