
The Effect of PDEODE (Predict-Discuss-Explain-Observe-Discuss-Explain) Strategy On The Concept And Retention Mastery In Nutrition And Health Course On Students With Different Ability

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Abstract: An indicator of the learning effectiveness could be seen from the student's mastery of concepts and whether the concept was long embedded in his memory or the so-called retention. Good retention is one of the factors that will conduct the learning process goes smoothly. The reality shows that the academic ability of each individual is different, and the student's mastery of concept and retention are still low, so the selection of strategy is an important factor and learning strategy of PDEODE (Predict-Discuss-Explain-Observe-Discuss-Explain) becomes the choice. The aim of this research is to explain the effect of learning strategy of PDEODE on the mastery of concept and retention in nutrition and health course on students with different academic ability in biology education of PGRI Ronggolawe University, Tuban. This study was a quasi-experimental research and the research design was pretest-posttest control group random subjects. The results of Manova indicated that 1) there was a difference in the mastery of concepts on nutrition and health subject among the students who were taught by PDEODE and conventionally, 2) there was a difference in retention on nutrition and health subject among students who were taught by PDEODE and conventionally, 3) there was a difference of mastery of concepts on nutrition and health subject among the students with the high academic ability and low academic ability, 4) there was a difference of retention on nutrition and health subject among the students with the high academic ability and low academic ability, 5) There was interaction between learning strategy and academic ability on the student's mastery of concept on nutrition and health subject, 6) there was interaction between learning strategy and academic ability on the retention of the students on nutrition and health subject.

Keywords: *learning strategies, mastery of concepts, PDEODE, retention*

1. INTRODUCTION

Each learning process has the goal to be achieved. One of goals that want to be achieved is the mastery of concept. The success of learning can be seen if all the students have a good mastery of concept. A good mastery of concepts need to be owned by the students because it can be used to solve problems in their daily lives. Mastery of concepts is not merely memorizing, but really understanding the concepts and being able to apply them to resolve the situation that occur in their life. Someone has a mastery of concepts if he really understands the concepts that he learned, so he can explain by his own words in accordance with his knowledge without changing the meaning (Sumaya, 2004). Thus it can be said that mastery of concepts is not just recitation that is saved shortly after the test and then forgotten, but the concepts are actually owned to

explain, and be applied to face problems in everyday life. In other words, the knowledge gained in the classroom in the form of theory can be integrated with practice in daily lives.

Besides the mastery of concepts, retention is also one of the indicators of the success of the learning process. Retention is shown by whether or not the concept studied remains in the short term memory and can be reproduced after being stored in long term memory for a while, which is the goal of learning. This retention will be used in subsequent learning process. The learning process will run smoothly if students have a good retention, but when they have a low retention, the problem will arise because the learning process become slow, so that the targets set cannot be achieved (Rahman [2010], Hartati, Ningsih & Syamswisna, 2012). This means that retention is needed by students in the learning process, which is also the ultimate goal of the

learning process. Learning will be ineffective if the retention factor is not owned by students. The reality shows that each individual has a different academic ability. As a result, each individual is different in the ability to recall. However, everyone can improve the ability to recall by setting better conditions and using more precise methods (Suryasubrata, 2004). According Dahar (Silaban, 2014) the ability to understand a concept strongly influenced by a person's ability to think, while the level of understanding of concepts that is expected depends on the complexity of the concept and the level of the students' cognitive development. These means the understanding of concepts and retention of each individual is different according to the level of his/her cognitive development. However, despite the differences, each individual can improve his/her understanding of concepts and retention, if the appropriate learning strategies are used in the learning process.

Nutrition and health is one of the subjects in Biology education study program. The material being studied includes the topic about food and health of the human body. These are about source, function, and human need for carbohydrates, fats, proteins, minerals and vitamins. The material should be easily understood by the students because the knowledge of this topic has already been owned by students and has become a part of the student life. The reality shows that understanding of concepts students are still low, shown by the average of students' test results is still 6.5 (Wulandari, 2015). Based on the result of interview with the students, it is stated that the subject of nutrition and health is very interesting, but with so many difficult and abstract concepts, the subject becomes difficult for the students. This condition is worsened by teaching strategy that is still teacher-centered which makes the learning ineffective.

Based on the result of observation in the past two years, it shows that the teaching learning process has not been centered on the students, because the role of the lecturer is still dominant. The use of LCDs in the learning process used by the lecturer only makes him/her easy in teaching. He/She just conveys information of knowledge. Meanwhile, the students activities are just listening and taking notes of what they heard, and when they feel that the explanation cannot be overtaken by taking a note, they rely on copying material slides shown in the LCD, and try to memorize all the material contained in the Slide- LCD before the exam. This makes them become lazy to learn, so the concepts

given by the lecturers are only stored in short term memory and the learning process goal that should be long term memory is not reached.

Furthermore, The material is not learned until it is completely understood. When class discussions are carried out, only a few students are active and dare to express their opinion, while others are passive. The discussion appears to be just questions and answers between the lecturer and the students, and the lecturer is still considered the only one of the source of information. From the interview, it is known that the students who were not active to express their opinions, admitted that they did not understand what they learned, because they already forgot what had been explained by the lecturer. They also did not dare to answer or ask a question.

The differences of ability of these students will influence the success in achieving the objectives of learning process. Learning that is centered on the lecturer makes the accumulation of knowledge. There are so many that are stored in the memory, but it is difficult to produce, so the process of forgetting is occurred. Consequently, the students' mastery of concepts and retention become low.

According to DITJEN DIKTI of Higher Education Curriculum, teacher centered learning is not sufficient to achieve the goal, so it has to be converted into student centered learning in three things: knowledge that was seen as a ready-made and just transferred from the lecturers to the students is seen as a result of the construction of knowledge by students, students learning to receive knowledge become students learning to construct knowledge actively with their own activity, lecturers imparting knowledge information have to change into participating with students to form knowledge (Wulandari, 2015). Thus the changing of in teaching strategies is essential, that is teaching strategy which is goal oriented, fun and innovative, allows students to empower knowledge initially, provides an opportunity to exchange ideas in group discussions, and construct their own knowledge, so that students can develop competence. It is in line with Susilo's statement (2011) that effective learning facilitates students to achieve the learning goals, that is to master the expected competencies they develop through learning experiences.

PDEODE learning strategies (Predict-Discuss- Explain-Observe-Discuss-Explain) is introduced by Savander-Ranne and Kolari (2003). PDEODE has been used extensively to see the students' understanding of the concept of science. PDEODE strategy creates an atmosphere of discussion with various

viewpoints. According to Posner, et al (1982) PDEODE begins with the student's initial idea which is then reexamined in small group discussions and in-class discussions, ended by trying to solve some contradiction between the preliminary understandings with observation. The PDEODE teaching strategy proves to lead to conceptual change and enhance conceptual understanding (Posner., Et al [1982]., Savander-Ranne and Kolari [2003], Costu, Ayas & Niaz, 2010).

PDEODE holds the constructivist learning theory. According to the constructivist learning theory, learning is a process of adjusting our mental models to accommodate the experience. Constructivism learning theory assumed that learning is the result of a mental construct, build knowledge, where students individually and socially construct meaning as they learn. Constructivism emphasizes the involvement of students in participating in learning activities, in providing experience, a variety of social interaction, the possibility of learning to build and test their knowledge. Constructivism approach also design environment which gives students the opportunity to be active in learning and applying their knowledge to the environment. Students are directed to build their knowledge starting from their own experience, and are encouraged to make observations and discussions to reach an understanding.

According to Savander-Calories (Wulandari, 2015) PDEODE strategy consists of six (6) steps, namely; 1) predict, at this stage the lecturer presents a phenomenon to students. Students individually are given the opportunity to write down predictions about what will happen and the reasons of the effect of a phenomenon, 2) discuss, the purpose of this phase the students will discuss and will exchange ideas of their predictions in their own group, 3) explain, students in each group have question and answer through class discussion in order to reach an agreement and the conclusion of the phenomenon and the idea based on the results of the discussion of their group. Students working again in the group take notes individually the results of the experiment and record their observations of what happens, 4) Observe: the students observe changes in the phenomenon and the lecturer guides them to focus on the observations that are relevant to target concept, 5) discuss: students are required to discuss again the results to match their predictions with the observations already made in the previous step. At this stage students will be analyzing, comparing, contrasting, and critiquing classmates in group 6) explain:

students experience the discrepancy between observations and predictions. At this stage, students have tried to solve a lot of mismatches. There was a change of concept. The lecturer's role in this strategy is to challenge students and facilitate the discussion. The lecturers also investigated by asking questions carefully regarding observations, and convincing understanding of the concept of student, rectify and make sure whether the concept expected has been achieved to overcome the false concepts that are not in accordance with scientific principles.

There are several studies on the application of PDEODE. Costu (2012) showed that effective PDEODE can change the alternative conceptions of students and facilitate a better understanding of the concept (Costu, Ayas & Niaz, 2009). According to Kolari and Savander (2004) PDEODE strategy also had a positive impact on learning outcomes and student learning situation. Strategy PDEODE increases student learning motivation, makes learning become better, deeper understanding of the concept, better and focused confidence. The existence of self-confidence is necessary for the success of a student with a learning discussion group. Wulandari (2015) showed that there is a significant increase in the mastery of the concept on nutrition and health subject after the implementation of learning strategies of PDEODE to the students of Biology Education Unirow Tuban. While a few studies that examined aspects of retention, which was written Hartati, Ning & Syamswisna (2012) showed that the use GI learning model on learning materials *Plantae* improved student retention better compared to the learning model of STAD. Similarly, Rahman and Rochintaniawati (2001) stated in the concept of the organ of sight in invertebrate, the use of experimental student worksheet with prompting question was more effective to increase the student's understanding of concept than the use of experimental student worksheet without prompting question. The students in the experimental group performed better retention on the concept than the students the control group.

However, no studies have looked at the effects of learning strategies PDEODE toward the mastery of concepts and retention of nutrition and health course to students with different academic abilities in Education of Biology Unirow Tuban. Therefore, it is necessary to study it with the formulation of the problems as follows: 1) is there any significant difference of mastery of concept of nutrition and

health of the students of Biology Education among groups of students who learned with a PDEODE learning strategy and those who learned with conventional learning strategy?, 2) is there any significant difference of retention of nutrition and health of the students of Biology Education among groups of students who learned with a PDEODE learning strategy and those who learned with conventional learning strategy? 3) is there any significant difference of mastery of concepts of nutrition and health of the students of Biology Education among the students who have high academic ability and those who have low academic ability? 4) is there any significant difference between the retention of the students of Biology Education among the students who have high academic ability and those who had low academic ability? 5) is there any significant effect of interaction between application of learning strategy and academic ability to the mastery of concepts of the students of Biology Education? 6) is there any significant effect of interaction between the implementation of learning strategies and academic ability to retention of the students of Biology Education?

2. RESEARCH METHODOLOGY

The population of the study was all the students of 2012 class in semester V of Biology Education at University of PGRI Ronggolawe Tuban, East Java, Indonesia. The samples, consisting of 70 students, were obtained randomly from class A and class B, each of which consists of 35 students. The research variables consist of the independent variables, that are the learning strategies (PDEODE and Conventional), the dependent variables, namely, the mastery of concepts and retention, and moderate variable, that is academic ability. This research is a quasi-experimental, with the research design pretest-posttest control group random subjects (Arifin, 2008) with the following picture:

Table 1. Pretest-posttest control group subjects Random

	Pretest	Treatment	Posttest	retention
(R)	O ₁	X	O ₂	O ₃
(R)	O ₁	-	O ₂	O ₃

Description:

- O₁ = Pretest
- X = Treatment
- O₂ = Posttest
- R = Random
- O₃ = Retention

The study is divided into three activities: 1) Preparation, this activity consists of

preparing a syllabus and lesson plans, creating instruments that have been validated, and testing the instruments, 2) Implementation, this activity consists of forming the group of the students randomly consisting of Class A as an experimental class, and Class B as the control class, doing a pretest to see the mastery of initial concept, doing tests of normality and homogeneity to know whether or not there is a difference in the two groups. After having known both groups had normal distribution and the diversity is homogeneous, then different learning strategies were applied. PDEODE learning strategy was applied to class A as experimental class and conventional learning strategy was applied to class B as control class. After the lesson ended, posttest was conducted to know the students mastery of concepts, using similar test items as done in pretest. Four weeks later test of retention was conducted. This is in accordance with Christoph and Irene Zehender (2006, in Hartati, et al). Then normality test and homogeneity test were conducted before going into Manova test, 3) Data analysis, Data analysis was done using Manova test and the data processing was conducted using SPSS windows version 19, to answer the problems formulated in the background.

3. RESULTS AND DISCUSSION

3.1 Research Findings

The Results of the analysis can be discussed one by one

3.1.1 Normality Test Data

Data normality test is used to see the normal distribution of data in both groups (experimental and control) by submitting two hypotheses, as follows: Hypothesis:

Ho: Data has normal distributionn

H1: Data is not normal

Table 2. Test Normality

		Tests of Normality					
		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
N	.000	.125	.35	.80	.265	.55	.32
15		.125	.35	.80	.265	.55	.32

a. Lilliefors Significance Correction

From table 2 above it can be seen that both the Kolmogorov-Smirnov test and Shapiro-Wilk test, Sig. prove that for the mastery of concept of nutrition and health the value is more than 0.05, so Ho is accepted, which means the data of the mastery of concept of nutrition and health for the classes that

learned with PDEODE and conventional learning strategies have normal distribution.

3.1.2 Homogeneity Test

To prove the data homogeneity, T test was applied. From Table 3 it can be seen that the Levene's Test of Equality of variances known that Sig. 0.488 is greater than 0.05, so Ho is accepted, which means the variety of both classes is homogeneous.

Table 3. Independent Samples Test

	Levene's Test of Equality of Variances		t-Test for Equality of Means	
	F	Sig.	t	Sig.
Posttest	,907	,343	1,635	,109
Retention	1,635	,190		

3.1.3 Equality test of Matrix Variance-Covariance

In this activity, some hypotheses are proposed as follows:

Ho: Both the dependent variables (mastery of concepts of nutrition and health, and retention) have equal variance-covariance matrix both at PDEODE learning strategy and the group of students with different academic abilities.

H1: Both the dependent variables (mastery of concepts of nutrition and health, and retention) have different variance-covariance matrix both in learning PDEODE strategy and the group of students with different academic abilities. Results of the analysis are shown in Table 4

Table 4 Box's Test of Equality of Covariance Matrices^a

Box's M	17,759
F	1,862
df1	9
df2	34405,721
Sig.	,053

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + class + group + class * group

From Table 4 visible figures Box's M is 17.759 with numbers Sig. 0.053 because the number Sig. is greater than 0.05, so Ho is accepted. This means that the variance-covariance matrix of the concept

mastery and retention are equal both for group of learning and group of academic ability.

3.1.4 Testing of Individual By using Lavene Test

To see the homogeneity of each treatment group. In this activity, the proposed hypothesis are as follows: hypothesis:

Ho: The dependent variable specified (mastery of concepts or retention) has equal variance-covariance matrix both with the use of learning strategies (PDEODE or conventional) and on the group of students with high and low academic ability.

H1: a certain dependent variable (mastery of concepts or retention) has different variance-covariance matrix both with the use of learning strategies (PDEODE or conventional) and on a group of students with high and low academic ability.

Table 5 Levene's Test of Equality of Error Variances^a

	F	df1	df2	Sig.
posttest	,907	3	66	,443
retention	1,635	3	66	,190

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + class + group + class * group

From table 5 Levene's Test of Equality of Error Variances it can be seen that sig. at posttest is 0.443, and the retention shows the mean value of 0.190 which is greater than 0.05, so Ho. The dependent variable (mastery of concepts or retention) has equal variance-covariance matrix both with the use of learning strategy (PDEODE or conventional) and the group of students with high and low academic ability.

After doing Lavene's test of Equality of Error Variances, to see the difference in each treatment the following hypotheses are proposed:

3.1.5 Testing of Individual using Tests between subject effect

3.1.5.1 Factor of Learning

Ho: there is no significant difference in the mastery of concept of nutrition and health between groups of students who learned with the PDEODE learning strategy and with conventional learning strategy.

H1: there is significant difference in the mastery of concepts of nutrition and health between groups of students who learned with the PDEODE learning strategy and with conventional learning strategy.

Ho: There is no significant difference in retention between groups of students who learned through

PDEODE learning strategy and with conventional learning strategy

H1: there is a significant difference in retention between groups of students who learned through the PDEODE learning strategy and with conventional learning strategy.

3.1.5.2 Factor of Academic Ability

.Ho: There is no significant difference in the mastery of concept of nutrition and health between groups of students with high and low academic ability.

H1: There is a significant difference in the mastery of concepts of nutrition and health between groups of students with high and low academic ability.

Ho: There is no significant difference in retention capability between groups of students with high and low academic ability

H1: There is a significant difference in retention capability between groups of students with high and low academic ability

3.1.5.3 For Interaction between Learning Strategies and Academic Ability to mastery of concepts

Ho: There is no significant interaction between learning strategy and the academic ability toward mastery of concepts of nutrition and health.

H1: There is a significant interaction between learning strategy and the academic ability toward mastery of concepts of nutrition and health.

3.1.5.4 Interaction between Learning Strategies and Academic Ability on retention

Ho: There is no significant interaction between learning strategy and academic ability on retention

H1: There is a significant interaction between learning strategy and the academic ability on retention.

3.2. Analysis

By looking at the results of the processing of the data in Table 6, the analysis are as follows:

3.2.1. Factors of Learning

From table 6 the tests of between-subjects effects can be known Sig. for mastery of concept nutrition and health are 0,000 smaller than 0.05, so Ho is rejected. This means that there is significant difference in the mastery of the concept of nutrition between groups of students who learned with PDEODE learning strategy and with conventional learning strategy. Likewise, from test of between-subjects effects it can be known Sig. for retention is 0.000, which is smaller than 0.05, so Ho is rejected. This means that there are significant differences in retention between groups of students who learned with a learning strategy PDEODE and with conventional learning strategies

3.2.2 Factor of Academic Ability

From table 6 the tests of between-subjects effects can be known Sig. for the mastery of concept of nutrition and health are 0,000 smaller than 0.05, so Ho is rejected. This means that there is significant difference in the mastery of the concept of nutrition and health between groups of students with high and low academic ability. Likewise from test of the between-subjects effects it can be known Sig. for retention capability is 0,000 less than 0.05, so Ho is rejected. This means that there is significant difference in retention capability between groups of students with high and low academic ability.

3.2.3 Interaction between strategies of Learning and Academic Ability

From table tests of between-subjects effects it can be known Sig. for interaction between learning strategy and the academic ability toward mastery of concepts of nutrition and health is 0,024 less than 0,05, so Ho is rejected. This means there is a significant interaction between learning strategy and the academic ability toward mastery of concepts of nutrition and health. Likewise, it can be seen Sig. for interaction between learning strategy and the academic ability to retention is 0.025 which is smaller than 0, 05, so Ho is rejected. This means there is a significant interaction between learning strategy and the academic ability toward retention.

3.3 Discussion

Number one until number four of the problem formulation were all answered that there is a significant difference of the mastery of concept and retention for nutrition and health of the students of Biology Education among

Table 6. Test of Between subject effect.

Tests of Between-Subjects Effects						
Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Total	pedbc	78,841 ^a	8	9,855	79,227	.000
	konbc	7,341 ^a	1	7,341	58,031	.000
Corrected Model	pedbc	57,022	1	57,022	799,097	.000
	konbc	21,782	1	21,782	708,049	.000
Error	pedbc	19,819	7	2,831	1,511	.000
	konbc	11,227	1	11,227	144,526	.000
Total	pedbc	1,371	1	1,371	1,371	.244
	konbc	1,224	1	1,224	23,627	.000
Interaction	pedbc	1,224	1	1,224	1,224	.274
	konbc	1,224	1	1,224	1,224	.274
Error	pedbc	11,022	7	1,575	1,575	.197
	konbc	11,022	7	1,575	1,575	.197
Total	pedbc	22,024	7	3,146	3,146	.000
	konbc	11,227	1	11,227	11,227	.000
Corrected Total	pedbc	11,022	7	1,575	1,575	.197
	konbc	11,022	7	1,575	1,575	.197

^a. R Squared = .725 (Adjusted R Squared = .694)

^b. R Squared = .725 (Adjusted R Squared = .694)

groups of students who learned with PDEODE strategy and with conventional strategy and the students with different academic ability. In the formulation of the problem number 5 and 6 was also answered that there was a significant interaction effect between implementation of learning strategies and academic ability with the mastery of concept and retention of the students of Biology Education.

This can be explained that PDEODE strategy consists of six steps (predicting, discussing, explaining, observing, discussing, and explaining). The activities consist of four conditions, which begins with empowering initial concept in the form of students' ideas already owned prior before they enter into the learning process. After that, students re-examine their ideas in small groups and discuss in class discussions, and finally they solve the problem which is the contradiction between the initial concept and the results of observation.

Learning PDEODE is relevant to constructivism learning theory that new knowledge is constructed solely by learners actively based on knowledge that has been acquired previously. Constructivism learning theory emphasizes three things. First, the active role of learners in constructing knowledge meaningfully; second, the importance of making the link between ideas in constructing meaningfully. Third, there is a process of linking the idea and the new information received (Zubaidah, et al, 2013). Therefore, it is clear by showing prior knowledge of students and associating it with everyday life, will strengthen the mastery of concepts. Students build their own knowledge based on their prior knowledge, so it will become embedded in its memory and is not easy to forget.

The existence of group discussions and classroom discussion with peers, will train students to question and answer and share ideas. As a result, the change of concept will occur relevant to scientific principles, which further strengthen the students' understanding of the concept. This is in accordance with cooperative learning, which form groups to share ideas, so as to deepen understanding, and the change of concept will be embedded into the memory. The activities carried out actively by the students

will make the concepts be stored in long-term memory, called retention.

In learning, academic ability is important to facilitate the learning process. Academic ability is related to the level of mastery of concepts and retention of students. The higher the academic ability, the better the mastery of concepts and retention of students. It is known that individuals vary in their academic abilities, but in learning, strategies are used to minimize the differences. PDEODE strategies can be used to overcome differences in academic ability.

The findings of the study proved statistically that the strategy PDEODE affect the mastery of concepts and retention of the students of different academic abilities in biology education students at Unirow Tuban.

4. CONCLUSIONS

From the data analysis and discussion of results, it can be concluded; 1) there is a significant difference on the mastery of concept of nutrition and health of the students of Biology Education among groups of students who learned with the PDEODE learning strategy with conventional learning strategy, 2) there is a significant difference of retention of nutrition and health of the students of Biology Education among groups of students who learned with the PDEODE learning strategy with conventional learning strategy, 3) there is a significant difference of the mastery of concepts of nutrition and health of the students of Biology Education among the group of students who have high academic ability and groups of students who have low academic ability, 4) there is a significant difference of retention of nutrition and health of the students of Biology Education among the group of students who have high academic ability with groups of students who have low academic ability, 5) there is significant effect of interaction between the application of learning strategies and academic ability to the mastery of concepts of the students of Biology Education, and 6) there is significant effect of interaction between the application of learning strategies and academic ability to retention of the students of Biology Education.

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