

# Predict-Observe-Explain (POE) Model and Self-Efficacy: A Study of Its Interaction Effect on the Elementary Students' Understanding of Science Concepts

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## ABSTRACT

This quasi-experimental design study with a 2x2 factorial design aimed to determine the simultaneous effect of the application of the POE (Predict, Observe, Explain) learning model and self-efficacy on students' ability to understand science concepts. The target population of this study were all elementary school students in Singkawang City. Samples were taken using cluster random sampling techniques. Five public elementary schools were selected as experimental groups and 5 schools as control groups totaling 235 students. There were 3 (three) main instruments in this study, namely; Lesson Implementation Plan (*RPP*), Concept Understanding Test, and Self-Efficacy Questionnaire. Based on data analysis, the following findings were obtained: (1) The POE learning model and self-efficacy simultaneously influenced students' ability to understand concepts on heat transfer material; (2) The understanding of science concepts among students involved in POE model learning was better than those involved in conventional learning on class heat transfer material; (3) self-efficacy influenced POE Model learning and did not influence conventional learning; and (4) There is an interaction effect between learning models and self-efficacy on understanding science concepts. In-depth analysis can be done by involving other factors; for example; learning independence, learning style, or the use of interactive media.

**Keywords:** POE Model, Self-Efficacy, Interaction Effect, Understanding of Science Concepts, Heat Transfer

## INTRODUCTION

Science lessons in elementary schools are intended for students to have knowledge, ideas, and concepts obtained from experience through a series of scientific processes. The scope of the study material includes two aspects, namely scientific process and conceptual understanding. The purpose of learning science in elementary schools is to develop knowledge and understanding of scientific concepts that will be useful and can be applied in everyday life. (Minister of National Education Regulation No. 22 of 2006).

A concept is an abstract idea or notion that exists in the mind (Susanto, 2016: 8), so that a person is able to distinguish between examples and non-examples (Dahar, 1995) which can produce knowledge products including principles, laws, and theories (Sagala, 2017: 71). Understanding a concept is very important during learning, because: (1) it can reduce the heavy burden on memory; (2) it is an element that builds thinking; (3) it is the basis for higher mental processes; and (4) it is needed to solve problems (Uno, 2019: 10).

According to Anderson & Krathwol (2010), there are seven indicators of conceptual understanding aspects, namely; 1) interpreting, which is changing information from one form to another; 2) exemplifying, which is the process of identifying the main characteristics of a general concept or principle; 3) classifying, which involves the process of detecting characteristics or patterns that correspond to certain examples, concepts or principles; 4) summarizing, which is stating one sentence that presents the information received; 5) concluding, which includes the process of finding patterns in a number of examples; 6) comparing, which

involves the process of detecting similarities and differences between two or more objects; and 7) explaining, which is when students can create and use cause-and-effect models in a system.

In fact, the ability to understand the concept of science of elementary school students is still relatively low. This is evidenced by data from the Trend in International Mathematics and Science Study 2015 (in Hadi & Novaliyosi, 2019), in the field of science, Indonesia is ranked 44 out of 49 with an average score of 397 and far below the international average of 500. Several previous research results showed that the ability to understand the concept of science of elementary school students in Indonesia is still low, which includes the ability to observe, interpret, explain, classify, predict (Widiawati et al., 2015; Nugraha, et al., 2019; Andriani, et al., 2017; Firdaus, et al., 2023).

One of the 6th grade science teaching materials that involves a lot of observing, predicting, and explaining processes is heat transfer (Independent Curriculum, 2023). Unfortunately, from the results of observations in several public elementary schools in Singkawang, it was obtained that students' ability to understand science concepts in this material was still low. The learning process still dominantly emphasizes memorization when receiving teacher explanations. Many students are unable to explain scientific concepts related to heat transfer events. The teacher also admitted that he rarely involved students in simple experiments. This empirical fact is actually not in line with the nature of science, as a process, product, and formation of scientific attitudes (Cary & Sund, 2005).

One of the learning models that can be considered appropriate to overcome the problem of lack of understanding of science concepts and is considered appropriate to the characteristics of the intellectual development level of elementary school students is POE (Predict-Observe-Explain). Learning activities in the POE learning model include predicting, observing, and explaining. The first step is the teacher asks students to observe what will and is being demonstrated. The second step, in the prediction stage, while waiting for the experiment to finish, students predict what will happen, by writing it down, according to their initial conception. The third step, students are asked to match the results of their predictions with what actually happened after the experiment or demonstration by the teacher is finished. Based on the results of these observations, students are asked to provide an explanation. The teacher asks students to scientifically explain the difference between the predictions they made and the results of their observations. These three learning activities are believed to be able to shape students' cognitive structures better, because the activities in this learning model provide opportunities for students to learn concretely (Warsono & Hariyanto, 2017; Juniari et al., 2014).

Several previous studies concluded that the POE learning model can improve students' ability to understand science concepts in elementary school (Andriani, et al., 2017; Nugraha, et al., 2019). However, several other studies concluded that students' science learning outcomes are also influenced by self-efficacy (Ghufron et al., 2017; Adni et al., 2018). For example, Novena & Kriswandani's (2018) research concluded that the science learning outcomes of students with high self-efficacy were better than those with medium and low self-efficacy. Firdaus et al.'s (2023) research also concluded that there was a positive relationship between student learning outcomes and self-efficacy in students' science lessons. Thus, it can be concluded that because POE is an instructional intervention, its effectiveness will also be influenced by self-efficacy.

Self-efficacy; (1) is the belief that students have to determine the amount of effort and the length of time to persist in facing each existing problem (Agustiana et al., 2019); (2) is one of the most influential aspects of self-knowledge in everyday human life (Ghufron et al., 2017); (3) could influence individuals in determining the actions to be taken to achieve a goal, including estimates of various events that will be faced (Rahmi et al., 2020). Students who want to learn well or have self-efficacy will easily understand concepts well (Bandura, in Ghufron et al, 2017).

From the tracing of several journal articles, it is believed that researches that examines the effectiveness of POE and self-efficacy simultaneously on science learning outcomes in elementary schools, especially on heat transfer material, have not been extensively conducted. Therefore, this research is considered rational to be conducted. Based on the background, the general problem in this study is "Do the application of the POE

learning model and self-efficacy simultaneously affect the understanding of science concepts of 6th grade elementary school students on heat transfer material? The research questions in this study are as follows:

1. Does the application of learning models (POE and conventional) affect the understanding of science concepts of 6th grade elementary school students on heat transfer material?
2. Does the level of Self-Efficacy (high-low) affect the understanding of science concepts of 6th grade elementary school students on heat transfer material?
3. Is there an interaction effect between learning models and self-efficacy on the understanding of science concepts of 6th grade elementary school students on heat transfer material?
4. Is there a difference in the understanding of science concepts of 6th grade elementary school students who used the POE learning model in terms of high and low self-efficacy in heat transfer material?
5. Is there a difference in the understanding of science concepts of 6th grade elementary school students who used the conventional learning model in terms of high and low self-efficacy in heat transfer material?

**METHOD**

This study applied a quasi-experimental design with a posttest only control group design (Borg & Gall, 1995; Creswell, 2015) using a 2x2 factorial design whose paradigm is described in Table 1 below.

Table 1. Factorial Design 2 x 2

Self-Efficacy	Learning Model	
	POE	Conventional
High	$\bar{Y}_{P-T}$	$\bar{Y}_{L-T}$
Low	$\bar{Y}_{P-R}$	$\bar{Y}_{L-R}$

*Note:*

$Y\#P-T$  = Average score of understanding of science concepts using the POE learning model reviewed from high self-efficacy

$Y\#P-R$  = Average score of understanding of science concepts using the POE learning model reviewed from low self-efficacy

$Y\#L-T$  = Average score of understanding of science concepts using the direct learning model reviewed from high self-efficacy

$Y\#L-R$  = Average score of understanding of science concepts using the direct learning model reviewed from low self-efficacy

The posttest only control group design with a 2x2 factorial design was applied considering that the material on heat transfer have never been studied and the POE learning model was considered to have never been applied by teachers before.

The target population of this study was 6th grade elementary school students in Singkawang City with the characteristic of not having studied heat transfer material. The sample was taken using the cluster random sampling technique. A total of 10 elementary schools were selected, with details of 5 public elementary schools as the experimental group and 5 elementary schools as the control group. The research sample consisted of 235 students, consisting of 111 students in the experimental group and 124 students in the control

group. The teachers who were voluntarily involved in this study were science teachers who taught heat transfer material in the even semester of the 2024/2025 academic year. They will be given brief training first regarding the practice of learning the POE model and the conventional model (which is commonly used in their schools), providing lesson plans, worksheets, and research test assessment rubrics.

Haysom & Bowen (as cited by Safitri et al., 2019:199) argued that POE sequences (predict-observe-explain) provide an important way to enhance your students understanding of important scientific ideas. If you are teaching an activity-based curriculum, they can help provide a firm basis for understanding. Operationally, the syntaxes of the POE learning model in this study were:

- Predict*, the teacher displays an image displayed via a projector or video. Students are asked to predict what events will occur.
- Observe*, the teacher asks students to prove the predictions they make with reasons, practice them, see them in reality, such as conducting experiments (observations) to prove whether the prediction is true or not, and what happens next.
- Explain*, the teacher provides an explanation of the events or statements that occur in the experiment or prediction. This is to convince students of the suitability of their conceptions with those in their textbooks. Students are asked to summarize what they have found, describe, or explain in more detail in front of the class as a representative. The teacher provides feedback explanations, so that students are expected to be able to change their misconceptions into conceptions that are in accordance with scientific concepts.

Research timeline (administration of treatments, subject matters, posttest) can be showed in Table 2.

Table 2. Research Timeline

<b>Treatments</b>	<b>Experiment Group (POE Model)</b>	<b>Control Group (Conventional)</b>
<i>Adminster the self-efficacy Questionnaire</i>	<i>Adminster the self-efficacy Questionnaire</i>	<i>Adminster the self-efficacy Questionnaire</i>
Treatment-1	Conduction heat transfer	Conduction heat transfer
Treatment-2	Convection heat transfer	Convection heat transfer
Treatment-3	Radiation heat transfer	Radiation heat transfer
<i>Immediate Posttest</i>	Test of understanding of science concepts	Test of understanding of science concepts

The provision of treatment and research tests were carried out by the teachers according to their respective Learning Calendars. The provision of treatment took place in the period from May to June 2025. The immediate posttest was to measure the extent of the effect of each learning model (POE and Conventional) and the level of student Self-Efficacy on understanding concepts in the heat transfer material.

There are 3 (three) main instruments in this study, namely the Learning Implementation Plans for 3 (three) treatments, the final test (concept understanding), and the self-efficacy questionnaire. The concept understanding test is in the form of a double-ended test with reasons totaling 20 questions with a time allocation of 60 minutes. Overall, the test of students' science concept understanding ability has a correlation of 0.43 to 0.60 (declared valid). The assessment of students' science concept understanding ability is assessed from the average post-test score. The ability to understand science concepts includes 5 indicators, namely: (1) interpreting, (2) exemplifying, (3) classifying, (4) comparing, and (5) explaining.

The self-efficacy questionnaire consists of 24 statements and consecutive answer scores; Score 4 for SS (Strongly Agree), 3 for S (Agree), 2 for TS (Disagree), 1 for STS (Strongly Disagree). The Self-Efficacy

questionnaire assessment score used in this study was a summated rating scale (Likert scale). Overall, the student self-efficacy questionnaire has a Cronbach Alpha coefficient of 0.41 to 0.68 (declared valid). The student Self-Efficacy questionnaire scores are classified into high Self-Efficacy levels (total score  $\geq 48$ ) and low (total score  $< 48$ ).

To answer the research questions (2 questions of main effect and interaction effect), the final test data/scores will be analyzed using two-way anova. And, the difference test on the final test scores for students in the experimental and control groups ---(2 simple effect questions), the data were analyzed using independent samples t-test. Statistical data analysis using SPSS version 25

## FINDINGS AND DISCUSSION

To determine the research results using parametric test data analysis (two-way anova and independent samples t-test), a data normality assumption test, a variance similarity (homogeneity) test, was first carried out on the post-test scores for understanding science concepts, the results of which are presented in Tables 3 and 4 below.

Table 3. Output of Normality Tests

Tests of Normality						
	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Experiment Group	0.226	110	0.138	0.957	110	0.057
Control Group	0.234	123	0.157	0.859	123	0.061

From Table 3, it is known that the sig value is  $0.138 > 0.05$  (experimental group) and sig  $0.157 > 0.05$  (control group), so the assumption of data normality for both groups is met.

Table 4. Output of Varians Equality Test

Levene's Test of Equality of Varians <sup>a,b</sup>						
			Levene Statistic	df1	df2	Sig.
Pemahaman IPA	Konsep	Based on Mean	2.110	3	233	0.111
		Based on Median	1.847	3	233	0.151
		Based on Median and with adjusted df	1.847	3	42.812	0.153
		Based on trimmed Mean	2.041	3	233	0.121

From Table 4, the Levene's statistical sig value for the average (based on Mean) is  $0.111 > 0.05$ , it is concluded that the variance of understanding of science concepts in the experimental and control groups is homogeneous (the same). Thus, the use of parametric test data analysis (two-way anova and independent samples t-test) meets the requirements to be applied.

### 1. The Influence of Learning Models, Self-Efficacy, and Their Interaction Effects on Understanding Science Concepts

To determine the influence of the learning model (main effect 1), self-efficacy (main effect 2), and their interaction effects, the data (final test scores of understanding science concepts) were analyzed using two-way ANOVA and the output results are presented in Table 5 below.

Table 5. Output of Two-Way Parametric Test

Tests of Between-Subject Effects					
Dependent Variable : Understanding of Science Concepts					
Source	Type III Sum Of Squares	df	Mean Square	F	Sig.
Corrected Model	20930.032 <sup>a</sup>	3	6976.677	66.047	0.000
Intercept	93891.996	1	93891.996	888.861	0.000
Model	9768.492	1	9768.492	92.477	0.000
Efficacy	5920.322	1	5920.322	56.047	0.000
Model*Efficacy	2852.154	1	2852.154	27.001	0.000
Error	15070.329	233	64.689		
Total	227068.750	237			
Corrected Total	26000.361	236			

a. **R Squared = 0.805 (Adjusted R Squared=0.793)**

From the SPSS output presented in Table 5, several research findings can be interpreted as follows:

- a. **Corrected Model** has an F value = 66.047, sig. = 0.000 < 0.05. This output shows that there is a simultaneous influence of the application of the POE learning model and self-efficacy on the understanding of science concepts.
- b. **Model** has an F value = 92.4777, sig. = 0.000 < 0.05. This output shows that there is a difference in the understanding of science concepts between students involved in the POE learning model and those involved in conventional learning. In other words, there is an influence of the application of learning models (POE and conventional) on the understanding of science concepts.
- c. **Efficacy** has an F value = 56.047, sig. = 0.000 < 0.05. This output shows that there is a difference in the understanding of science concepts between students who have high self-efficacy and low self-efficacy. In other words, there is an influence of self-efficacy on the understanding of science concepts.
- d. **Model\*Efficacy** has an F value = 27.001, sig.= 0.000 < 0.05. This output shows that there is an interaction effect between the learning model and self-efficacy on the understanding of science concepts. This is also indicated by the presence of an intersection between the model and self-efficacy factors below.

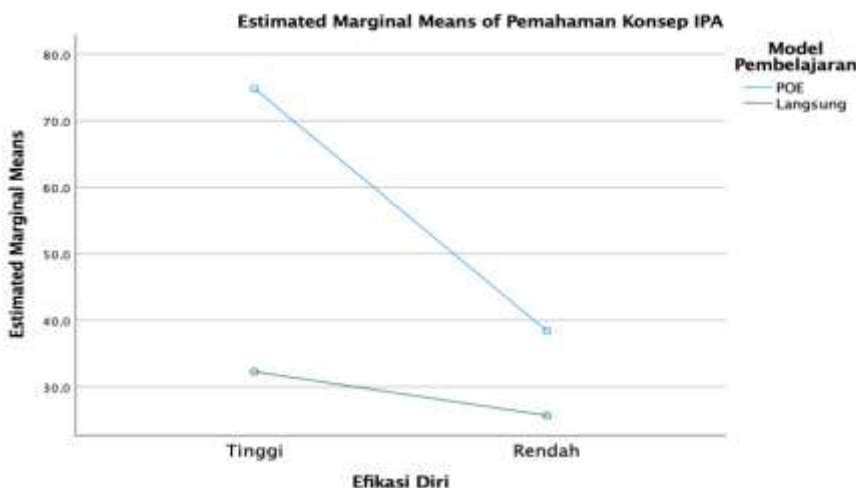


Figure 1 . Intercation Effect POE Model and Self-Efficacy on Understanding of Science Concepts

This study concluded that the understanding of science concepts among students involved in POE model learning was better than those involved in conventional learning on class heat transfer material. This finding is in line with the results of Prasetyo et al. (2019) which concluded that the POE learning model which begins by confronting students with a problem prediction produces better learning outcomes than conventional learning (Aurah et al., 2014; Kala et al., 2013; Yuksel & Ates, 2017).

This difference can be explained from several factors. *First*, prediction activity, Nugraha et al. (2019) emphasized that the POE learning model can improve students' conceptual understanding because the prediction activity allows students to construct the concepts they are learning (Nurliana et al., 2019; Humairoh et al., 2022; Wiguna et al., 2018). At the prediction stage, students are given the freedom to express their opinions, hypotheses, or concepts (Huinker & Laughlin, 2001). According to Joyce (2008), making predictions is effective in finding and describing students' prior knowledge and providing teachers with information about students' thinking abilities. Several co-researchers reported that in the experimental class using POE, each group of students had to give their opinions and make more than one prediction. This means that the more perspectives on the prediction, the more material can be used to address the concept and strengthen the understanding of the concept. In the prediction activity, teachers can help students analyze misconceptions after making predictions.

*Second*, observation activities. In the observation stage, students conduct simple experiments on heat transfer. During this process, students become more motivated to explore concepts and study them seriously. Students are eager to prove the truth of previously made predictions. According to White and Gustone (1992), POE has the potential to motivate students who want to explore concepts more deeply. In addition, students are directly involved in a simple investigation process related to the predictions they make. Bars & Oral (2017) revealed that students' self-efficacy can increase in the experiments they conduct to find evidence that supports their predictions.

*Third*, explaining activities. In this process, students are invited to explain the results of observations made by their group. The explanation aims to compare the results of observations with predictions that have been made. Among the different groups, only one group made a prediction that did not match the observation. The POE model has the potential to cause concept consolidation and cognitive conflict. According to Piaget in Sujiono (2008), if students' observations are the same as the assumptions made, then there will be reinforcement, while if what is observed is different from the assumptions made, then there will be cognitive conflict. During this process, the teacher provides explanations to strengthen the concept and explain the reasons for students' prediction errors. The POE learning model is based on the theory of constructivism learning which assumes that through the activities of predicting, observing, and interpreting observation results, cognitive structures will be formed properly (Warsono, 2017: 93). Abdawiyah et al., (2016) stated that the POE model has an influence on students' ability to understand science concepts. The application of the POE Model is in line with the nature of natural science, especially science as a way of thinking.

## **2. The Influence of Interaction of the POE Learning Model and Self-Efficacy on the Ability to Understand Science Concepts**

Interaction can be interpreted as a form of cooperation between two or more variables in influencing the dependent variable. In other words, interaction refers to the influence or influence of one independent variable on the dependent variable. Depending on the state of the other independent variables. Interaction is the combined effect of two or more independent variables on the dependent variable (Creswell, 2013).

The interaction of the POE learning model and students' self-efficacy on the ability to understand concepts. Caused by several things as follows. First, this is due to differences in learning stages. From the stages of the two learning models, the interaction between the POE learning model can be seen which emphasizes the activities of teachers and students through many stages (Indrawati, 2009: 45), especially predictions, the teacher asks students to observe the content displayed in front of the class. Students will observe the facts shown, then predict the results and review the results of their predictions. Observation, the teacher demonstrates, presents the demonstration process, and asks students to record and observe directly what happens. explain The teacher asks students to make hypotheses or tentative predictions about why something

happens the way they do or what they see, and then explains the difference between the predictions they make and the results of their observations.

Meanwhile, in the conventional learning model, the teacher presents all the materials and students only play a role in receiving and memorizing the materials. This makes students quickly bored and quickly forget the learning materials. Students only memorize the materials and do not understand the concept of the learning materials. The existence of prediction, observation, and explanation activities in the POE learning model can increase students' confidence in their ability to complete the exercises and questions given by the researcher.

*Second*, learning according to the POE learning model is constructivist because students are free to think about scientific problems posed by the teacher and they try to develop their knowledge by thinking, practicing and seeking explanations, this helps children to be confident in completing the knowledge they already have. learning tasks, according to White and Gustone (1992), POE can motivate students who want to explore concepts more deeply. In addition, students are directly involved in a simple investigation process related to the accusations they make. Based on the explanation above, it can be concluded that learning according to the POE learning model has a significant influence between the POE learning model and students' self-confidence in their ability to understand scientific concepts because of the interaction between the POE learning model and self-efficacy.

### 3. Differences in Understanding of Science Concepts Using the POE Learning Model and the Conventional Model Reviewed from Self-Efficacy

To analyze whether there are differences in the understanding of science concepts of students involved in POE Model learning and conventional Model in terms of self-efficacy (high-low), the data were analyzed using independent samples t-test and the results are presented in Table 6 and Table 7.

Table 6. Effect of Self-Efficacy on POE Model

Independent Sample Test						
	Self-Efficacy	n	Mean	SD	t	Sig.
Understanding of Science Concepts in	High	65	78.167	10.241	7.203	0.000
POE Model Classes	Low	46	38.409	12.417		

From the SPSS output presented in Table 6, it is obtained  $t = 7.203$ ,  $\text{sig (2-tailed)} = 0.000 < 0.05$ . It can be concluded that there is a difference in understanding of science concepts (on heat transfer material) involved in POE learning between students with high and low self-efficacy. In other words, self-efficacy affects POE.

Table 7. Effect of Self-Efficacy on Conventional Model

Independent Sample Test						
	Self-Efficacy	n	Mean	SD	t	Sig.
Understanding of Science Concepts in	High	71	32.500	10.871	1.869	0.074
Convent. Classes	Low	53	25.179	9.118		

From the SPSS output presented in Table 7, it is obtained  $t = 1.869$ ,  $\text{sig (2-tailed)} = 0.074 > 0.05$ . It can be concluded that there is no difference in understanding of science concepts (on heat transfer material) involved in conventional learning between students with high and low self-efficacy. In other words, self-efficacy does not affect conventional learning.

This study concluded that self-efficacy had an effect on POE Model learning and does not have an effect on conventional learning. This finding is in line with several previous research results. It was found that; (1) students who have conceptual understanding with high self-efficacy are better able to complete tasks (Nurani et al., 2021); (2) students with high self-efficacy do not give up easily and have high confidence in solving their problems, so it can be interpreted that students who have high self-efficacy have better conceptual understanding abilities; (3) students who have high self-efficacy will be more confident and try hard to show the best results (Destiniar et al., 2019); (4) students with high self-efficacy will find it easier and succeed in passing the exercises given to them (Jatisunda, 2017); (5) self-efficacy will have a positive influence on students' conceptual understanding (Akuba et al., 2020).

Theoretically, people with high self-efficacy view problems as challenges that need to be solved. When he faces a problem, he will be motivated to solve the problem that occurs, because he has a strong commitment. With high self-control, he will not give up easily when doing something. He always tries harder when he fails in the goals he wants to achieve. He assumes that failure occurs due to lack of effort and lack of knowledge (Jannah et al, 2022). According to Bandura (1977), the function of self-efficacy can be increased in the following ways: (1) choosing behavior, (2) making efforts and determining the level of tolerance to overcome obstacles, (3) thinking and reaction patterns, (4) predicting subsequent behavior, (5) determining subsequent performance. Second, this is seen through the lens of self-efficacy.

According to Bandura (1977), self-efficacy includes three aspects, namely *magnitude*, *strength*, and *breadth*. The first dimension is magnitude, which refers to the level of difficulty of the task that students believe they can overcome. This level of self-confidence will affect the choice of activities, level of effort, and resilience of students in facing and completing the tasks they are given. Students with high self-efficacy are confident in their ability to complete and complete difficult tasks. Students with high self-efficacy view difficult tasks as challenges that must be overcome. In contrast to students who have low self-efficacy, they will feel unable to complete difficult tasks. Students with low self-efficacy actually avoid difficult and challenging tasks. The efforts they make are not as optimal as those made by students who have high self-efficacy.

The second dimension is strength, which concerns the strength of the assessment of personal abilities. This aspect also refers to how stable students are in their expressed beliefs. Students with high self-efficacy show resilience and perseverance when faced with task demands or problems. They strategize and commit to completing their tasks with perseverance. If they encounter failure, they will try to improve the situation. Focus on solutions to overcome the obstacles faced. Conversely, students who have low self-efficacy will tend to give up easily and complete tasks incompletely. They will stop when they encounter obstacles and focus on the failures they encounter.

The third dimension, generality, is the concept that a person's self-efficacy is not limited to a particular situation. This aspect is associated with students' self-confidence in their ability to complete tasks in various activities. Various activities require students to be confident in their ability to complete tasks or activities. Students with high levels of self-efficacy find it easier to master various fields and complete tasks. Conversely, students with low self-efficacy tend to master fewer fields to complete their work. The last thing of this discussion section, we would like to declare that several threats to internal validity in this study i.e. *the instrumentation*, *selection*, and *maturation* factors, are expected to have been reduced by implementing a posttest only control group design.

## CONCLUSION

Based on the results of data analysis, it is concluded that the POE learning model and self-efficacy simultaneously influence students' conceptual understanding ability in the heat transfer material. The understanding of science concepts among students involved in the POE learning model is better than those involved in conventional learning in the class heat transfer material. Furthermore, self-efficacy influences POE Model learning and does not affect conventional learning. For further researchers, in-depth analysis can be carried out by involving other factors; for example; learning independence, learning style, or the use of interactive media, Phet Simulation, virtual laboratory.

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