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IMPROVEMENT OF STUDENT COMPETENCY IN PHYSICS USING PREDICT-OBSERVE-EXPLAIN-WRITE (POEW) LEARNING MODEL AT SENIOR HIGH SCHOOL

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ABSTRACT

The problem of low achievement of physics concept at SMA Negeri 1 Berastagi was observed due to unsuitable teaching and learning process. The purpose of this research is to know the influence of Predict-Observe-Explain-Write (POEW) learning model to student learning achievement and critical thinking about static fluid concept. We conducted quasi experimental research using experimental class and control class. The population is all students of class XI IPA SMA Negeri 1 Berastagi of Academic Year 2011/2012, consist of 5 classes. Experiment class was teach using POEW learning model and control class using conventional teaching and learning. Research data were collected using test and observation sheet. Analysis of posttest data in experiment class shows that student concept mastery score is 68.37 and critical thinking skill is 74.97, whereas the posttest data in control class shows average score of 60.25 for concept mastery and 73.05 for critical thinking skill. Using t-test for concept mastery, the $t_{\text{count}} < t_{\text{table}}$, means that H_0 is accepted. This result shows that student learning achievement is better using POEW learning model. We also found student critical thinking skill is also improve using the model.

Keywords: POEW, Physics, learning model

Background

Thinking skills is important in learning physics. Thinking skills are important because mastery of the 'basics' knowledge only in education are not sufficient to fulfil human potential, or to meet the demands of the labour market. Learners must develop awareness of themselves as thinkers and learners, practice strategies for effective thinking and develop the habits of intelligent behaviour that are needed for lifelong learning (Fisher, 2005). One type of thinking skill is critical thinking skills. Critical thinking is reasonably and reflectively deciding what to believe or do. Critical thinking means making reasoned judgments. Critical thinking is a disciplined manner of thought that a person uses to assess the validity of something (Rusbult, 2011).

Science underlie the products and interactions of today's technological society. Beyond repeating theory and formula, students need to understand how to apply science knowledge to different situations challenges. Science activity provide opportunities to students to think critically about the use of science in solving problem, deepening their knowledge of the basics (Route, 2007). Teachers must be able to plan learning in to improve student's critical thinking skills. But in reality, learning process in classroom still less varied. Teachers are less concerned to the student's understanding level for information submitted. So far, our education is still dominated by the view that knowledge as a set of facts that has to be memorized. Teaching and learning process still focused on the teacher as

the main source of knowledge (Depdiknas, 2004). Students are directed only to memorize information without required to understand and relate it to daily life. Students are not active in learning process, their just listen to the teacher and write what their teacher ask. It is cause the learning content just memorizing and the students do not understand the essential concepts itself. Proved from data IEA's Trends in International Mathematics and Science Study (TIMSS) 2007 for second grade of Junior High School noted that Indonesia was ranked 36 of 56 countries for the science ability in Junior High School level (TIMSS, 2007). This data proves that the quality of science in Indonesia is still low.

In physics learning process at SMAN 1 Berastagi, students are usually not encouraged to develop their thinking skills. Teaching and learning is dominated by the teacher which inform the concepts of physics. As a result, students are only good in theory but poor in application. Whereas the delivery of the physics subject matter studies generally can not be separated from experimental activities. One of the goals of physics subject is to make student develop their experience to be able to formulate the problem, propose and test the hypothesis by experiment, designing and assembling the experimental instruments, collect, process, and interpret data, and communicate the experiment results in oral and written (Content Standard for High School based on Permendiknas RI No. 22 Tahun 2006). Experimental activities can provide a positive influence on mastery of concepts, because of there is correlation between theory and experiment. The principles set out in the theory will be studied in the experiment, and vice versa, experiences gained in the experiment will look for the basics in theory and principles.

Based on the above problems, it is necessary to modified physics teaching and learning model appropriate for student at SMAN 1 Berastagi. We proposed Predict-Observe-Explain-Write (POEW) learning model which is a combination of Predict-Observe-

Explain (POE) learning model and Think-Talk-Write (TTW) learning strategy. POEW learning model consist of four stages of core activities, that is: (1) Predict, students make allegation, (2) Observe, students doing observation, (3) Explain, students give an explanation in their discussion, (4) Write, students write a conclusion using their own language. Formulation of the problem in this study is: "Does the application of POEW learning model improve student competency of static fluid concept and critical thinking competency compared to the use of conventional learning?"

POEW Learning Model

POEW learning model developed from the learning model Predict-Observe-Explain (POE) and the strategy Think-Talk-Write (TTW). POE learning model using an experimental method in which the first activity students are asked to observe a phenomenon and then give provisional estimates of the likelihood that the case, then students are invited to observe directly the physics problems which later proved directly by conducting an experiment to compare the results with the initial allegations. POE learning model introduced by White and Gunston in 1988 (Joyce, 2006) involves students predicting the result of a demonstration and discussing the reason for their prediction, observing the demonstration and finally explaining any discrepancies between their predictions and observations (Kearney, 2002). TTW learning strategies introduced by Huinkier Laughlin (1996) consist of three phases, (1) Think, students are given problems and think about the possible answer, (2) Talk, students work in groups to discuss what is obtained in think phase, (3) Write, student works individually, giving idea acquired in talk phase and write the result of discussion by their own language so that students can master the concepts being studied further.

POEW learning model allows students actively in the learning process, provides the opportunity for students to construct knowledge,

communicate ideas and discuss the results of their discussion so that students better understand, master the concepts, and critical thinking skill of students increase. Student participation in learning will increase because students are involved in making allegations of problems that can stimulate their critical thinking skill; conduct experiments to test the predictions, by directly observe the students can compare the theory with the reality; describes the communication and interaction through discussion groups; write down the result by their own language. Communication (oral and written) in learning is very important, because through communication, ideas can be exploited in a variety of perspectives; the way of student's thinking is sharpened.

The POE learning model was develop to uncover individual students' predictions, and their reasons for making these, about a specific event. Through the learning strategies students are expected to master these three skills. POE is a strategy that often used in science. It works best with demonstrations that allow immediate observations, and suits physical and material world contexts. It can be used for finding out students' initial ideas, providing teachers with information about students' thinking, generating discussion, motivating students to want to explore the concept and generating investigations. Constructivist theories of learning consider that students' existing understandings should be considered when developing teaching and learning programmes. Events that surprise create conditions where students may be ready to start re-examining their personal theories.

In a POE activity, students are first asked to predict what would happen next in a demonstration. Subsequently, they have to observe the demonstrations carefully and finally to explain what they observed. The teacher can have a follow-up group or whole class discussion with the students to discuss their observations and explanations. The commitment to a prediction enhances student's understanding of the situation involving the demonstration while the reasoning stage provides a further focus for

the observation and builds motivation. The observation phase can initiate discussion and foster valuable learning, especially if it is contentious, while the explanation phase also provides a significant opportunity for discussion. These positive learning effects are enhanced when students are required to write their response to each component of a POE task (Kearney, 2002).

Learning Achievement

Learning is always defined as a change in the individual caused by experience (Djiwandono, 2006). Humans have learned so much since they were born, that learning and development is a relationship that can not be separated. Learning occurs in many ways. Sometimes intentional learning, when students obtain the information conveyed by teacher in the classroom, or when they are looking for something that is in encyclopedias or books. From the learning process that takes, is expected students can acquire and master the concepts and subject matter being studied. Therefore, the mastery of the concept is very important to have students who have undergone the learning process.

According Suparno in Nurjanah (2009), learning physics correctly must develop the concept changes. Both changes in the form of expansion of the concept, nor change the wrong concept to be true is in accordance with the concept of the physicists. Learning physics is a good concepts that allows the process of change takes place quickly and efficiently. In order of POE, the change process begins with the concept: (1) teachers reveal issues that the answer can be obtained through experiments that have been prepared, (2) students are asked to make a hypothesis first and the reason, (3) students conduct experiments, (4) students conclude the result, if the result is not consistent with the hypothesis, the teacher questioned why this happened. Of the whole process above, students may experience change in both the concept of extending the concept that has been owned or change the wrong

concept that is incompatible with the concept of physical scientist.

Critical Thinking

Arthur L. Costa in Wahidin (2008) illustrates that critical thinking is: “using basic thinking processes to analyze arguments and generate insight into particular meanings and interpretation; also known as directed thinking”. R. Matindas in Wahidin (2008) stated that critical thinking is a mental activity performed to evaluate the truth of a statement. Generally, the evaluation ends with a decision to accept, deny, or doubt the truth of the statement in question. Matindas also revealed that many people do not really distinguish between critical

thinking and logical thinking when there are big differences between the two that is that critical thinking be done to make the decision, while the logical thinking required just to make a conclusion. Basically the same critical thinking involves logical thinking is forwarded to the decision-making.

Critical thinking enables us to recognize a wide range of subjective analyses of objective data, and to evaluate how well each analysis might meet our needs. Critical thinking includes a complex combination of skills. The relationship between syntax POEW learning model with the level of mastery of concepts and critical thinking skills students are expected in this study are shown in Table 1.

Table 1. Relationship Between Syntax of POEW Learning Model, Concept Mastery, and Critical Thinking Skills of Students

Syntax of POEW Learning Model	Mastery of Concepts	Critical Thinking Skills
Stage 1: Predict; Student make predictions (temporary answers) for the given problem	Aspects of knowledge/ memories	Able to give reasons
Stage 2: Observe; Students make observations or experiments	Aspect of the application Aspects of understanding	Applying the principle Decide on an action Making conclusion
Stage 3: Explain; Students conduct group discussions relating to the allegations and observations made	Aspects of understanding	Justify Making conclusions Defining the term
Stage 4: Write; Students write observations and discussions; write back an answer; write a conclusion with their own language	Aspects of understanding Aspects of the analysis Aspects of knowledge memories	Making conclusion and hypotheses

RESEARCH METHOD

This research was conducted at Senior High School, RSBI SMAN 1 Berastagi in academic year 2011/2012 on March-April. The population in this research is all students of second grade of science class of SMAN 1 Berastagi which consist of 5 classes. The total students is 160 students where the total of student in each class is 32 students. Sample selected randomly and obtained two classes that used as an experiment and a control class.

The method used in this research is quasi experiment. This experiment method used to explore the concept mastery level and student’s critical thinking skills. In quasi experiment method, there are some matters to be considered as internal validity, that is considering the different of influence that caused by experimental treatment and comparative treatment, and also external validity, which consider the results of research can be applied generally to the conditions of the corresponding. Dependent

variable examined is the increasing mastery of physics concepts and critical thinking skills of students. In this case, to be examined are changes in the mastery of physics concepts and critical thinking skills of students based on the manipulation of independent variables tested.

Table 2. Research Design

Group	Pre-Test	Treatment	Post-Test
Experiment	T ₁	X ₁	T ₂
Conventional	T ₁	X ₂	T ₂

T₁: Pre-test; and T₂: Post-Test; X₁: POEW Learning Model; and X₂: Conventional Learning

Data collected involves the score of concept mastery test, data of critical thinking skills, and observation sheet.

RESEARCH RESULT AND DISCUSSION

Data was analyzed using parametric statistical test, where the requirement is the data tested must have normal distribution and homogen. Therefore, it must be tested the normality and the homogeneity. The testing of

data normality using Liliefors test and homogeneity using test F. The hypothesis testing using t-test that is to distinguish the average of posttest result of students in experiment and control class to know whether or not the influence of POEW (predict-observe-explain-write) learning model to the increasing of static fluid concept and critical thinking skill of student in class XI Semester 2 SMA Negeri 1 Berastagi Academic Year 2011/2012.

The testing criteria is accept H₀ if t_{count} between -1.99 and 1.99, and rejected H₀ if t has the other score. From the calculation result of concept mastery obtained t_{count} = 3.57, so H₀ is rejected and H_a is accepted or in other word, there are significant influence between POEW learning model and conventional learning to increase the ability of student concept mastery. Critical thinking skill data analysis shows that t_{count} = 1.05, so H₀ is accepted and H_a is rejected or in other word, there is no differences between experiment class and control class although the critical thinking skill itself is improve.

Table 3. Hypothesis Testing

Ability	Class	Average	t _{count}	t _{table}
Concept Mastery	Experiment	68.37	3.57	1.99
	Control	60.25		
Critical Thinking Skill	Experiment	74.97	1.05	1.99
	Control	73.05		

Based on pretest analysis, it is known that the student mastery of fluid static concept for experiment class did not differ significantly with the control class. Both groups have the same initial ability before implementation of POEW (Predict-Observe-Explain-Write) learning model. After the treatment, experimental class obtained better result in learning achievement. Based on observation data, it can be concluded that student following the POEW learning model were more active and obtained meaningful learning. POEW has important role in learning process to master and strengthening the student concept. When the students discuss

in their group and express the argument, their improvement of concept understanding is evidently observed. Based on the result of hypothesis testing, it can be concluded that the increasing of student mastery of static fluid concept of experiment class with POEW learning model is higher than students who follow conventional learning.

Based on the result of pretest and analysis of critical thinking skill, it is known that there is no differences between the students from experiment group and control group before the treatment. Posttest scores of critical thinking skill shows that there is an increasing

skill compared to the pretest. Using POEW learning model stages, students are encouraged not simply accept that what they hears and actively constructed their own knowledge. Students were given opportunity to predict the answers on the presented problem, make observations independently to find answers of their predictions, cooperate and discussion with friend, explain or present the results of observations and make a summary of the knowledge gained from the learning process. However, based on hypothesis testing, it is found that no significant difference of student critical thinking skill between the two classes.

Based on the observations, the experimental group students who are taught using POEW learning model, the students and teachers seemed very enthusiastic, active, and enthusiastic in following the learning process. When faced with the problem in the prediction stage, the students looked confused. While doing the experiment, the teacher is busy with student questions and somewhat difficult to direct because the students are not familiar with laboratory activities. Since POEW learning model is quite new to the student, the gain of critical thinking skill is not satisfying at the first meeting. Later in the second, third, and fourth meeting, student activity is increase and teacher activity is decreases. On the prediction activity, students seemed enthusiastic giving the prediction. Students seemed happy and enthusiastic in making observations, fill out a worksheets, discussion with colleagues in the concluding the results. After receiving reinforcement from teachers, students conducting the write phase. Overall student activities are included in good category.

Researcher also observed the teacher activity in implementation of POEW learning steps. Teacher implemented the learning steps accordance with the plan that had been developed. The teachers is actively engaged in giving motivation to the students in make predictions and express opinions or ideas. Teachers provide guidance to the students who have difficulties in practical activities, and

answer student questions. From the first meeting to the next activity, the role of teachers is decreased, where teachers function is more as a facilitator to guide and motivate students so that the learning is student-centered. As a facilitator, the teacher plays a role in providing services to facilitate students in learning activities.

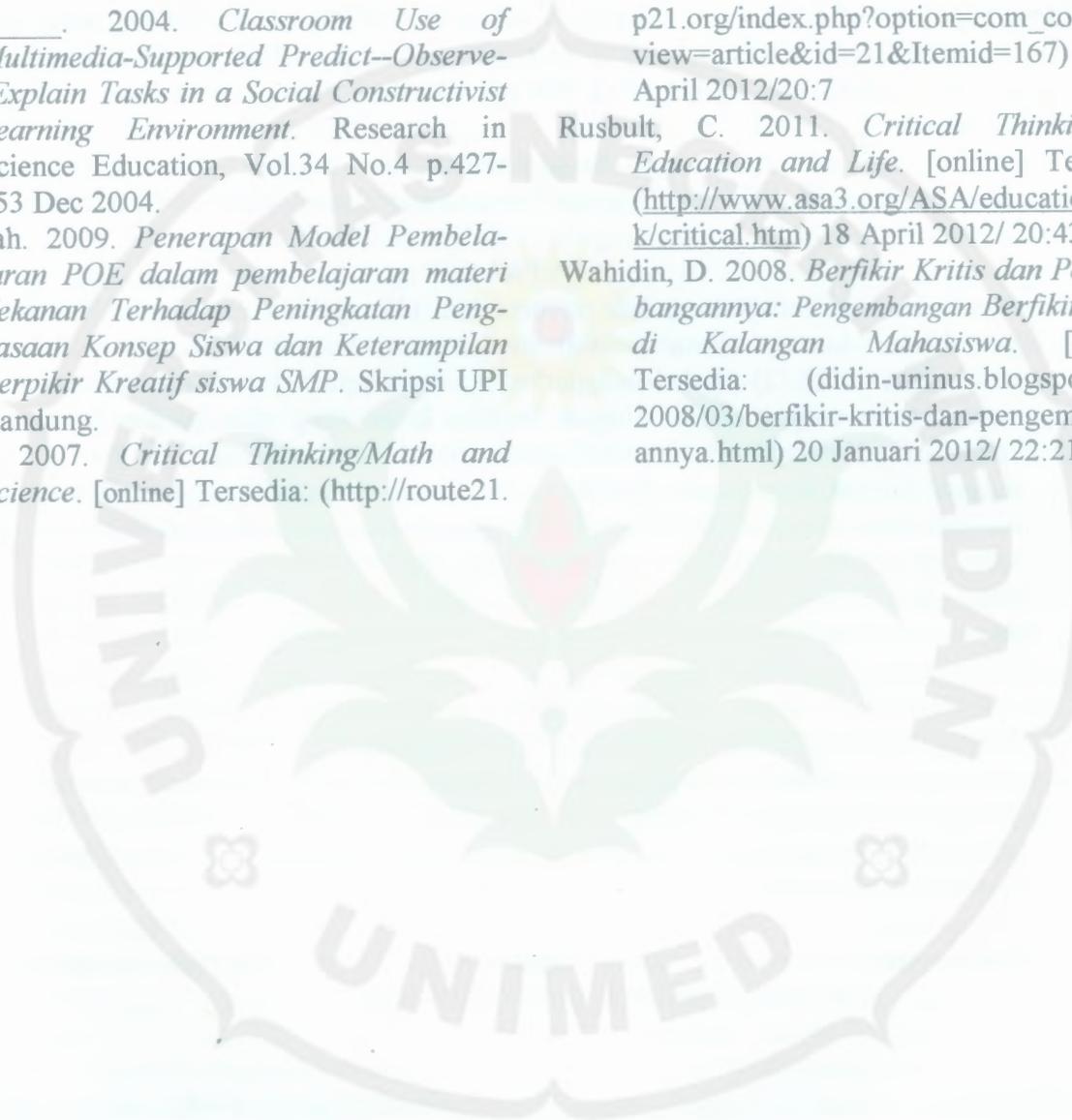
CONCLUSION

Based on the research result, data analysis, and discussion so can be concluded that POEW learning model makes students more active, more enjoyable learning atmosphere, and the learning model very supportive in increasing in the concept mastery and critical thinking skill of student.

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