4th ICRIEMS Proceedings
Published by The Faculty Of Mathematics And Natural Sciences
Yogyakarta State University, ISBN 978-602-74529-2-3

Application of *Predict-Discuss-Explain-Observed-Discuss-Explore-Explain* (PDEODE*E) Strategy to Remediate Students' Misconceptions on Hydrostatic Pressure

Suci Cahyaningsih[1, a)], Andi Suhandi[2, b)], Johar Maknun[3, c)]

[1]*Program Studi Pendidikan Fisika, Sekolah Pascasarjana Universitas Pendidikan Indonesia*
Jl. Setiabudhi No. 229, Bandung, Indonesia
[2]*Departemen Pendidikan Fisika, Universitas Pendidikan Indonesia*
Jl. Setiabudhi No. 229, Bandung, Indonesia
[3]*Departemen Pendidikan Arsitektur, Universitas Pendidikan Indonesia*
Jl. Setiabudhi No. 229, Bandung, Indonesia

[a)] Corresponding author : cahya6168@gmail.com
[b)] andi_sh@upi.edu
[c)] joharmaknun@upi.edu

Abstract. The aim of this study was to remediate students' misconceptions on the hydrostatic pressure using strategy *predict-discuss-explain-observed-discuss-explore-explain* (PDEODE*E). This study used a quasi-experiment method with Control Group Pretest-Posttest Design. The sample of this study was the students of class XI IPA in one of the MA in Purbalingga the second semester of the academic year 2016/2017. Research samples were selected by random sampling technique. The instrument data collection was a diagnostic test conception with three tier format test (TTT) given before and after treatment. Students' conceptions were analyzed by students answer combination analysis on three tier test (TTT) accordingly by Kaltakçi, D & Didiş. The students whose quantity decreased have misconceptions was calculated by the student misconceptions (ΔM) formula that were adapted from Hake's normalized gain value. The results showed that students' quantity of misconceptions was decreased in every hydrostatic pressure conceptions with high category.

INTRODUCTION

In physics, students do not gain in the lesson with no knowledge that could be filled with the knowledge of physics. On the contrary, student head is full of students experience and knowledge related to the knowledge of physics. With the experience, it was formed the intuition and "student theory" about the events of physics in the environment of human daily activity. However, the institution formed was not necessarily correct. The first concept or intuition that was not compatible with the scientific concept which agreed by the experts was called misconceptions [1].

In physics learning there are misconceptions happen in the concept of hydrostatic pressure. From the previous research by [2] who found the misconceptions that most experienced by students is about the magnitude of the hydrostatic pressure inversely proportional to the cross section. Whereas, [3] was found that students had misconceptions on hydrostatic pressure with the most percentage that is the hydrostatic pressure depends on the shape of the vessel where the liquid place. [4] states, that it was discover students misconceptions related to the hydrostatic pressure, the fluid pressure experienced by the object at the bottom of the container that narrow in the bottom like inverse trapezoidal is greater than the pressure experienced by the object at the bottom of the container that flat in the bottom with the same depth. On the other hand, [5] found the misconceptions associated with the other hydrostatic pressure pipe cross-sectional area which has small size then the pressure will be high.

When the initial observation is doing, misconceptions that have been found by the researcher about the concept of hydrostatic pressure in one of the MA in Purbalingga: (1) 65% students found a large hydrostatic pressure depends on the shape of the vessel where the liquid place. (2) 35% students found the most hydrostatic

pressure is depend on the height of liquid in it, (3) 65% students found a large hydrostatic pressure depends on the cross sectional area of the vessel where the liquid place.

Based on observations and experience of the researcher as a teacher, the misconceptions caused by several factors,such as: 1) generally, the practice of physics learning is tend to use traditional methods and drill a matter to solve the subject matter and pursue the target of the national exam, 2) Students simply memorize knowledge but not trained to do the scientific process to develop the skills of the process, 3) The teacher acts as the most information source that is always cramming concepts and less use other learning resources such as the internet and the environment, 4) Handbook that is used to further highlight the count (slightly once associated with understanding and natural phenomena), 5) The availability of facilities and infrastructure which makes students rarely do practicum. Learning which always insists on rote-memorization of facts IPA should begin to reduce. The objectives learning should be directed to the formation of skills through a series of activities in the learning of physics. To realize the physics learning that is capable to remediate misconceptions students must also required an appropriate learning strategy. One strategy that can be used is the learning-Discuss Predict-Observe-Explain-Explore-Discuss-Explain (PDEODE*E).

PDEODE*E strategy is an improved model of learning PDEODE and POE. POE strategy introduced by White and Guston in 1995 in his probing understanding that has three stages. The first stage, students must predict the outcome of some event or situation and must justify their prediction (P: Predict). The second stage, they describe what they see and what was happen then (O: Observe). The third stage, they must reconcile any discrepancy between prediction and observation (E: Explain) [6]. PDEODE strategy is the development and modification of the POE strategy. PDEODE strategy initially is suggested by Savander-Ranne & Kolari (2003) and firstly used by Kolari et all,(2005) in engineering education. This is an important teaching strategy in which there is an atmosphere that supports discussion and diversity of views. Hence, it is intended that this strategy is used as a vehicle in helping students make sense of everyday situations [7]. PDEODE strategy provides the opportunity for students to express their initial knowledge of related concepts that will be given, the cooperation between students in the form of group discussions, the exchange of opinion between one and the other students. In addition, this strategy also facilitates the conceptual change on the knowledge possessed by students [8]. Conceptual change that occurs is a change in the original concept of the students into the new knowledge attested through observation (investigation).

The E* phase embedded into PDEODE as previous version eliminated a few disadvantages and empowered. Furthermore, we utilized exploration sheet (E*) separately, to be explored the concept in order to change students' misconceptions towards scientific conceptions. As described by [9], PDEODE*E consists of seventh steps. Firstly, "P (Prediction)" phase, a conceptual phenomenon was presented to students via sheets and invited them to write a prediction independently, and to confirm their prediction. Secondly "D (Discuss)" phase, in each group, the students discussed in their groups and shared their thinking to group-mates. Thirdly "E (Explain)"phase, students in each group probed in order to grasp a conciliation and deduction about phenomenon given in the first phase, and present their concepts to other groups through whole class discussions. Then, they worked in groups to accomplish a hands-on experiment and separately recognized their observations. Fourth "O (Observe)" phase, the students observed the changes in the phenomenon and the teacher lead them to concentrate on observations relevant concepts. Fifth "D (Discuss)" phase, the students were requested to reconcile their predictions with the genuine observations made in the earlier step. Here, the students were asked to analyze, compare, contrast and criticize their classmates in the groups. In the sixth "E* (Explore)" phase, the students were facilitated to explore the concepts deeper and more comprehensive way. Lastly "E (Explain)" phase, the students confronted all discrepancies between observations and predictions. At this point, the students had to attempt and determine any contradictions. The role of the teacher in all phases was to challenge students and to organize proper discussions in each group or in the whole class.

Based on explanation above, the author interested in creating a research on the implementation of the strategy PDEODE*E in teaching physics to remediate misconceptions high school students. In this study, researcher took the title of the study: "Application of Predict-Discuss-Explain-Observed-Explore-Discuss-Explain (PDEODE*E) Strategy to Remediate the Students' Misconceptions on Hydrostatic Pressure"

METHOD

This study used a quasi-experiment method with Control Group Pretest-Posttest Design [10]. Before learning is started, initial tests were given to the students to identify students' abilities. Then study was conducted using a strategy PDEODE*E. After the learning has done, final tests are given to identify students who experienced a decrease in the quantity of misconceptions. The sample of this study was the students of class XI IPA in one of the MA in Purbalingga the second semester of the academic year 2016/2017 as manny as 26 students. Research samples were selected by random sampling technique. The instrument data collection was a diagnostic test conception with three tier format test (TTT) given before and after treatment. Students' conceptions were

analyzed by students answer combination analysis on three tier test (TTT) accordingly by [11], presented in Table 1.

TABLE 1. Combination Analysis on 1-tier, 2-tier and 3-tier (TTT)

Tier Analysis	Categories	Response Types
1-Tier analisysis	Scientific knowledge	correct response
	Misconception	incorrect response
2-Tier analysis	Scientific knowledge	correct response + scientific explanation
	Error	incorrect response + scientific explanation
	Miskonsepsi	correct response + unscientific explanation
		incorrect response + unscientific explanation
3—Tier analysis	Scientific knowledge	correct response + scientific explanation + sure
	Lack of Knowledge	correct response + scientific explanation + not sure
		incorrect response + scientific explanation + not sure
		correct response + unscientific explanation + not sure
		incorrect response + unscientific explanation + not sure
	Error	incorrect response + scientific explanation + sure
	Misconception	correct response + unscientific explanation + sure
		incorrect response + unscientific explanation + sure

The students whose quantity decreased have misconceptions was calculated by the student misconceptions (ΔM) formula that were adapted from Hake's normalized gain value is :

$$\Delta M(\%) = \frac{\%pretest - \%posttest}{\%pretest - \%ideal} \quad (1)$$

where,

ΔM : The students whose quantity decreased have misconceptions

% Pretest : The percentage of students whose have misconceptions given before treatment

% Posttest : The percentage of students whose have misconceptions given after treatment

% Ideal : The ideal misconceptions (0%)

To determine the percentage reduction in student misconceptions the criteria adapted from Hake [12] used and presented in Table 2.

TABLE 2. Percentage of Decreased Misconceptions

Percentage (P)	Criteria
$0 \leq \Delta M \leq 0{,}3$	Low
$0{,}31 \leq \Delta M \leq 0{,}70$	Moderate
$0{,}71 \leq \Delta M \leq 0{,}10$	High

TABLE 3. Distribution Hydrostatic Pressure Concepts and Misconceptions Problem

Concept	No Misconception	Misconception	Scientific Concepts	No Question
Hydrostatic Pressure	1	Large hydrostatic pressure depends on the shape of the vessel where the liquid.	Hydrostatic pressure does not depend on the shape of the vessel (container) but depending on the depth, so every point at the same depth have the same hydrostatic pressure vessel even if the shape is different.	1, 2, 3
	2	Large hydrostatic pressure depends on the size of the object in liquid.	Hydrostatic pressure does not depend on the size of the object in liquid, but depend on the depth, so the most valuable hydrostatic pressure when the deepest depths not depend on the size of the object.	4
	3	The most hydrostatic pressure depends on the height of liquid above it.	Hydrostatic pressure does not depend on the height of liquid in it but depending on the depth measured from the surface of the liquid.	5, 6
	4	Large hydrostatic pressure depends on the cross sectional area of the vessel where the liquid place.	The magnitude of the hydrostatic pressure depends on the density of the liquid, the acceleration of gravity and depth of objects from the surface of the liquid.	7, 8

Distribution of scientific concepts and misconceptions hydrostatic pressure on the matter are presented in Table 2. Each number represents about concepts covered in the material hydrostatic pressure. Numbers matter in the table is used to subsequent data exposure.

RESULTS AND DISCUSSION

In this study, the misconceptions of students identified from the results of pretest and posttest by using Three Tier Test (TTT). Three Tier Test consists of three levels of questions, the first level (first tier) is a multiple-choice with four options (A, B, C, D) and the second level (second tier) is the reason of choosing an answer first tier consisting of four option (A, B, C, D). The third level (third tier) is the student confidence level choice in selecting answers first tier and second tier. The data obtained and analyzed in every item because the combination of analysis techniques on a three-tier response test (TTT). A recapitulation of the results of the analysis of Three Tier Test (TTT) to distinguish between students who have misconceptions, scientific knowledge, Lack of Knowledge and error are presented as follow in Table 4.

TABLE 4. Summary of Results Analysis TTT

No Misconception	No question	% Number of Misconceptions Students		% Number of Scientific knowledge Students		% Number of Lack of Knowledge Students		% Number of Error Students	
		Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
1	1,2,3	76,92	11,53	3,84	80,77	15,38	7,69	3,84	0
2	4	38,46	3,84	30,76	88,46	15,38	0	15,38	0
3	5,6	38,46	11,53	42,31	84,62	19,23	3,84	0	0
4	7,8	69,23	7,69	3,84	88,46	19,23	0	3,84	3,84

Based on the results of the analysis recapitulation Three Tier Test (TTT), the percentage of students who have misconceptions before and after the learning strategy PDEODE*E decreased. This suggests that treatments provided to remediate misconceptions students although there are still some students who have misconceptions. TTT recapitulation of the data shows that students who did not understand the concept or lack of knowledge and error are also decreased. This was indicates that the implementation of the strategy PDEODE*E is a physics learning alternatives that can be used to lower the quantity of students who have misconceptions and remediate misconceptions students as well as extending the concept to those who do not understand the concept or Lack of Knowledge.

The result shows that the concept of the most experienced misconceptions is the concept of large hydrostatic pressure depends on the shape of the vessel where the liquid (number 1) and the most hydrostatic pressure depends on the height of liquid above it (number 3) that is equal to 11,53%, followed by the most hydrostatic pressure depends on the height of liquid above it (number 4) amounted to 7.69%. Students had misconceptions on the concept of large hydrostatic pressure depends on the size of the object in liquid (number 2) of 3,84%.

Below this is a recapitulation of the reduction in the quantity of students' misconceptions on any concept of hydrostatic pressure that presented in Table 5.

TABLE 5. Decrease Quantity Student Misconceptions on Hydrostatic Pressure Concept

No Misconception	No Questions	% Misconceptions Students		ΔM	Categories
		% M pretest	% M posttest		
1	1,2,3	76,92	11,53	0,85	High
2	4	38,46	3,84	0,90	High
3	5,6	38,46	11,53	0,71	High
4	7,8	69,23	7,69	0,89	High

Based on data in Table 5, the percentage of students is decrease who have misconceptions when the pretest and posttest. The declines in the number of students who have misconceptions occur in the whole concept of hydrostatic pressure. Percentage of correct conception of the number of students increased in every concept of hydrostatic pressure. This shows that the treatment which given to remediate misconceptions students become true conception.

Based on Table 5, it could be seen that the whole concept of the hydrostatic pressure has decreased the quantity of students misconceptions once implemented strategies PDEODE*E. The reduction in the quantity of students' misconceptions significantly in the concept of hydrostatic pressure depends on the size of the object in liquid with a value reduction in the quantity of students misconceptions (ΔM) of 0,90 to a high category.

Judging from the overall results of the study it becomes clear that misconception indicated by previous researchers like [2,3,4,5] obviously occurs in the majority of high school students in particular on the concept of

hydrostatic pressure. Therefore, this material with an emphasis on understanding the concept of students should be taught especially in students of Madrasah Aliyah in order to avoid misconceptions.

CONCLUSSION

Based on the results of research and analysis of data concerning the Application of Predict-Discuss-Explain-Observed-Discuss-Explore-Explain (PDEODE*E) to remediate the Students' Misconceptions on Hidrostatic Pressure conclusion that the reduction in the quantity of students who have misconceptions on any concepts of hydrostatic pressure experienced a decrease in the high category

REFERENCES

1. E. V. D. Berg, *Miskonsepsi Fisika dan Remediasi* (Universitas Kristen Satya Wacana Press, Salatiga, 1991)
2. R. Muliyani, *Pengaruh penerapan model pembelajaran predict-observe-explain (POE) berbantuan refutation text terhadap peningkatan pemahaman konsep dan penurunan kuantitas siswa yang miskonsepsi pada materi fluida statis* (Tesis Universitas Pendidikan Indonesi, Bandung 2014).
3. Marwiah, *Penggunaan Conceptual Change Model berbantuan media simulasi virtual untuk menurunkan kuantitas siswa yang miskonsepsi dan meningkatkan pemahaman konsep siswa SMK pada materi fluida statis* (Tesis Universitas Pendidikan Indonesi, Bandung 2014).
4. Ç. ŞAHİN &S. ÇEPNİ, *Journal of TURKISH SCIENCE EDUCATION*, Vol. 8 (1), *79-110* (2011)
5. Zane Satterfiled, *National Environmental Services Center*, Vol 9 (4), 1-4 (2010).
6. B. Coştu, A. Ayas, & M. Niaz, *Instructional Science,*Vol 40 (1),47-67 (2012).
7. B. Costu, *Journal of Mathematics, Science & Technology Education*, vol. 4 (1), 3-9 (2008).
8. C. Savander-Rane & S. *Global Journal of engineering Education*, vol. 7 (2), 189-199 (2003).
9. A. Samsudin A, A. Suhandi, D. Rusdiana, I. Kaniawati And B. Coştu, *Asia-Pacific Forum on Science Learning and Teaching*, Vol. 17 (1), (2016).
10. Frenkel, Jack, Wallen, dan Hyun, *How to Design and Evaluate Research Instrumen Education.*(Mac Graw Hill Publishing, New York, 2012).
11. D. Kaltakçi, & N. Didiş, Sixth International Conference of the Balkan Physical Union: American Instirute of Physics, (2007).
12. Hake, *Analyzing Change/Gain Scores,* [online], (http://www.physics.indiana.edu/~sdi/Analyzing Change-Gain.pdf). (1999)