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Article

Effectiveness of the POE (predict-observe-explain) Learning Model with the Mind Mapping Method to Reduce MisconceptionsNova Oktavia Saputri^{1*}, Syaiful Arif^{2*}¹Institut Agama Islam Negeri, Ponorogo²Institut Agama Islam Negeri, Ponorogo**Corresponding Address: novasaputri0920@gmail.com***Article Info**

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ABSTRACT

Students' conceptual understanding is formed not only from the environment and learning processes they experience but also from the experiences and initial knowledge that students receive. Students' understanding of concepts that do not match the concepts scientifically believed by experts is said to have occurred as a misconception. Misconceptions are deviations from the concepts that students believe in the concepts of scientists or experts. Misconceptions have very fatal consequences for the continuity of learning, including causing low achievement, impacting other material, disrupting students' psychology and can hinder classroom management. Based on this impact, it is necessary to reduce misconceptions. According to several experts, an effective learning model in reducing misconceptions is the POE (*predict-observe-explain*) learning model because it can improve understanding of concepts and skills in the science learning process through reconciliation and negotiation between initial knowledge and new knowledge. The aim of this research is to determine the effectiveness of the POE learning model using the *mind mapping method* in reducing misconceptions experienced by students. This research uses quantitative research with an experimental design. The population in this study were all class VIII students at MTs Muhammadiyah 1 Ponorogo with a sample of 2 classes divided into two classes, namely the experimental class and the control class. Based on the results of research data analysis, it is proven that the ability to reduce students' misconceptions using the POE learning model with the *mind mapping method* is much more effective in learning compared to conventional learning models.

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INTRODUCTION

In the 21st century, students require abilities in all fields. The current educational process is required to produce students who have the ability to think critically, creatively, and are active in learning (Wahyuni, 2021). Science education is a stage in teaching students to better understand and interpret the nature of science. In essence, science education is not only an understanding of some knowledge about nature, but also about how to become a method or step that can be used to create, deepen and apply knowledge. (Nida et al., 2017). Based on the

Ministry of Education and Culture's decree, 21st century learning is characterized by several things, including information that can be accessed anytime and anywhere, learning is directed at helping students in finding information in various research, learning is directed at being able to state a question, learning involves all life activities, Learning is directed at honing students' skills in analytical thinking. And learning is carried out in a student-centered manner. *Student centered* science learning processes in the 21st century are encouraged with the aim of opening up opportunities for students to think scientifically and creatively and can foster behavior like a scientist in students. Students' ability to think creatively and critically cannot be separated from students' understanding of concepts in a material (Pratiwi et al., 2019).

Based on the 2013 curriculum, science learning is learning that focuses on students playing an active and creative role, and being able to apply various perceptions in learning. Students are expected to gain knowledge from learning activities carried out in the classroom so that they will later find understanding and confidence in knowledge for themselves. In the learning process information management must be considered in order to develop and apply new knowledge. Basically, students already know the concept through natural events before the concept is taught formally. That way, students should have a good understanding of the concept. However, in reality it is quite the opposite, based on research conducted by Degeng, it was proven that students' reasoning abilities were not successfully developed through conventional learning taught by teachers (Laksana, 2016). In research conducted by Cakir, it was shown that this failure was due to the inability of students to solve problems faced in real life (Laksana, 2016). According to Risma in her research, students' learning success is not only influenced by the environment and learning conditions, but also the students' initial insights (RU Rohmah & Fadly, 2021). In this situation, Flower revealed that the concepts built by students do not match the understanding of scientific concepts by experts, which is called a misconception (Jaapar et al., 2020).

Based on the results of several studies conducted by experts, it shows that teachers are the most urgent element in learning. Apart from teachers, other elements are also no less important. (Mufidah & Budiarto, 2021) This is because students' activeness during the learning process will determine the atmosphere in the classroom, whether it is competitive between individuals in achieving understanding of concepts or it will actually result in misconceptions. According to Novak's research, misconceptions in the science learning process can start from elementary or MI, SMP or MTs, SMA/MA/SMK students and can even occur at the high school or college level. (RU Rohmah & Fadly, 2021) According to Abidin, it is important to identify student misconceptions, because wrong concepts or misconceptions can cause students to also face errors in perceptions at the next level or not be able to link perceptions. (Lintong et al., 2018) Contained in many previous studies and studies that examine the importance of detecting misconceptions in science learning, one of which is research conducted by Pettina which explains that many misconceptions in science material occur because students do not master the concepts in the material taught at this level. previously (Medina, 2017).

Misconceptions have 3 indicators. The first indicator of misconception is wrong conceptual understanding (RU Rohmah & Fadly, 2021). In this indicator, students recognize the concept of something captured by their senses without knowing the scientific truth, this is what ultimately causes misconceptions. Based on the statement contained in the Ministry of Education and Culture's decision on science teaching, it is explained that to obtain the cultivation of perception, achieve understanding of concepts, students are obliged to participate in the teaching process which is carried out intensively and full of confidence. The second indicator of misconception is unscientific belief. The purpose of this indicator is that in this indicator students have confidence in a perception that is not in line with the perception created by scientists. The third indicator of misconceptions is misconceptions based on facts (RU Rohmah & Fadly, 2021). According to Marshall, conceptual errors stem from the fact that they

are caused by mistakes that occur in childhood and do not change until school (RU Rohmah & Fadly, 2021) .

Based on data from preliminary research taken at MTs Muhammadiyah 1 Ponorogo in class VIII A students regarding the movement of objects and living creatures, there have been misconceptions which are known based on the average score of the test results which is equal to 45.91667 and is in the moderate misconception category. The results of observations carried out at MTs Muhammadiyah 1 Ponorogo show that the misconceptions that occur among students are because during the learning process students are less focused and have fun chatting with their classmates. Apart from that, teachers still find it difficult to apply learning models that are suitable for the material to be delivered. Quoting the results of interviews with science teachers at MTs Muhammadiyah 1 Ponorogo, the learning implemented by teachers in the classroom mostly uses lecture and discussion methods and in reality teachers still have difficulty implementing the desired learning methods. With teaching and learning activities like this, it is possible for students not to understand or grasp the material explained by the teacher. So this results in students having difficulty grasping concepts well and resulting in misconceptions.

Seeing the condition of MTs Muhammadiyah 1 Ponorogo students who still experience misconceptions, especially regarding science material, research is needed that is able to examine in depth how to reduce the misconceptions that occur in students. In Mesutoglu and Brigili's opinion, misconceptions have four basic consequences, namely low learning achievement, impact on other themes, student psychology and also impact on classroom management. (Mufidah & Budiarto, 2021) It is hoped that this research can reduce the misconceptions that occur in students, so that students can implement their beliefs and insight into understanding the concepts they have correctly.

Applying a learning model that is appropriate to the conditions in the field is a solution that must be implemented. An alternative learning model that can be used to reduce misconceptions is the POE learning model . This is because according to Erviana the application of the POE model has a good influence on students in increasing students' activeness and criticality in the learning process that takes place in the classroom so that it can reduce misconceptions that occur among students (Fitriyah, 2020) . Apart from that, with the POE learning model The preconceptions that students already have will be connected to learning which requires students to observe an event that is not necessarily in line with their predictions, so it is hoped that this can prevent misconceptions and strengthen conceptions that are in line with scientific concepts (Teguh & Tandililing, 2006) . This is also reinforced based on previous research conducted by Meliyani Khusna which proves that the POE learning model is able to reduce misconceptions that occur in students.

According to Joyce, the advantages of the POE learning model include being able to encourage students to increase creativity, especially in conveying assumptions, being able to reduce verbalism, making teaching and learning activities more enjoyable, this is because students not only sit quietly listening to the teacher's explanation but also observe a phenomenon that occurs through a observation or experiment, so students will have the opportunity to compare theory (conjecture) with reality (Yupani et al., 2013) .

The method used to support the POE (Predict-Observe-Explain) learning model is to use the mind mapping method . In Juhji's opinion, using mind mapping throughout learning is able to combine real and correct mastery of the meaning and relationship of each concept (Juhji, 2017) . In this way, teaching and learning activities will become more active and interactive. In accordance with the learning theory presented by Ausubel, it is explained that educators must master concepts and must bring them up in the learning process so that the learning process can be carried out. well (Negoro et al., 2018).

Mind mapping method to reduce misconceptions of class VIII students at MTs Muhammadiyah 1 Ponorogo because, basically, students have very good potential to be developed, with this potential it can grow students' mastery and skills. Then, by implementing the POE learning model with the mind mapping method, it is hoped that it will be able to develop students to be more focused when studying in class, have a high sense of curiosity about something, have creativity and good predictive, observation and explanation skills, and can help participants. students understand the material better and are able to increase students' understanding of scientific concepts.

This is where the author became interested in conducting research with the title "Effectiveness of the POE (Predict-Observe-Explain) Learning Model with the Mind Mapping Method to Reduce Misconceptions".

METHODS

The type of research used is quantitative research. Quantitative research is a method used by a researcher to test a real theory by testing the relationship between variables in a study. The research method used in this research is an experimental method, namely *pre-experimental design* with a design in the form of *a randomize pretest posttest control group design*. This method aims to determine the impact of a treatment on a goal. The following is an overview of the research design that will be carried out.

Table 1. Randomize Pretest Posttest Control Group Design

<i>Sample</i>	<i>Pre-test</i>	<i>Treatment</i>	<i>Post-test</i>
<i>Eksperimen</i>	<i>N1</i>	<i>X</i>	<i>O1</i>
<i>Control</i>	<i>N2</i>	<i>X1</i>	<i>O2</i>

This research procedure begins by giving a pretest to determine students' initial understanding of concepts. Then material was given on the theme of the human respiratory system by applying the POE learning model with the *mind mapping* method to increase students' mastery of the concept of learning so as to reduce misconceptions experienced by students. After that, posttest t was carried out. The next procedure was to carry out statistical tests to see the results of reducing the misconceptions of class VIII students at MTs Muhammadiyah 1 Ponorogo as an experimental class.

This research applies a data collection method, namely through a written test to determine misconceptions that occur among students. The test was carried out twice in the form of a pretest and posttest. The form of test questions used in this research is multiple choice questions. Multiple choice questions were chosen with the aim of making it easier for researchers to find out indicators of misconceptions that occur in students. Techniques for managing data in this student misconception reduction research include analysis of essay tests to determine the range of student misconception reduction using a quantitative descriptive model. The location of this research is at MTs Muhammadiyah 1 Ponorogo which is located at Jl. East Stadium Number 20B Babadan District, Ponorogo Regency. The subjects of this research were class VIII at MTs Muhammadiyah 1 Ponorogo with a total of 32 students consisting of 14 male students and 18 female students.

The instruments used in this research have been adapted and validated based on indicators and descriptors of misconceptions. The explanation of the misconception indicators is as follows:

Table 2. Indicators and Descriptors of Misconceptions

Indicator	Descriptor
Early concept understanding	misinterpretation of concepts image of an object
Belief is not scientific	wrong belief beliefs are not based on research
Factual misconceptions	wrong experience discrepancy between theory and facts

RESULTS AND DISCUSSION

In this misconception reduction research, to determine the reduction ability, it was carried out by conducting a test using 10 multiple choice questions. This question relates to the material of the human respiratory system. This question relates to the material of the human respiratory system. In this question, indicators for reducing misconceptions have been adjusted, including early *concept understanding* with descriptors. misinterpretation of concepts and descriptions of an object, second indicator unscientific beliefs (*Belief is not scientific*) with descriptors of false beliefs and incorrect beliefs, the third indicator. Misconceptions originate from facts (*factual misconceptions*) with descriptors of wrong experiences and inconsistencies between theory and facts (RU Rohmah & Fadly, 2021).

The results of the research analysis of the pretest and posttest results of the two classes were first tested using normality and homogeneity tests. Based on the results of the *pretest* normality test used with the help of SPSS using the Kolmogorov Smirnov test, it shows that the significance value for the experimental class is 0.123, while in the control class the significance value for the control class is 0.200. Meanwhile, in the posttest normality test, the significance value for the experimental class was 0.099, while in the control class the significance value for the control class was 0.200. From the results of the values for the two classes, it shows that both have a significance value of more than 0.05. So it can be concluded that the data from these two classes come from a normal distribution. In the homogeneity test for the pretest it was 0.925 and for the posttest it was 0.296 which proves that the two classes are homogeneous. So it can be interpreted that the data resulting from the analysis is normally distributed and varies homogeneously.

After carrying out the prerequisite tests in the form of the normality test and homogeneity test, the next stage is the hypothesis test or t-test. The t-test is a method of data analysis that is carried out statistically to test the significance level of 2 means of two paired distributions. In this research, the t-test was used to test the researcher's hypothesis or to see whether or not there was a difference in the ability to reduce misconceptions between the experimental class and the control class. In this study, researchers used SPSS 25 to carry out the t-test. The following is a table of t-test results on the misconception reduction ability of class VIII students at MTs Muhammadiyah 1 Ponorogo.

Table 3. Independent Sample t-Test Results for Control Class and Experimental Class

		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
Nilai	Equal variances assumed	.896	.347	5.093	62	.000	21.25000	4.17229	12.90971	29.59029	
	Equal variances not assumed			5.093	59.911	.000	21.25000	4.17229	12.90392	29.59608	

Decision making based on H_0 is accepted and H_1 is rejected with a signal if the significance value is more than 0.05. And H_0 is rejected if the significance value is less than 0.05. From table 4.15 shows the *sig value. (2-tailed)* or a significance value of 0.000. This shows that the significance value is less than 0.05, so the decision is that H_0 is rejected and H_1 is accepted. So it can be interpreted that there is a significant difference in the level of misconception reduction between classes that use the POE learning model with the *mind mapping* method and classes that do not use the POE learning mode or those that use conventional learning models.

From the results of the *Independent t-test* that has been carried out, it can be concluded that there are differences in the average level of misconceptions in both the experimental class and the control class. Then the next stage after the *Independent t-test* is to carry out the *N-Gain Score test*. The *N-Gain Score test* was carried out with the aim of seeing the difference in scores between the *pretest score* and the *posttest score*.

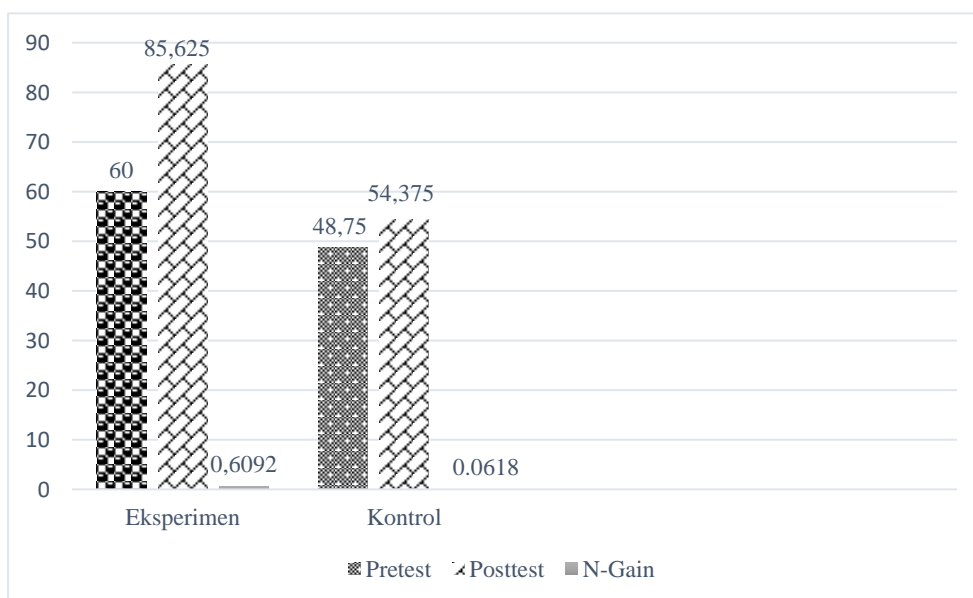


Figure 1 Graph of Average *Pretest* and *Posttest* Scores for Experimental and Control Classes

Based on the N-Gain Score results, it can be seen that the average value in the experimental class is 0.6092 while in the control class it is 0.0618. So it can be concluded that

experimental classes that apply the POE learning model with the mind mapping method are quite effective in reducing misconceptions that occur among students. This is because the N-Gain Score value for the experimental class is between $0.30 \leq g \leq 0.70$. Meanwhile, the control class which did not use the POE learning model with the mind mapping method was not effective in reducing students' misconceptions .

Next, an N-Gain test was carried out on each indicator for reducing misconceptions in the experimental class at pretest and posttest to determine the research results based on each indicator for reducing misconceptions. The graph of the N-Gain indicator test results can be seen in the following image.

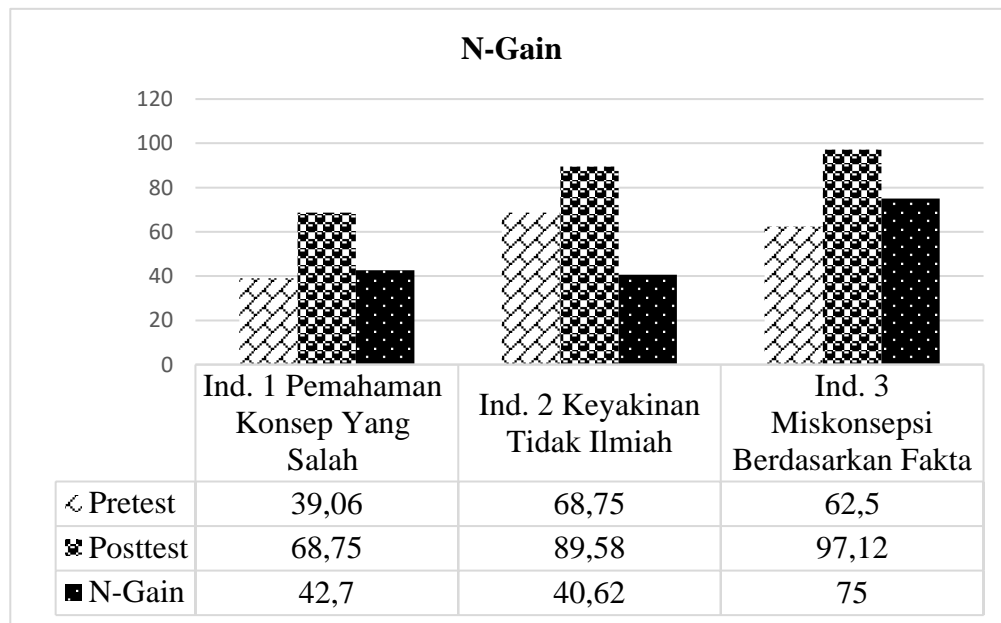


Figure 2. Graph of the Average Pretest, Posttest and N-Gain Values for Each Indicator in the Experimental and Control Classes

Based on research data, the average value of the ability to reduce misconceptions in the experimental class was higher, namely 85.625, while the control class was 54.37. The results obtained show that there is a difference in the misconception reduction ability of experimental class students who apply the POE (Predict-Observe-Explain) learning model with the mind mapping method and the control class which applies the conventional learning model. This is in accordance with previous research conducted by Meliyani & Ida Kaniawati that the POE learning model was proven to be able to reduce students' misconceptions, where before being given treatment in the form of the POE learning model the level of students' misconceptions regarding the concept of temperature and heat was 32.25% but after the model was applied POE learning students' misconceptions were reduced to 24.43%. The reduction in students' misconceptions of 10.82% indicates that the POE learning model has been proven to be able to reduce students' misconceptions (Hasanah & Kaniawati, 2015) .

Based on the results of the independent sample t-test in answering the problem formulation related to the effectiveness of the POE (predict-observe-explain) learning model using the mind mapping method , it shows that the significance value of the two tailed is 0.000 which is less than 0.05. So it can be decided that H_0 is rejected and H_1 is accepted. So it can be concluded that there is a significant difference in the level of misconception reduction between the control class which applies the conventional learning model and the experimental class which applies the POE (predict-observe-explain) learning model with the mind mapping method.

Overall N-Gain Score test results , the experimental class which applied the POE (predict-observe-explain) learning model with the mind mapping method had an N-Gain score of 0.6092 and the control class which applied the conventional learning model had a score of 0.0618. In accordance with the results of the N-Gain test score, the interpretation of the effectiveness of the experimental class's N-gain is in the quite effective category while the control class is in the ineffective category. So it can be concluded that the POE (predict-observe-explain) learning model using the mind mapping method is said to be quite effective in reducing students' misconceptions regarding the human respiratory system material in class VIII MTs Muhammadiyah 1 Ponorogo. This is in accordance with the theory presented by Istnan Dikdoyo in his research which states that the POE (predict-observe-explain) learning model is able to reduce misconceptions among students. According to Kearney in Meliyani, learning with the POE model can be an effective teaching strategy in facilitating students' understanding of a concept (Hasanah & Kaniawati, 2015) . This is also supported by the mind mapping method which is able to strengthen memories and bind new conceptions that they have acquired. Apart from that, mind mapping is an easy way to place information into the brain and take information out of the brain, so that learning will be more effective.

Based on the results of data processing using the experimental class N-Gain Score, there are differences in each misconception reduction indicator. It is known that the first indicator, namely incorrect conceptual understanding, with descriptors in the form of errors in interpretation and description of an object contained in 4 questions, obtained an N-Gain value of 42.7 in the quite effective category. The second indicator, namely unscientific beliefs with descriptors of false beliefs and beliefs that are not in accordance with the research contained in the 3 questions, has an N-Gain value of 40.62 in the quite effective category. Meanwhile, the third indicator, namely misconceptions based on facts with descriptors in the form of wrong experiences and discrepancies between existing theory and facts, has an N-Gain value of 75 in the effective category.

From obtaining the N-gain score data , the highest and lowest average values for each indicator can be seen. The indicator with the highest average N-Gain is the factual misconceptions indicator with incorrect experience descriptors and a discrepancy between theory and fact which has the highest average compared to the other indicators. According to Marshall, factual misconceptions are caused by mistakes that occur during childhood and develop into adulthood (Ayu Dewanti, 2017). Indicators of factual misconceptions with incorrect experience descriptors include questions presented in the form of news about events related to disorders of the human respiratory system. Then students analyze the news, until they are able to get clues about the cause of the respiratory problems experienced by the problem in the incident. Meanwhile, in the descriptor of the discrepancy between theory and fact, the misconception that is reduced is related to the theory of human respiratory frequency factors with the statements presented, for example the following statement "The data obtained are as follows: Grandfather's ability to breathe/minutes 12-15, Mother's ability to breathe/ minutes 14-18, Grandmother's ability to breathe/minutes 13-16, Father's ability to breathe/minutes 14-17, Brother's ability to breathe/minutes 15-18, Sister's ability to breathe/minutes 20-24. Based on the results of these observations it can be concluded that breathing speed is influenced by age, why is that so, give the reason. So students can analyze whether the statement is true or false. In the POE learning model, one of the most important syntaxes is being able to prove (observe) a predictio . Which at this stage is able to prove wrong beliefs based on facts (Harris Rosdianto, Eka Murdani, 2017) . Based on the data analysis that has been carried out, it can be concluded that misconceptions based on facts can be reduced to the effective category with the highest average value compared to other indicators. This result is also the same as previous research conducted by Risma and Lyca, where in both studies the fact-based misconception indicator was at the highest average N-gain. The difference between the previous research

conducted by Risma and the current research is that in the previous research, the reduction of misconceptions on the fact-based misconception indicator was in the quite effective category, whereas in the current research, the reduction of misconceptions on this indicator was in the effective category (Wakhidah & Arif, 2022). However, in previous research conducted by Lyca, reducing misconceptions using fact-based misconception indicators was equally effective as the current research (R. Rohmah & Fadly, 2021).

The second indicator with the highest N-Gain score is an indicator of early concept understanding. with a descriptor of the main educational results and a description of an object. Similar to previous research conducted by Risma and Lyca, the indicator with N-Gain with the second highest value in their research was a wrong conceptual understanding (R. Rohmah & Fadly, 2021). In this research, the indicator of incorrect conceptual understanding is seen from the students' ability to present the learning results obtained. Students are required to understand the concepts in this research to be active in the teaching and learning carried out (RU Rohmah & Fadly, 2021) . Science learning outcomes that are classified in the low category can impact students' understanding of concepts incorrectly, this is because learning is not directed at thinking skills and building understanding of concepts that are in accordance with scientific theory (Ayu Dewanti, 2017) . Here, the misconceptions that occur among students in the form of learning outcomes that they have obtained include students' misconceptions regarding gases related to breathing, human respiratory mechanisms including inspiration and expiration, factors that influence human breathing, bacteria that cause respiratory system disorders, and habits that are detrimental to the respiratory system such as frequent inhalation of cigarette smoke. Meanwhile, the descriptor depicts an object which includes students' ability to analyze the image according to the questions and answers asked. In this descriptor, the misconception that occurs among students is in the form of the ability to distinguish between respiratory organs which function to exchange oxygen and carbon dioxide gases. Based on the analysis of data obtained from the N-Gain test , the indicator of early concept understanding is in the quite effective category so that misconceptions can be reduced quite well even though overall there are several students who still experience misconceptions.

The third indicator that has the lowest N-Gain score is the belief is not scientific indicator with the descriptors false belief and belief not based on research. This is also the same as previous research conducted by Risma and Lyca. The indicator with the lowest N-Gain in the research they conducted was the indicator of unscientific beliefs (R. Rohmah & Fadly, 2021) . In this study, the descriptor of false beliefs is shown by students' activities in analyzing and sequencing the respiratory mechanism process (RU Rohmah & Fadly, 2021) . According to Malikha, it is categorized as a misconception if there is a mismatch of concepts, use of the wrong concept, inappropriate classification and hierarchical relationships that are not in accordance with the concept (Aini & Wiryanto, 2020) . Meanwhile, in the belief descriptor not based on research, there are questions related to human respiratory frequency factors. Where human respiratory frequency is caused by several factors that influence it. The misconception that is reduced based on this indicator is about how to measure the average human respiratory frequency in the calculations that students carry out in investigation activities. During the learning process, the teacher has provided an understanding of how to calculate the correct average human respiratory frequency and what factors influence it, but regarding this indicator, it turns out that there are still many students who have not been able to reduce their misconceptions. Based on the data analysis that has been carried out, it shows that students' reduction abilities in justifying false beliefs are in a fairly effective category. This is because students are able to justify their conceptions in their posttest results . According to Lambi, the helplessness of being in new conditions or the helplessness of following changes in concepts, results in mistakes in exploring concepts (Dedi et al., 2015) .

Based on the data analysis, it shows that the POE (predict-observe-explain) learning model using the mind mapping method is quite effective in reducing students' misconceptions about the respiratory system material, because in this POE learning model students are faced with problems and make predictions about the causes. In addition to this problem, students are also exposed to direct evidence (observation) so that students will more easily understand a concept and reduce misconceptions or conceptual errors. This is in accordance with Roestiyah's research in Handayani which states that with observation activities at the POE stage students can prove for themselves their initial conceptions which they believe are the correct concepts from scientists (Teguh & Tandililing, 2006). Apart from that, it is also supported by Meliyani's research which proves that the POE model is proven to be able to reduce misconceptions that occur in students. (Hasanah & Kaniawati, 2015). Apart from that, in this research the learning carried out was also supported by the mind mapping method so that it was able to increase students' understanding, and misconceptions that occurred among students could be minimized or reduced. This is in accordance with research conducted by Avant Patria which states that mind mapping is an easy way to place information into the brain and take information out of the brain (Rasu & Djudin, 2019). Mind mapping which is designed in such a way aims to develop scientific concepts that students have acquired. Apart from that, it aims to make it easier for students to convey the results of students' ideas and make it easier for students to remember new concepts that have been formed in accordance with scientific concepts. This is in accordance with research conducted by Avant Patricia which proves that the mind mapping method is able to reduce misconceptions that occur in students (Rasu & Djudin, 2019). This is able to increase students' ability to understand concepts so that students can reduce the misconceptions they experience.

CONCLUSION

Based on the results of research carried out by researchers regarding reducing students' misconceptions using the POE (*predict-observe-explain*) learning model with the mind mapping method in science lessons with the theme of the human respiratory system at MTs Muhammadiyah 1 Ponorogo, it can be concluded that the POE (*predict*) learning model - *observe-explain*) with the mind mapping method has better effectiveness in reducing students' misconceptions compared to conventional learning models.

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