How the Predict-Observe-Explain (POE) learning strategy remediates students’ misconception on Temperature and Heat materials?

S Latifah, I Irwandani,*, A Saregar, R Diani, O Fiani, W Widayanti, U A Deta

1Universitas Islam Negeri Raden Intan Lampung
2Universitas Lampung
3Universitas Negeri Surabaya

Email: irwandani@radenintan.ac.id

Abstract. The purpose of this research is to know how the Predict-Observe-Explain (POE) learning strategy is able to remediate misconception experienced by students. This research was onset by the existence of educators who are not quite precise in choosing learning strategies in accordance with the characteristics of the material, thus resulting in high misconception among students. The research method used was Quasi-Experimental with Non-equivalent Control Group Design. The population of this research was the students of the eleventh grade with 30 students as the sample of the research obtained by using purposive sampling technique. The sample class was given treatment through POE learning strategy. The instrument of data collection used was tested (pretest and post-test). The results showed that POE learning strategy was able to improve students’ misconceptions seen from the reduction on the percentage of misconception in problem 2, number 4, and question number 19. It can be concluded that POE learning strategy is effective to remediate the eleventh-grade students’ misconception of temperature and heat materials.

1. Introduction
Misconception can be viewed as a cognitive structure that adheres strongly and steadily to the minds of students but actually, it has deviated from the conceptions proposed by experts [1-2]. The misconception has become a serious concern of educators as well as a frightening thing for the development of physics learning in school. Learning which focuses on emphasizing mathematical understanding is not involving the students in learning, lack of student activities (discussion, lab work, proof of concept) in learning activities, improper use of instructional media potentially leads to students’ misconceptions [2–4]. The students’ initial conception has great potential for misconception [5-6]. The process of absorption of information that is less than optimal has the potency to cause students’ misconceptions. In addition to learning process factors, misconception can also occur because of the students’ experiences on the concepts that exist in everyday life [6-7]. Interaction with the environment will create an early conception in the mind of the students. This is one of the causes of the difficulty in learning a concept [7–9].

One way to identify misconceptions is by using Certainty of Response Index (CRI). CRI is a measure of the respondents’ level of confidence or certainty in answering each question. It has a degree of confidence or assurance in answering every question tested. The degree of confidence on the
answers to the problems is grouped into six scales, i.e. from the smallest scale of zero to the largest scale of five \[11-12\]. Table 1: CRI differentiates the students who know the concepts, misconceptions, and do not know the concepts.

| Criteria          | Low CRI (<2.5)                                                                 | High CRI (>2.5)                                                                 |
|-------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Correct Answer    | The correct answer with low CRI means not knowing the concept                 | The correct answer with high CRI means mastering the concept well             |
| Incorrect Answer  | The wrong answer with low CRI means not knowing the concept                  | The wrong answer with high CRI means there is a misconception                 |

The analysis to distinguish between misconceptions and not knowing the concept was done through answer analysis. The right and wrong answers and the indices (CRI > 2.5) and (CRI < 2.5) were used to distinguish between misconceptions, knowing the concepts, and not knowing the concept. If the answer is true with the index of CRI > 2.5, then it indicates that it knows the concept \[13\].

Based on the observation in the eleventh grade of SMK Bandar Lampung, the number of students who experienced misconception reached 67.74% on temperature and heat material \[16\]. Students’ misconceptions on physics materials can lead to learning failure \[17\]. Students’ misconceptions that appear continuously can disrupt the formation of scientific conception \[18\], \[19\]. Learning that does not pay attention to misconception leads to learning difficulties and ultimately leads to low students’ achievement \[20\].

In this case, the students need a suitable and appropriate strategy for learning to be meaningful and can lead learners to the real concept \[1\]. POE (Predict-Observe-Explain) is one of the learning strategies developed to find students' ability to predict a natural phenomenon as well as their reasons for making the prediction. Then the students are directed and invited to find their own concept of knowledge from observation through POE learning strategy (Predict-Observe-Explain) by demonstrating method or experimenting in a laboratory \[21\]. The difference between this study with the previous research lays in the site of research that is dominated by male students. Therefore, this study aims to find out how to remediate the eleventh-grade students' misconception of SMK Bandar Lampung through POE learning strategy (Predict-Observe-Explain) on temperature and heat material.

2. Research Methods

This research employed quasi-experiment design. The design used was non-equivalent control group design \[22\]. The population in this research was the eleventh-grade students of SMK Bandar Lampung. Before and after the implementation of learning, students were given 20 questions of pretest and post-test equipped with column of Certainty of Response Index (CRI) to distinguish students who know the concept (TK), do not know the concept (TTK), and misconception (M) \[23\]. If the wrong answers with CRI values above 3 are said the students are experiencing misconceptions \[24\]. The research data was in the form of a cognitive test on temperature and heat material obtained from the results of pretest and post-test using parametric statistic namely t-test.

3. Result and Discussion

Based on 20 items of questions, there were 3 problems in the very high misconception category.

3.1. Case I: Students’ misconceptions on item number 2

The pretest result indicated that 27 students (90%) were having a misconception on item 2. This question investigated the utilization of the thermometric properties of substances. The detail of the problem is as follows.
Misconceptions experienced by students were quite high, thus POE (Predict-Observe-Explain) consists of stages capable of remediating students’ misconception. The learning strategy of POE (Predict-Observe-Explain) specifically involves learners in situations or problems [1]. The first stage was predicting. The students predicted the thermometric phenomena in everyday life. Individually the learner predicted the given problem and stated the reason. Hypotheses made were based on their initial knowledge.

The next stage was the demonstration (observe). In this stage, the students were guided to do a practicum or observation about the utilization of parametric properties of a substance. The demonstration or practicum provided the facts of the predicted hypothesis and the opinions conveyed by the students, the results of this demonstration or practicum can also address the misconceptions that the students had. The last stage was explaining (Explain). In this stage, learners synchronized all the differences between observations and predictions that had been made. The students obtain a proven explanation that the thermometric nature of matter was the expansion of a bimetallic piece.

The 3 stages were able to reduce the percentage of students’ misconceptions. In the posttest, only 2 students (6.6%) who were having the misconception, so the decreased of the misconception reached 83%. Comparison of percentage of misconception on question number 2 on pretest and posttest can be seen on figure 2.

![Figure 2. Percentage of misconception reduction](image)

### 2. Thermometer is a tool to measure temperature by utilizing the substance thermometric nature. One of the natures of thermometric substance is…

| a. objects that are hit with great force |
| b. expansion of a bimetal piece |
| c. clumping starch when exposed to water |
| d. the use of chairs as a seat |
| e. immersion things in liquid |

- **Figure 1. Question of number 2**

### 3.2. Case I: Students’ misconceptions on item number 4

The next misconception was about students’ lack of understanding on the cold sensation when their hands were dripped by alcohol. The result of pretest on misconception percentage of question number 4, there were 20 students or 67% experienced misconception.
4. When alcohol is dripped onto the skin, we will feel cold sensation because……
   a. alcohol seeps into the skin
   b. alcohol evaporates after absorbing heat from our skin
   c. alcohol evaporates while transferring heat into our skin
   d. alcohol absorbs heat from our skin

| scale of confidence | 0 | 1 | 2 | 3 | 4 | 5 |
|---------------------|---|---|---|---|---|---|

Figure 3. Question of number 4

The first stage of the POE strategy (Predict-Observe-Explain) was Predict. The students predicted the problem of absorption of heat on the skin. The students predicted the answer to the problem. Then the students tested the correctness of the prediction by doing an observation. The students did a practicum as the existing problems predicted. Demonstration or observation is a very useful way of teaching to reduce misconceptions (Anam & Edie, 2015). The last stage was explained. In this stage, the students exchanged opinions about the comparison of predictions with observations made, so that students knew that when the droplets of alcohol touched the skin, the alcohol evaporated after absorbing the heat from the skin. This was proofed by the direct observation. So, after the posttest, no students were having the misconception on question number 4 (0%). The data can be seen in Figure 4.

Figure 4. The misconception decrease on question number 4

3.3. Case I: Students’ misconceptions on item number 19
The misconception on question number 19 was very high. In this case, the students were having difficulty in understanding the statement about the high heat type. There are two students or 90% who had the misconception. For details, the question on number 19 can be seen in Figure 5.
19. A substance is known to have a high heat level. When it is heated…
   a. the temperature is slowly rising
   b. hard to melt
   c. the temperature is quickly rising
   d. hard to boil
   e. quickly evaporates

| scale of confidence | 0 | 1 | 2 | 3 | 4 | 5 |
|---------------------|---|---|---|---|---|---|

Figure 5. Question of number 19

There were 27 students (90%) who experienced misconception, but the POE strategy (Predict-Observe-Explain) was able to overcome the problem. Based on the result of posttest, only one student (3.3%) who experienced misconception. The misconception decreased by 86.7% which means the misconception was far less than the pretest. Stage in this strategy was predicting. The students could express the phenomenon that occurs in the daily life; at this stage, students were given a problem with the heat in everyday life.

At the observing stage, the students could find their own ideas through practicum so it can be easy to remember. Then the last was explaining. The students knew the actual concept by discussing among groups and the opinion was given by other groups that the substances with high heat level will rapidly increase its temperature when heated. The ratio of pretest and posttest percentage on the question number 19 can be seen in the Figure 6.

![Figure 6. The decrease of misconception](image)

The POE learning strategy (Predict-observe-explain) can be used to explore students’ initial knowledge and to explore the concept they possess. So it can train the students to find solutions to problems that have been given independently [25]. This strategy includes ways that teachers can take to help learners improve their understanding and their psychomotor [26]. The students had a vast opportunity to explore their knowledge and to reconstruct false concepts and then compare the differences between predictions and observations so that students are active in the class [1]. The decrease in the percentage of misconceptions is due to experience in learning such as the direct observation that can make it easier for the students to understand and remember learning materials. They can also overcome misconceptions resulting in the enhancement of their concepts mastery [27].
4. Conclusion

Based on the results of the study and discussion, it can be concluded that the POE learning strategy (Predict-Observe-Explain) can remediate the students’ misconception as can be seen in the misconception percentage on question number 2 which is 83.4%, number 4 which is 67%, and number 19 which is 56.7%. It can be concluded that POE learning strategy (Predict-Explain-Observe-Explain) is effective to remediate the students’ misconception on conceptual understanding of Temperature and Heat materials.

References

[1] Anam AC and Edie SS 2015 *Unnes Phys. Educ. J.* 4.
[2] Nofitasari I and Yuliana S 2017 *J. Penelit. Fis. Apl.* 7 44.
[3] Pratiwi WA 2013 *J. Inovasi Pendidik. Fis.* 2 117.
[4] Irwandani, Latifah S, Asyhari A, Muzannur, and Widayanti 2017 *J. Ilmu Pendidik. Fis. Al-Biruni* 6 221.
[5] Dewi PS 2016 *Tadris: J. Kegur. Ilmu Tarb.* 1 179.
[6] Ahliif UF and Samsudin A 2014 *J. Pendidik. Fis.* Tedulako 2 57.
[7] Zahara S, Haji A G and Syukri M 2018 *Tadris:J. Kegur. dan Ilmu Tarbiyah* 3 55.
[8] Suparno P 2013 *Miskonsepsi dan Perubahan Konsep dalam Pendidikan Fisika* (Jakarta: Grasindo)
[9] Saregar A, et al. 2018 *J. Educ. Gift. Young Sci.* 6 39.
[10] Mosik ASR 2015 *Unnes Phys. Educ. J.* 4 2.
[11] Muliyani R, Kurniawan Y, and Sandra DA 2017 *Tadris J. Kegur. dan Ilmu Tarb.* 2 81.
[12] Sulistiyowati S, Abdurrahman A, and Jalmo T 2018 *Tadris J. Kegur. dan Ilmu Tarb.* 3 89.
[13] Gumilar S 2016 *Gravity* 2 59.
[14] Hakim A, Lilia, and Kodalohman A 2012 *Int. Online J. Educ. Sci.* 4 544.
[15] Hasan S, Bagayoko D, and Kelley EL 1999 *Phys. Educ.* 34.
[16] Setyadi EK and Komalasari A 2012 *Berk. Fis. Indonesia.* 4 46.
[17] Aprilianingrum F 2015 *J. Penelit. Pembel. Fis.* 6 318.
[18] Ansori I, Ramalis TR, and Utama JA 2013 *J. Wahana Pendidik. Fis.* 1 76.
[19] Syafi’i M and Nasir M 2016 *J. Pendidik.* 86.
[20] Sa’idah SG 2012 *Penerapan Strategi Pembelajaran PDEODE untuk Meremediasi Miskonsepsi Fisika di SMK BLK Bandar Lampung* unpublished.
[21] Saregar A and Sunarno W 2013 *J. Inkuiri* 2 100.
[22] Sugiyo 2013 *Metode Penelitian Pendidikan* (Bandung: Alfabeta)
[23] Hidayatulloh M, Humairoh F, Wachidah U, and Iswati DA 2015 *J. Penelit. Fis. Apl.* 5 28.
[24] Kurniawan R and Arief A 2015 *Inov. Pendidik. Fis.* 4 1.
[25] Lebdiana, Sulhadi R and Hindarto N 2013 *Unnes Phys. Educ. J.* 4 1.
[26] Lestari PAS and Rahayu S 2015 *J. Pendidik. Fis. Teknol.* 1 146.
[27] Atriyanthi SY 2012 *Chem. Educ.* 2.