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Physics Learning Based on Virtual Laboratory to Remediate Misconception in Fluid Material

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Abstract: An understanding of concepts is very necessary in physics learning. It has been confirmed that often students have different understanding of scientific concepts, this term is what commonly called Misconception. Misconception is a problem that must be addressed immediately because misconception is one factor that causes students to experience difficulties in learning physics. This study aims to determine the effect of physics learning with the PDEODE model (predict-discuss-explain-observe-discuss-explain) assisted by virtual laboratory in the form of PhET simulation in remediating students' misconceptions in the fluid material. This type of research is a Pre-Experimental One Group Pretest-Posttest design. The samples of this study were eleventh-grade science students of State Senior High School in Gadingrejo District, Lampung Province, taken through simple random sampling technique. The test used was in the form of a multi-tiered multiple-choice test of the four-tier diagnostic test with certainty response index (CRI) consisting of 20 items. The result of this study indicates that students' misconceptions decrease for all sub-concepts of fluid material. Based on the previously described statements, it can be concluded that physics learning based on virtual laboratory can remedy students' misconceptions, especially in fluid material.

INTRODUCTION

Education cannot be separated from the process of teaching and learning activities. One means of supporting the learning process is through formal education in schools (Diani, 2016). The learning process in schools is done so that students get new knowledge from what they learn (Yudhittiara, Hindarto, & Mosik, 2016).

Understanding of concepts is very important in the early stages of thinking, especially in the field of physics. Physics is one of the fields of science that focuses on understanding the concepts rather than memorization (Sholihat, Samsudin, & Nugraha, 2017). Physics contains many scientific concepts, laws, equations, and events that occur in everyday life (Aldila, Setyarsih, & Kholiq, 2016; Syahrul & Setyarsih, 2015; Yuwarti, Pasaribu, & Hatibe, 2017; Zulia Witanecahya & Jatmiko, 2014). Learning physics can make students master knowledge in the form of facts, concepts, principles, and the process of discovery (Diani, Yuberti, & Syafitri, 2016).

Knowledge possesses by the students is not just poured into their minds but must be actively constructed

(Saputra, Halim, & Khaldun, 2013). Prior to obtaining a formal education, students have preconceptions with different understandings. In line with Pinker's research in wahyuningsih, et al., generally students come to school not with a blank mind, but they have brought a number of experiences or ideas formed before when interacting with their environment (Wahyuningsih, Raharjo, & Masithoh, 2013). The concept that students have could be in accordance with scientific concepts yet can also experience irregularities. Concept deviations or incompatibility of understanding of these concepts are often called misconceptions (Hono & Yuanita, 2014; Subagyo, Suyono, & Tukiran, 2014; Suparno, 2005). The misconception is the initial concept held by students, which is not in harmony with scientific conceptions or physicists (Ariyastuti & Yuliawati, 2017; Martinez-Borreguero, Pérez-Rodríguez, Suero-López, & Pardo-Fernández, 2013; paul suparno, 2013).

The students' misconceptions often occur in a fluid material, which is also one of the fields of mechanics, where mechanics experiences the greatest misconception. According to the data obtained by Wandersee, et al. in Suparno, with an article entitled Research on Alternative Conception in Science, which was studied from 700 studies of alternative concepts in physics (Suparno, 2013). It reveals that there is 300 research on misconceptions in mechanics, 159 research on electricity, 70 research on heat, optics, and material properties, 35 research on earth and space, and 10 research on modern physics (Zulvita, Halim, & Elisa, 2017). One form of misconception on the fluid is that students assume the density of water is smaller than the density of kerosene with the same volume and height (Pratiwi & Wasis, 2013).

One of the causes of the students' misconception is the lack of the mastery of concepts (Arjanggi & Suprihatin, 2010), wrong intuition (Fariyani, Rusilowati, & Sugianto, 2015) and broadly caused by students, teachers, textbooks, contexts, and teaching methods (Jannah, Ningsih, & Ratman, 2016; Wahyuningsih et al., 2013). Misconceptions that occur as early as possible must be known and corrected, because the ignored conceptual errors will have an impact on the low learning outcomes (Chaniarosi, 2014; Susanti, 2013), influence the process of understanding of the subsequent concepts, and disrupt the process of identifying examples of physics phenomena in everyday life (Artiawati, Mulyani, & Kurniawan, 2016; Pebriyanti, Sahidu, & Sutrio, 2015).

Therefore, one effort to overcome misconceptions is by remediation which is an activity to improve learning that is less successful in understanding subject matter (Zulvita et al., 2017). Remediation needs the right and complex learning model, one of which is the application of the Predict-Discuss-Explain-Observe-Discuss-Explain (PDEODE) learning model. PDEODE Learning Model is a model that refers to the views of constructivism (Costu, 2008), which has six stages namely Predict, Discuss (first), Explains (first), Observe, Discuss (second), Explain (second) (Sdarmi, Suarni, & Dibia, 2013). The stages of the PDEODE model can familiarize the students to form scientific concepts because they can think independently, carry out and directly investigate an experiment, discuss in groups, and get more scientific new concepts because the students' initial concepts are compared to the results of investigations (Ardiyan, 2015).

The PDEODE learning model also helps students to understand science in daily life (Costu, 2008), the learning process is more active and conceptual. The changes occur from the students' incorrect initial thoughts to the new knowledge that is definitely true (Kolari, Savander-ranne, & Tiili, 2005). In addition, the PDEODE Model is effective in identifying misconceptions and improving critical-thinking skills (Sri & Wulandari, 2013), effectively reducing misconceptions that occur in students (Dewi & Suhandi, 2016; Siregar, 2015), and can improve students' learning outcomes (Budianto & Istyadji, 2015).

To support the PDEODE learning model which contains observe stage (experimentation), an instructional media is needed that may improve the concepts understanding as well as lowering misconceptions (Suhandi, Sinaga, Kaniawati, & Suhendi, 2008). Along with the development of the times marked by the development of products and the use of technology and information, the implementation of learning has also shifted into an effort to realize modern learning.

One of the learning media that enables an experiment without using many tools is PhET simulation equipped with student worksheets. PhET Virtual Media simulation can help students to understand concepts, receive feedback, provide interactive approaches, constructivists, and think critically and creatively because PhET simulation prioritizes the relevance of real-life phenomena with underlying knowledge (Perkins, Adams, Dubson, & Finkelstein, 2006; Sholihat et al., 2017). Students will compare their predictions with the experiments conducted. PhET media simulation can reduce misconceptions and can improve learning outcomes (Atmoko & Wasis, 2015; Jauhari, Hikmawati, & Waahyudi, 2016).

Based on the results of pre-research conducted on the eleventh-grade science students of State Senior High School in Lampung Province, learning is still dominated lecturing centered on teachers. The students only focus on memorizing formulas without understanding the concepts. In addition, the identification of misconception was done using the four-tier diagnostic test equipped with the certainty of response index (CRI) on fluid material. The average percentage of misconceptions in fluid material is 44.83%. One form of misconception in Archimedes' sub-law is that students assume that the density of objects is greater than the density of the water, so the object will sink. So, the effort made in this study was by applying the PDEODE model assisted by PhET simulation in reducing misconceptions in a fluid material.

METHOD

This study employs a pre-experimental method. The design of the research is One-Group Pretest-Posttest Design. This design is used in one group of subjects (Irwan, Thamrin, & Budayawan, 2016). Treatment is given to a subject group after that the effect of the treatment is observed (Saputra et al., 2013). The research variable is the PDEODE model assisted by PhET simulation as an independent variable and a misconception as the dependent variable.

This study aims to remedy students' misconceptions in a fluid material. It was conducted in the first semester of the 2018/2019 academic year. The population of this study was all students of eleventh-grade science students of State Senior High School (SMA) in Gadingrejo District, Lampung Province, with the sample of 30 students as an experimental class. The sampling was carried out through simple random sampling technique. The instrument of this study was 20 items of multiple choices in the form of four-tier diagnostic tests equipped with CRI. The test was a four-tier test developed from the three-tier test. There also present a confidence rating (level of confidence) using CRI on the reason for the answer so that the level of confidence is more accurate (Zaleha, Samsudin, &

Nugraha, 2017). The categories of combinations of answers to the four-tier diagnostic tests are shown in Table 1 (Fariyani et al., 2015; Sheftyawan, Prihandono, & Lesmono, 2018), and the categories for confidence level scale of the Certainty of Response Index (CRI) is in Table 2 (Hasan, Bagayoko, & Kelley, 1999).

Table 1. The Answer Combination of the Four-tier Diagnostic Test

Answer Combination	Answer Combination			
	Answer	**Level of Confident**	**Reason**	**Level of Confident on the Reason**
Understand the Concept	Correct	Sure	Correct	Sure
	Correct	Unsure	Correct	Unsure
	Correct	Sure	Correct	Unsure
	Correct	Unsure	Correct	Sure
Do not Understand the Concept	Correct	Unsure	Incorrect	Unsure
	Incorrect	Unsure	Correct	Unsure
	Incorrect	Unsure	Incorrect	Unsure
	Correct	Sure	Incorrect	Unsure
	Incorrect	Unsure	Correct	Sure
	Correct	Unsure	Incorrect	Sure
	Correct	Sure	Incorrect	Sure
Misconception	Incorrect	Sure	Correct	Unsure
	Incorrect	Sure	Correct	Sure
	Incorrect	Sure	Incorrect	Unsure
	Incorrect	Unsure	Incorrect	Sure
	Incorrect	Sure	Incorrect	Sure

Table 2. The Category of the Scale Confidence Level of Certainty Response Index (CRI)

Category	Scale	Level of Confident
Guessing	0	Low/Unsure
Really Unsure	1	
Unsure	2	
Sure	3	High/Sure
Really Sure	4	
Very Sure	5	

Before the question was used for the research on misconception, first the validity was tested using the Karl Pearson correlation test (Arikunto, 2013). The 20 questions were stated as valid. The reliability test used was Cronbach alpha formula. The differentiating power and the level of difficulty of the questions were also tested.

After it can be used, the questions were tested for its normality by using the Lilliefors test (Samidi, 2015), homogeneity with the F-test (Irwan et al., 2016) and hypothetical test using the t-test to see the difference in the mean between pretest and posttest, which conclusions were then drawn. Furthermore, the scores of students' learning achievements were compared between the pretest and posttest, and then analyzed using the N-gain test (Khairati, Feranie, & Karim, 2016). The normalized N-gain score obtained were categorized as shown in the Table 3 (Simbolon & Tapilouw, 2015).

Table 3. Category of N-Gain Value

Category	Criteria
$g > 0,70$	High
$0,30 \leq g \leq 0,70$	Moderate
$g < 0,30$	Low

Then to calculate the percentage of the students who understand the concept, misconception, and do not understand the concept, the equations proposed by (Arikunto, 2013; Sudijono, 2013; Utami, Agung, & Bahriah, 2017) was used. Then the results of calculation of the misconceptions were categorized according to the percentage in Table 4 (Fitria, Muhibbuddin, & Safrida, 2017; Suwarna, 2014).

Table 4. Criteria for Misconceptions Level

Value of P	Criteria
61 % - 100 %	High
31 % - 60 %	Moderate
0 % - 30 %	Low

RESULT AND DISCUSSION

The Implementation

This study was conducted at the eleventh-grade science students of State Senior High School in Gadingrejo District, Lampung Province, in four meetings. The following is the data from the implementation of the learning process through PDEODE model assisted by PhET Simulation.

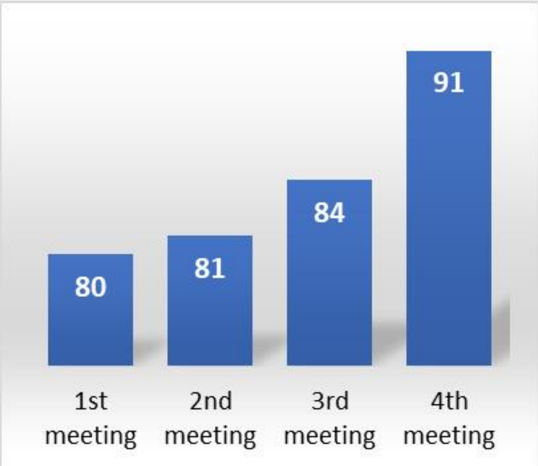


Figure 1. Percentage of Implementation of Learning Models

Based on Figure 1, the average percentage is 84% with a very good category. The following is one of the results of the implementation of the PDEODE model assisted by PhET on Archimedes law subconcept.

Predict Stage

In this stage, the students observed the problem formulation of static fluid events in daily life as follows.

Based on the images above, iron nails or steel nails that are placed into a glass of water immediately sink but why does a ship made of iron that weighed up to thousands of tons could float? Why are the two events different even though they are both made of iron? Explain according to your hypothesis!

Figure 2. Formulation of Problems in Archimedes Law

Students individually observed and give hypotheses from the answer to the problem given. The following is the hypothesis of one of the student.

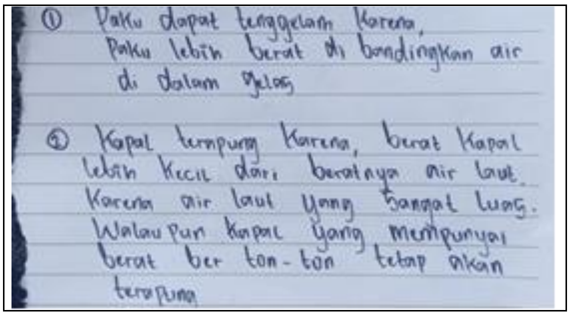


Figure 3. Answer of the Predict Stage

In the first answer, it can be seen that students experienced a misconception in which the nails sink due to the density of nails is greater than the density of water, not weight but density. Misconceptions in question number 2 are that the ship is able to float because the ship's volume is smaller than the volume of seawater so that the density of the ship is lesser than the density of seawater.

Discuss Stage I

In this stage, the students were grouped to discuss the formulation of the problem. They combined the individual prediction to produce a problem-solving. Here is the result of discussion from one of the groups.

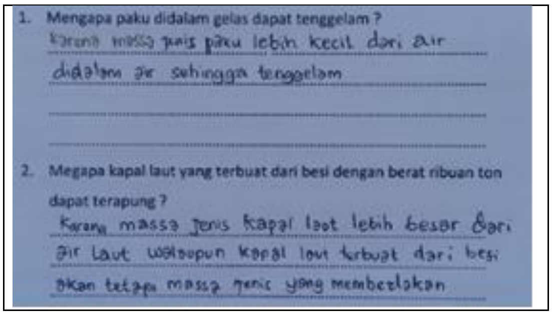

1. Mengapa paku didalam gelas dapat tenggelam ?
Karena massa jenis paku lebih kecil dari air didalam air sehingga tenggelam
2. Megapa kapal laut yang terbuat dari besi dengan berat ribuan ton dapat terapung ?
Karena massa jenis kapal laut lebih besar dari air laut walaupun kapal laut terbuat dari besi akan tetapi massa jenis yang membedakan

Figure 4. Results of the Discuss Stage I

Explain Stage

In this stage, the representative of each group come forward to read the results of the discussion. The result of the study reveals that there are differences between groups, one of which is shown in the following images.

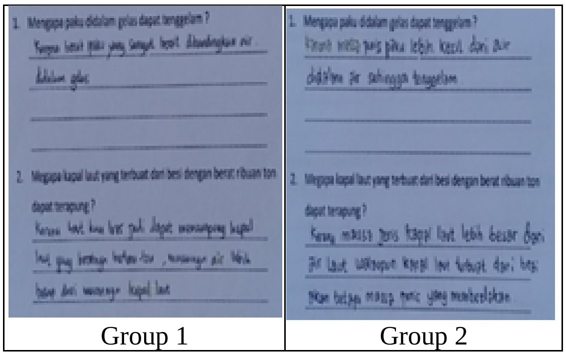


Figure 5. The Results of Explain Stage I

It can be seen that there are differences of opinion between groups in which group 1 experiences a misconception that nails sink because they are heavier than seawater while sea water is heavier than the ship, so it floats. For group 2, there is a misconception where the density of nails is smaller than the density of seawater, so it sinks while the density of the vessel is larger so it sinks. Both groups experienced a misconception that it should be the first group that affects density not weight and the second group should be the density of objects is greater than the density of water so that objects float while the density of objects is smaller than the density of water so that objects sink. The misconceptions will be proven in the later stage.

At the observing stage, the students did an experiment using PhET simulation equipped in the student worksheet. The experiment was carried out based on the formulation of the problem above. The following are the PhET simulation images.

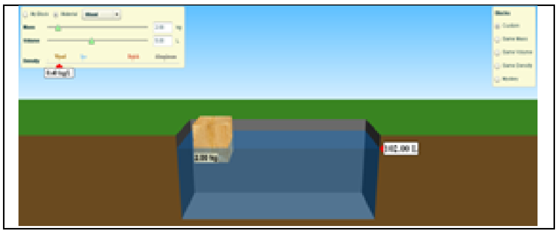
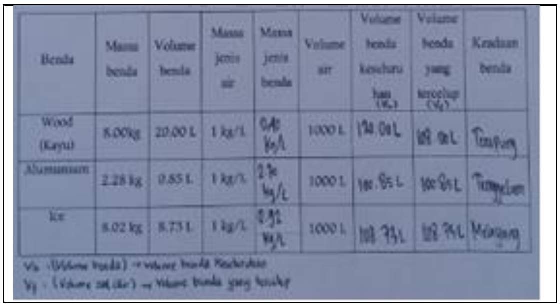


Figure 6. Experiment on PHET Simulation

Students did 3 experiments. The following are the results of the experiments on Archimedes law.



Benda	Massa benda	Volume benda	Massa jenis air	Massa jenis benda	Volume air	Volume benda keseluruhan (V_b)	Volume benda yang tercelup (V_f)	Keadaan benda
Wood (Kayu)	8.00 kg	20.00 L	1 kg/L	0.40 kg/L	1000 L	[illegible]	[illegible]	Terapung
Aluminium	2.28 kg	0.85 L	1 kg/L	2.7 kg/L	1000 L	[illegible]	[illegible]	Tenggelam
Ice	8.02 kg	8.73 L	1 kg/L	0.92 kg/L	1000 L	[illegible]	[illegible]	Melayang

Figure 7. Students' Experiments Data

In this second discussion stage, the students in groups discussed the results of the experiments conducted. The results of the discussion are shown in the following images.

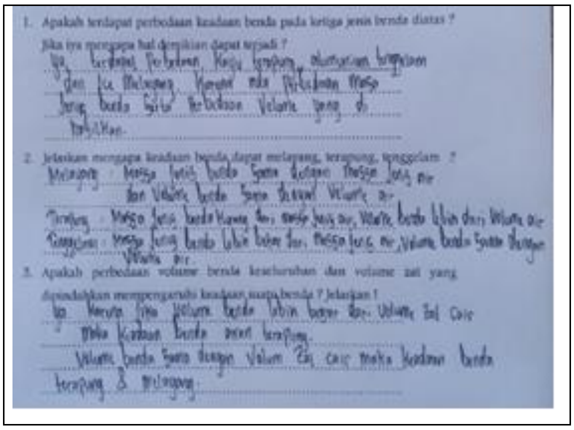
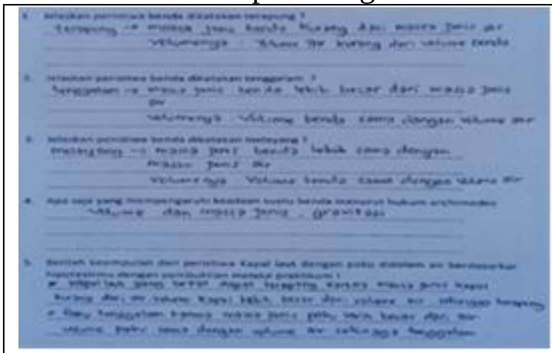


Figure 8. Results of Discuss Stage II

Based on the results of observation, the students compared the initial hypothesis with the results of experiments. It is known that the students who experience misconceptions can change their concepts to understand the concepts. For example, the students initially predict that the ship floats because the density of the ship is greater than the density of seawater. After the observing stage was applied using PhET simulation, they know that the ship can float because the density of the ship is smaller than the density of seawater.

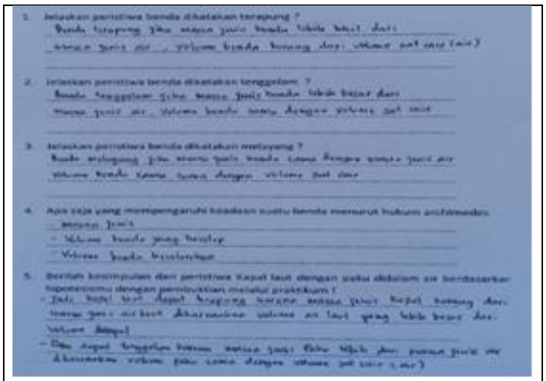
Explain Stage II

The representatives of each group explained the answers to the formulation of the problem in detail. The following is the result of the explain stage II.



Group 1

Figure 9. Results of Discuss Group 1



Group 2

Figure 10. Results of Discuss Group 2

The Results of Students' Misconception

The differences in the results of the pretest and posttest can be calculated using the normalized gain formula. The following is the data of pretest and posttest.

Table 5. Normalized Gain Test

Test Type	Average Score	N-Gain	% N-gain	Category
Pretest	16.9%	0.413	41%	Moderate
Posttest	26.3%			

Statistical test which is one of the characteristics of quantitative research that aims to direct the researcher to answer the formulation of the problem and to test the predetermined hypothesis. Before the hypothesis can be accepted, a series of statistical tests are conducted on the data of pretest and posttest obtained in the study. The recapitulation of statistical tests is presented in Table 6.

Table 6. Statistical Test Results of the Pretest and Posttest

Data Analysis Techniques	Types of Test	Results
Normality	Lilliefors	Sig. Pretest = 0.140 Sig Post-test = 0.09
Homogeneity	Test-F	Sig. = 1906
Hypothetical Test	T-Test	Sig. = 12:15
A	0:05	
Conclusions	data were normally distributed and Homogeneous Ho is rejected H_1 is accepted	

Based on the results of the t-test, there is a difference of significance seen from the average score that posttest is greater than the pretest. It can be claimed that the PDEODE learning model assisted by PhET simulation can remediate students' misconceptions in the fluid material. The decrease of the misconceptions' average in the fluid material is presented in Figure 10.

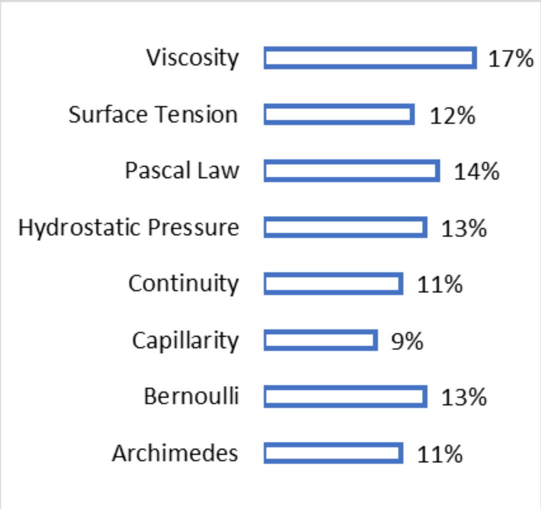


Figure 11. The Percentage of the Misconception's Average Decrease in Each Sub-concept of Fluid Material

Based on the implementation of the PDEODE learning model assisted by PhET simulation in 4 meetings, it obtains a positive response from the students based on the interviews and conditions in the field. The students said that the learning process is very fun so that they can better understand the fluid material. seen from the enthusiasm and activeness of students, they followed all stages of the PDEODE model assisted by PhET simulation although initially they felt confused with the repetitive learning process and the use of PhET media simulation but in the next meeting, with the guidance of teachers, the students could understand the purpose of using the PDEODE model and the use of PhET simulation. This opinion is also reinforced by research from Costu stating that the PDEODE model is effective in helping students to understand science in everyday life and contribute to get a better understanding of concepts (Costu, 2008). This research was also conducted by Fatimah et al., that state the PDEODE model receives good responses from students and increases the ability to understand the concept of organizational life (Fatimah, Martono, & Hadiansah, 2015). Besides, according to Kolari et al., the PDEODE model makes the students more active in interacting with study groups, more active in constructing their own knowledge, and feeling confident (Kolari et al., 2005).

The steps of the PDEODE model assisted by PhET simulation are: (1) predict, students individually predict the formulation of the problem given by the teacher, so that it gives an initial picture of the misconceptions. In line with research from Riko which states that the predict stage is used as an estimate of the initial knowledge that students have about DC electrical circuits (Riko, 2018). (2) Discuss stage I, the students are grouped to actively exchange opinions and to unite their individual predictions into one conclusion. This is in line with research by Nursinar, which states the discussion makes students able to complete the task by exchanging opinions between students which influence the learning outcomes (Nursinar, 2017). (3) Explain stage I, and each group has a different opinion so that at this stage, the students experience cognitive conflict. In line with the research from Suparno, that cognitive conflict can arise if the data or concepts possessed by students are very different from what was thought before, then students experience conflict on their minds (Suparno, 2013). (4) Observe, the activeness of the students is high when students were experimenting using PhET simulation. It is seen that students really enjoy learning when they experience and shape their own knowledge through experiments using the PhET simulation. In accordance with the opinion of Nurjanah in Riko, that through experiments, the learning process becomes very interesting because students can observe events that occur directly, so they don't just listen (Riko, 2018).

In addition, the Observe stage makes learning become more interesting students' conception at the beginning of learning could be quickly corrected during the experiment in which students can obtain data. This is because students interact directly with the fluid material when they are changing the size, comparing, and finding out the criteria contained in the experiment using PhET simulation so that the truths can be more believed by the students who experienced misconception.

The results of this study were also conducted by Joyce in Mursalin, stating that PhET simulation makes students more active in increasing their knowledge of concepts or principles, making it simpler to understand the concept of electric circuits, and learning becomes more interesting so that many things can be learned (Mursalin, 2013). Research by Sari et al., reveals that students can relate their initial knowledge with PhET simulations experiments (Sari, Lutfi, & Qosyim, 2013). The learning activity is in the form of playing while learning, so that learning becomes more interesting. (5) Discuss stage II, in this stage, and the students construct knowledge from existing knowledge (existing hypotheses) with new knowledge (experimental results) and the students fix the errors of thinking. This is in line with the research conducted by Costu that the PDEODE model at the Discuss stage promotes knowledge construction (Costu, 2008). (6) Explain stage II, by reading the results of the discussion in front of the class, and the groups verify the truth. Because at this stage, through the guidance from the teacher, the students respond to questions asked by other groups to find out which concepts are right and wrong on prediction stage, experiment stage, and discussion stage so that misconceptions that occur can be resolved and the students could construct old knowledge and new knowledge. This is in line with the research conducted by Kearney in Riko, which reveals that when the discussion phase of the experiment runs properly, the students' misconceptions can be overcome (Riko, 2018).

Based on the percentage of the average misconception experienced by students, the following are the misconceptions in the hydrostatic pressure sub concept which reveal that in a flat plane, the large density of a vessel will have a large pressure. The pattern of students' answers is in accordance with the research conducted by Wartono et al., that there is a misconception in the hydrostatic pressure sub concept but after remediation, the misconception decreases (Wartono, Saifullah, & Sugiyanto, 2016). Misconceptions that occur in the hydrostatic pressure sub-concept in the pretest are 59.17%, but after remediation with the PDEODE model assisted by PhET simulation, it decreased by 26.67% in the posttest. Students' misconceptions, in this case, are caused by incomplete information, or according to Suparno are caused by incomplete reasoning due to over generalization (Suparno, 2013).

Whereas in the Pascal law concept, the students assume that a plastic bag containing water with three holes when it is squeezed, the big hole will get a great pressure as well as a greater force, this is, however, different from the scientific concept. Misconceptions that occur in the Pascal law concept at pretest are 56.67%, but after being remediated with the PDEODE Model assisted by PhET simulation, it decreases by 33.3% in the posttest. This misconception is thought to be caused by the students' experience in their daily lives and according to Suparno is caused by the wrong associative thinking (Suparno, 2013).

For the sub-concepts of Archimedes law, students consider the object sinks because the density of objects is less than the density of water, but while floating, the density of objects is greater than the density of water. When the density of objects is similar to the density of water, the concept deviates from the real concept. The misconception that occurred in Archimedes law concepts in pretest was 43.44%, but after being remediated with the PDEODE Model assisted by PhET simulation, it decreased by 24.44% in the posttest. Misconceptions that occur are thought to be caused by the students' wrong intuition based on provided pictures, or the students only guess the answers and the reason. According to Kurniawan and Arief, that the lecturing method is used by the teachers can cause misconceptions (Kurniawan & Arief, 2015). In line with the research conducted by Rukmana, that in the sub-concepts of Archimedes law, the students experience many misconceptions regarding the position of objects in the fluid (Rukmana, 2017).

In the principle of continuity, the students assume that in a large pipe, the speed will be large while in a small pipe the speed will be small. The concept deviates from the actual concept. Misconceptions that occur in the continuity sub-concept is 42.22%, but after remediation with the PDEODE model assisted by PhET simulation, it decreases by 23.33% in the posttest. The misconception is allegedly caused by the students themselves. In addition, according to Repi in Winarto et al., information received by students is incomplete when the teacher explains, and the students also use wrong intuition (Suparno, 2013; Winarto, Tandililing, & Mursyid, 2015). Intuition can influence the students in giving reasons. In this case, it occurs in the concept of continuity where students rely on the characteristics of the image. In the Bernoulli principle, students assume that the small fluid velocity in the pipe with a small cross-sectional area will produce small pressure also. Misconceptions that occur in the Bernoulli principle are 50.56%, but after being remediated with the PDEODE model assisted by PhET' simulation, it decreases by 22.22% in the posttest. The students' assumptions give rise to misconceptions due to the students' lack of understanding and analysis. The reason for the answer is shown in the CRI level of confidence. This is in line with the research conducted by Sholihat et al., that the misconceptions experienced in the Bernoulli concept are caused students' analysis using inappropriate understanding and logical thinking (Sholihat et al., 2017).

Misconceptions experienced by students with the average pretest score of 50.66% and after remediation using the PDEODE model assisted by PhET simulation, it decreased by 24.58% so that there is a decrease in misconceptions between pretest and posttest by 51.96%. This proves that there is an influence of the PDODE model assisted by PhET simulation in reducing misconceptions. The success of the PDEODE model assisted by PhET simulation in this study in reducing misconceptions is in line with the research from Kolari et al., which suggests the PDEODE model can enable students to have conceptual changes from the initial mistaken concept into correct new knowledge (Kolari et al., 2005). Another study shows the success of the PDEODE learning model in remediating misconceptions and to get a better understanding of the concept in the material changes in physics and chemical change (Dewanti & Hidayat, 2018), and effective in identifying misconceptions and improving critical-thinking skills (Sri & Wulandari, 2013). As well as the research conducted by Dewi and Suhandi, that the PDEODE model can reduce misconceptions and change the incorrect conceptions into scientific concepts (Dewi & Suhandi, 2016). The PhET media simulation plays a role in strengthening the PDEODE model in remediating misconceptions. This is in line with the results of the study by Atmoko and Wasis, that state the guided discovery learning using the demonstration method in the form of PhET simulation can reduce misconceptions in dynamic electrical matter (Atmoko & Wasis, 2015).

So that by decreasing the level of misconception, it will also have an effect on increasing students' learning outcomes based on the result of pretest and posttest data shown in Table 3. The results of this study are also in accordance with research conducted by Lebdiana et al., which states that students who experience misconceptions are reduced after remediation and it could improve students' learning outcomes in temperature and heat material (Lebdiana & Sulhadi N.Hindarto, 2013). The research by Budianto and Istyadji, regarding multimedia-based PDEODE learning model, could effectively improve learning outcomes (Budianto & Istyadji, 2015). In addition, the use of PhET can also improve student learning outcomes (Jauhari et al., 2016).

However, this study did not completely reduce misconceptions because misconception is a difficult thing to fix and usually it is consistently maintained by the students. This opinion is also reinforced from the research conducted by Ibrahim in Rahayu and Nasrudin, that misconceptions are resistant to change, tend to maintain the concept so that it is difficult to change (persistent) (Rahayu & Nasrudin, 2014).

CONCLUSION

Based on the results of the study, it can be concluded that physics learning with the PDEODE learning model based on virtual laboratory PhET simulation was influential in remediating students' misconceptions in the fluid material. The results obtained also show that misconceptions have not been completely erased. This is because misconception is a difficult thing to fix. For this reason, there is a need for continuous and consistent effort to implement the PDEODE learning model based on virtual laboratory PhET simulation on physics learning.

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