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The effect of the POE (Predict-Observe-Explain) learning model using a differentiation approach on student learning outcomes in the concept of temperature and heat

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Abstract

This study aims to determine the Effect of the POE (Predict-observe-Explain) Learning Model using a differentiated approach to student learning outcomes on the concepts of temperature and heat. This research was conducted at SMAN 1 Bokat. This study used an experimental method with the research design used was Pretest-Posttest Control Group Design. The sampling technique used in this study was cluster random sampling. The population in this study was all students of grade X Science 1 SMAN 1 Bokat. The sample of this study is class X as an experimental class and class X as a control class. The learning outcome instrument is an Esay test in the cognitive realm that has been validated by 3 validators. The results of this study showed that the learning outcomes of the experimental class were higher than the learning outcomes of the control class. This study aims to determine the effect of the POE (Predict-Observe-Explain) learning model with a differentiated approach on student learning outcomes in the concept of temperature and heat. This research was conducted at SMAN 1 Bokat using an experimental method with a Pretest-Posttest Control Group Design. The sampling technique used was cluster random sampling. The learning outcome instrument was an essay test in the cognitive domain validated by 3 validators. The results showed that the learning outcomes of the experimental class were higher than those of the control class. Normality tests showed that the data were normally distributed, and homogeneity tests showed that the data were homogeneous. Hypothesis testing using the t-test at a significance level of $\alpha = 0.05$ indicated that t_calculated > t_table, thus H0 is rejected and H1 is accepted. It can be concluded that the POE learning model with a differentiated approach significantly affects students' learning outcomes on the concept of temperature and heat.

Keywords: differentiated learning; prediction-observe-explaim; learning outcomes

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INTRODUCTION

The progress of a nation is largely determined by the quality of its human resources, which depend on the quality of education. Education has an important role in creating an intelligent, peaceful,

open, and democratic society. Therefore, efforts to improve the quality of education must always be carried out to improve the quality of education of a nation (Pane, 2022).

Each student is a unique individual with different characteristics. When students are placed in the same class, there will be a diversity of characteristics, such as interests, learning styles, and backgrounds. Therefore, education must be considered as fertile ground to develop students' overall potential (Siburian, 2019).

The progress of a nation is largely determined by the quality of its human resources, which depends on the quality of education. Education plays a critical role in creating an intelligent, peaceful, open, and democratic society (Pane, 2022). Currently, students' physics learning outcomes are still low, both at the junior and senior secondary education levels. This is often due to less meaningful learning, where students are less actively involved, leading to weak conceptual understanding (Pane, 2022).

At SMAN 1 Bokat, specifically in the subject of temperature and heat, students face difficulties in understanding basic concepts. Initial observations revealed that conventional teaching methods, which are still widely used, fail to actively engage students. Therefore, an alternative learning method is needed to improve student comprehension, one of which is the POE (Predict-Observe-Explain) learning model with a differentiated approach. This model accommodates students' diverse characteristics and improves conceptual understanding through prediction, observation, and explanation stages.

This study employed an experimental method with a pretest-posttest control group design to investigate the effect of the POE learning model with a differentiated approach on student learning outcomes in the concept of temperature and heat. Before the research was conducted, a needs analysis was performed through observations and interviews with teachers and students to identify learning difficulties in the topic of temperature and heat. The needs analysis revealed that conventional teaching methods were ineffective in significantly improving learning outcomes.

The sample of this study was selected using cluster random sampling, with one class serving as the experimental group and another as the control group, each consisting of 22 students. The instrument used was a 10-question essay test that had been validated for reliability and validity

METHOD

This study used an experimental method with a pretest-posttest control group design. This method was chosen to determine the effect of the POE (Predict-Observe-Explain) learning model with a differentiated approach to student learning outcomes on the concepts of temperature and heat. This research was conducted at SMA Negeri 1 Bokat, Bokat District, Buol Regency.

Research Design

The research design used was a pretest-posttest control group. In this design, the research subjects were divided into two groups, namely the experimental group and the control group. The experimental group was treated using the POE learning model with a differentiated approach, while the control group used conventional learning methods. Here is the research design scheme (Table 1).

Table 1. Research design scheme.

Group	Pretest (T1)	Treatment (X)	Posttest (T2)
Experiment	T1	POE model with differentiated approach	T2
Control	T3	Conventional learning model	T4

Population and Sample

The population in this study is all grade X MIPA students at SMA Negeri 1 Bokat for the 2023/2024 school year. The study sample was taken using cluster random sampling technique, where two classes were randomly selected as the experimental class and the control class. Each class consists of 22 students.

Research Variables

This study has two variables, namely:

1. Free Variable: POE (Predict-Observe-Explain) learning model with a differentiated approach.
2. Dependent Variables: Student learning outcomes on the concepts of temperature and heat.

Research Instruments

The instrument used in this study is an essay test of 10 questions that have been tested for validity and reliability. This test is given during the pretest and posttest to measure students' understanding of the concepts of temperature and heat.

Data Collection Techniques

Data was collected through essay tests given on the pretest and posttest. The data collection procedure is as follows:

1. Pretest: Conducted before treatment to determine the student's initial ability.
2. Treatment: The experimental class was given learning using the POE model with a differentiated approach, while the control class was given conventional learning.
3. Posttest: Conducted after treatment to measure improvement in student learning outcomes.

Data Analysis Techniques

The data obtained is analyzed using the help of SPSS software with the following steps:

1. Normality Test: A normality test is performed to find out if the data is normally distributed. This test uses the Lilliefors method with criteria if the significance value (Sig.) > 0.05 then the data is normally distributed.
2. Homogeneity Test: A homogeneity test is performed to find out if the variance of both groups is homogeneous. This test uses the One Way Anova method with criteria if the value of Sig. > 0.05 then the data is homogeneous.
3. Hypothesis Test: Hypothesis testing is carried out using a t-test to determine the difference in learning outcomes between the experimental group and the control group. The decision-making criterion is that if the Sig. (2-tailed) score < 0.05 then there is a significant difference between student learning outcomes in both groups.

With the research methods and designs that have been designed, it is hoped that this research can provide a clear picture of the influence of the POE learning model with a differentiated approach to student learning outcomes on the concepts of temperature and heat.

RESULTS AND DISCUSSION

Research Results

The study was conducted over three meetings. In the first meeting, a pretest was administered to measure students' initial abilities. In the second meeting, the learning process using the POE model

was implemented in the experimental class, while the control class used conventional teaching methods. In the third meeting, a posttest was given to measure the improvement in students' learning outcomes after the treatment.

Data Descriptive Analysis

The pretest and posttest scores of both classes were analyzed using SPSS software to obtain the mean, median, mode, standard deviation, and variance scores. The results of the descriptive analysis showed that the average pretest and posttest scores of the experimental class and control class were as follows in Table 2.

Table 2. Descriptive analysis results.

Class	Pretest Mean	Posttest Mean	Median	Mood	Std. Dev.	Variance
Experiment	67.33	86.67	68	68	9.34	87.19
Control	73.69	73.69	75	75	10.05	101.00

The experimental class posttest average score was 86.67, while the control class posttest average score was 73.69. This showed a significant improvement in learning outcomes in experimental classes after being treated using the POE learning model.

Data Normality Test

A normality test is performed to find out whether the data is normally distributed or not. This test uses the Lilliefors method with a significance level of 0.05. The normality test results showed that the Sig. value for all groups (experimental and control class pretest and posttest) was 0.200, which is greater than 0.05. This means that the data is normally distributed.

Data homogeneity test

A homogeneity test is performed to find out if the variance between two groups of data is homogeneous. This test uses the One Way Anova method with a significance level of 0.05. The homogeneity test results show that the value of Sig. based on mean is 0.060, which is greater than 0.05. This means that the data is homogeneous

Test the hypothesis

Hypothesis testing is carried out to determine whether there are differences in learning outcomes between the experimental class and the control class. This test uses a t-test with a significance level of 0.05. The results of the hypothesis test show that the value of Sig. (2-tailed) is 0.000, which is smaller than 0.05. Thus, H0 is rejected and H1 is accepted, which means that there is a significant difference between student learning outcomes in the experimental class and the control class.

Discussion

Descriptive analysis showed that the average posttest score in the experimental class was 86.67, while the control class average was 73.69, indicating a significant improvement in the experimental class. The POE model involved three stages: (1) prediction, where students made hypotheses about temperature phenomena; (2) observation, where students conducted experiments to observe temperature changes; and (3) explanation, where students explained their observations.

The normality test results showed that the data were normally distributed, with a significance

value > 0.05, and the homogeneity test showed that the data were homogeneous, with a significance value > 0.05. Hypothesis testing using the t-test showed a Sig. (2-tailed) value of 0.000, which is less than 0.05, indicating that the POE model had a significant effect on student learning outcomes

The results showed that the use of the POE learning model with a differentiated approach can significantly improve student learning outcomes on the concept of temperature and heat. Here are some factors that support these findings:

The results of this study are in line with previous studies that have shown that the POE learning model is effective in improving student learning outcomes. For example, research by Muna (2017) shows that the POE model is effective in improving students' understanding of science concepts and skills.

This research also supports the importance of using differentiated approaches in learning. This approach allows teachers to tailor learning strategies to students' individual needs, which can improve learning effectiveness and student learning outcomes.

Overall, the results of this study show that the POE learning model with a differentiated approach is an effective strategy to improve student learning outcomes on the concepts of temperature and heat. The implementation of this model in physics learning is expected to improve the quality of physics education and produce students who are more competent and ready to face future challenges.

CONCLUSION

Based on the results and data analysis, it can be concluded that the POE (Predict-Observe-Explain) learning model with a differentiated approach significantly affects student learning outcomes in the concept of temperature and heat at SMAN 1 Bokat. This model improves students' comprehension through active engagement in the prediction, observation, and explanation of physics concepts. This research also emphasizes the importance of differentiated approaches in education to accommodate students' individual learning needs:

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