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The Development Of Predict, Observe, Explain, Elaborate, Write, and Evaluate (Poe2we) Learning Model in Physics Learning At Senior Secondary School

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Abstract
The objectives of this research are: (1) to produce Physics learning model and instrument at Senior secondary School with the POE_2WElearning model; (2) to examine the feasibility of the Physics learning model and instrument at Senior secondary School with the POE_2WE learning model; and (3) to study the effectiveness of the POE_2WE learning model at Senior Secondary School.

This research used the research and development (R&D) method so as to produce a certain learning model and to examine its effectiveness. It also used the procedural development model, adapting the development model of 4-D (four D model). According to Trianto (2011:93), the development research included four phases, namely: defining, designing, developing, and disseminating.

The results of the research are as follows:1) The development of Physics learning model at Senior Secondary School with the *POE2WE* learning model is done by using the development model of R2D2, which is applied through four focused phases, namely: (1) defining, (2) designing, (3) developing, (4) disseminating. 2) The result of the examination on the learning model and the components of the learning instrument product by the experts shows that it is feasible to be used with the following reasons: (a) the expert of subject matter assesses that the learning material and student work sheet are feasible to used or applied in the Physics learning in Grade X Semester I of Senior Secondary School; (b) the physics teachers asses that the learning material and student work sheet are feasible to be used; and (c) the subjects of the research exposed to the experiment assess that the components of the learning material are very good and interesting to be learned. 3) Quantitatively, there is a significant difference in the result of Physics learning with the use of the Physics learning model of the students in Grade X, Semester I of Senior Secondary Schools in Ciamis regency as indicated by the result of t test of $p< 0$, 0000.The response of the students to the learning process is regarded positive as shown by the variation of their attitudes. 63.34% of the students have a very positive attitude, and the rest 36.67% have a positive attitude. The response of the students to the Physics learning material is also positive. 50.83% of them have a very positive attitude, and the rest 49.17% have a positive attitude. In addition, the response of the students to their teachers is also positive. 72.50% of them have a positive attitude, and the rest 27.50% have a positive attitude.
Keywords: POE2WE learning model, and Physics learning at Senior Secondary.

1. Introduction

Law of the Republic of Indonesia Number: 20 of 2003 regarding National Education System, Chapter II, Article 3 states that National Education functions to develop abilities and to form character and civilization of the nation, which is dignified as to educate the nation life by developing the potentials of the learners so that they become faithful and devoted to the Almighty God, healthy, knowledgeable, competent, creative, independent, democratic, and responsible and bear noble characters.

The enactment of the School-Based Curriculum requires paradigm changes in education and learning, particularly at the formal education types and levels (schooling). The changes shall be followed by the teachers who are responsible for the learning administration at schools. All this time, most of variety of learning is based on the three domains of Bloom taxonomy, namely: cognitive, affective, and psychomotor. In its implementation, the Bloom domain-based learning is not balanced and holistic but is merely emphasized on the objectives of the cognitive domain and avoids the objectives of the affective domain. As a result, the learning goes on: (1) uninteresting, which brings negative traits to the science subject matter, (2) passive, which is dominated by lecturing method, (3) monotonous, which does not give any opportunities for creativity development; and (4) ineffective, in which the time allotted has not maximally been utilized for the fulfillment of competencies of the learners.

Thus, it is necessary to develop Science learning models and methods, which is able to fulfill the three domains of Bloom taxonomy. One of the learning methods which can help the learners to develop a number of scientific skills or works through a scientific method and to train their scientific attitudes is experimental method. With this method, the learners can identify problems, arrange hypotheses, predict consequences of hypotheses, conduct

experiments to test the hypotheses, and to formulate a simple general law, which is organized from the hypotheses, prediction, and experiment. In the experimental method, the teachers can observe not only the cognitive aspect but also the affective and psychomotor ones.

Nowadays, Physics learning at Senior Secondary School has still been dominated by classical and lecturing learning methods, in which a teacher becomes the center and source of learning and dominates the learning activities. The activities of learners are merely listening to the explanations given by the teacher and taking down matters regarded necessary. The teacher explains the Physics learning material. Yet, it is only limited to products, and little bit to process. It happens due to the abundance of the learning material to be discussed and accomplished based on the effective curriculum. Meanwhile, a good Physics learning shall be emphasized not only on the products but also more importantly on the process so as to prove or to get a theory. Physics subject matter at Senior Secondary School which is tested in the National Test determines whether or not a student graduates from the school.

The learning method used by State Senior Secondary School teachers is lecturing method. A preliminary research to the Physics teachers of Senior Secondary Schools of Ciamis shows that the lecturing method has the highest percentage (95%), and the rest 5% is occupied by the experimental method as the most relevant method for the Physics learning.

The conclusion of the preliminary research shows that the learning used by the Physics teachers of Senior Secondary Schools of Ciamis is the expository learning model. The teachers still mostly dominate the learning process so that the learning activities of the learners in the learning process are still low. Books are still the main resource for the Physics learning even though there are many other potential learning resources such as internet.

The POEW learning model is developed from the learning models of *Predict, Observe, Explain* (POE) and *Think, Talk, Write* (TTW). The POE learning model is a learning model with the knowledge development process, which begins with predicting solution over a problem, and then it goes with conducting experiment to prove the prediction, and finally it ends with explaining the result of experiment (White and Gystone, 2006). The strategy of the TTW learning model was introduced by Huinker and Laughlin (1996). It consists of three phases, namely: think, talk and write. Firstly, the learners are given a problem, and they think the possible answer to the problems. Then, the learners work in group to discuss the existing problem. Lastly, the learners individually write the result of their discussion in group in his or her own language so that he or she masters the learned concept. The integration between the POE learning model and the TTW learning model enable the learners to be active in the learning process. This gives an opportunity to the learners to construct knowledge, to communicate his or her thoughts, and to write the result of their discussion so that the learners much more master the concept which will affect the learning result improvement.

The application of the prevailing POEW learning model still less optimizes the ability of the students to predict and to solve a problem given. The lack of initial knowledge of the students becomes a constraint to the formation of their prediction. A prediction made by a student needs initial and extensive knowledge of a problem. Besides, during a practicum the students only play their role in the implementation of the practicum. The instruments, materials, and measures of experiment were provided by the teachers. This makes the student untrained to have critical thinking to design his or her own experiment based on the prediction that he or she makes. Therefore, it is necessary to develop *predict, observe, explain, elaborate, and write* (POE_2WE) learning model, which is a collaboration between the POEW learning model and the constructivist model. The collaborative model can enable the students to make prediction based on the initial knowledge that they own so that they can solve the problems given by their teachers or the ones that they encounter in their daily life. Besides, the students are expected to apply it in their daily life.

The result of initial research to the students in Grade X of State Senior Secondary School 1 of Ciamis taken randomly as summarized in shows that from the mapping of National Test, there are many pieces of incompleteness and misconceptions on the rectilinear motion concepts by the students. The average percentage of the students undergoing misconceptions in the rectilinear motion learning is 70.4 %. The result of the research can be used as the basis for conducting research so as to reduce Physics misconceptions particularly in the rectilinear motion concepts.

The POE_2WE learning model is very appropriate to be applied in the motion kinematics, which can mostly be observed in experiments. In this learning model, the teacher usually gives a problem related to the topic to be instructed to the learner, and the students are asked to predict conclusion for the problem. After that, the students do observation. Draw conclusion, and match their prediction as to find out whether or not his or her prediction is accurate. This method can be done individually or in group, and in relation to this the teacher can ask the students to convey how the learners solve the problems with the POE_2WE learning model.

The POE_2WE learning model can also help to solve misunderstanding. The students are given a problem that the teacher has provided. Then, the students have a discussion in their own group and produce a hypothesis. Next, they do observation by conducting experiments so as to support and to verify whether or not their hypothesis is correct. By solving the problem with the POE_2WE learning model, the students are trained to organize their

understanding and ability as proven by observation so that the learning process conducted is meaningful.
Based on the research held by the Research and Development Body of the Ministry of National Education regarding the Mapping of Education Quality of the Result of Research on the National Test Material, which is not complete. The learning material that required development is rectilinear motion for the students in Grade X Semester 1.

2. Theoretical Review

According to Piaget, cognitive development is a genetic process which is based on the biological mechanism, that is, the nervous system development. When one grows, he or she undergoes a biological adaptation with his or her environment, which causes the qualitative changes in his or her cognitive structure.

The application of Piaget theory in the learning with the POE_2WE learning model can be seen from their way of thinking and use of language. In relation to the Piaget theory, in their cognitive development the students of Senior Secondary School are in the formal operational phase. Such a cognitive development can be seen from the students' activities which are conducted according to the phases of the POE_2WE learning model which emphasizes the students to play an active role in the learning process in which the students find and construct their own knowledge. The students of this phase will think logically and theoretically based on the proportion and hypothesis, and they are able to take decisions. Meanwhile, the teacher plays his or her role as a motivator and facilitator to the students in the learning activities. The teacher guides, directs, and helps the students so that they can interact with their environment and daily life. The problem given to the students and the experiment conducted are related to the surrounding environment of the students so that they can think of to look for solutions in accordance with their cognitive development.

The application of Bruner theory in the learning process with the POE_2WE learning model means that the students will get a freedom to investigate a problem individually or together with other students to solve it. The knowledge attained through discovery prevails longer. The students solve the problem presented through group discussion, and the result is then presented in front of the class. In this way, the learning activities train the students so that they can gain new information, which has never been obtained before.

Kearney (2002) claims that POE learning model is a learning method, which involves the students to predict and discuss considerations for their prediction, to observe directly, and to compare the result obtained to their former prediction. This learning method makes the instruction more exciting and improves the conceptual mastery of the students.

Meanwhile, Tuckerman (2007) argues that POE learning model is a technique to ensure that the students articulate their former ideas with activities that lead them to understanding. The phases of the POE learning model include the following: (1) the students are introduced to a situation so that they are able to make predictions based on their experience; (2) the students are requested to make predictions and give reasons for their predictions; (3) the students do activity observations; (4) the students explain the differences between what they predict and the results of their predictions; and (5) the students are requested to propose new ideas to explain their understanding.

The POE learning model can be used to recognize the initial ideas of students, to give information to the teacher about the students' thinking, to generate discussion, and to motivate them to investigate concepts (White and Gustone, 1992). The roles of the teacher in the POE learning method are as a motivator and a facilitator. As a motivator, the teacher is expected to be able to stimulate the students to solve problems through the following measures: (1) proposing relevant, challenging, and curious problems for the students, (2) trying to get the students cognitively active in each phase of the POE learning model; and (3) developing interaction among the students through questions and answers and discussions.
The POEW learning model has four main phases in the learning process, namely: 1) **Predict**: it is a process to make a prediction toward a problem given by the teacher. In making the prediction, the students have thoughts the reasons why they make such a prediction. In this process, they are given an extensive freedom to arrange their prediction including its reasons. Therefore, the teacher should not limit the students' thoughts so that they produce many ideas and concepts. In this prediction process, the teacher can also understand the misconceptions made by the students. This is important for the teacher to help the students to develop right concepts.2) **Observe**: it is a process to investigate and observe what happens. In other words, the students are asked to do experiments to examine the prediction righteousness that they deliver. In this phase, the students do investigation or experiment to examine the prediction that they convey. The students observe what happens, and the most important thing in this measure is confirmation on their prediction.3) **Explain**: it is a process to give explanation

mainly the ones about the conformity between the prediction and the result of experiment of the observation phase. If the result of prediction is suitable with that of observation and after they obtain explanations about their prediction righteousness, the students will be more convinced about their concepts. However, when their prediction is false, the students can look for explanation why their prediction is not right. The students will experience the change of concepts from the false to the right ones. In this regard, they can learn from the mistake, and learning things from mistake will not be easily vanished or forgettable. 4) **Write**: in this phase, in this process, the students write conclusions in their own language about the learning material that they understand.

2.1 The Strengths of the POEW Learning Model

Through the POEW learning model, the students can critically think to give prediction on the problem conveyed by their teacher. Through observation, the students are requested to do a direct observation i.e. conducting experiments. The integration of the POE learning model and the TTW learning model communicates the result of discussion and expresses their ideas not only orally but also in writing. This will make the students easier to memorize and understand the learning material.

2.2 The Weaknesses of the POEW Learning Model

The weaknesses of this learning model are as follows. It requires good preparation and skills to conduct experiments. In relation to the time required for holding a practicum, the required instruments and materials must be well prepared prior to its execution. The activeness of the students influences the learning very much. If the students are inactive, the learning process will not run smoothly. Therefore, the teacher should motivate the students so that they are active in the learning process. The students are very much in need of motivation so as to enable them to predict and express their ideas. Supriyati (2012) in her research claims that in the learning process which uses the POEW learning model, the students are less creative to convey their prediction so that in exploring the information to study the existing problem and to prove their initial prediction, the students become less detailed. This has to do with the fact that they are less sensitive and lack of insights toward the problems taking place in surrounding environment.

3. Research Method

This research used the research and development (R&D) method. Simply, R&D can be defined as a research method, which is intended, systematic, directed to discover, formulate, improve, develop, produce, and examine the effectiveness of a certain product, model, method, or strategy, which is newer, more excellent, more effective, more efficient, more productive, and more significant as claimed by Sugiyono (2010:407). The procedures employed in this research adapted the 4-D model development. According to Trianto (2011:93), the development research includes four phases, namely: defining, designing, developing, and disseminating.

The instrument of learners' response was adapted from the one developed by Mustaji (2009), namely: (1) the learners' response to the learning process, learning material, student work sheet, and teacher; (2) the instrument to gain scores during the learning process on the cognitive, affective, and psychomotor aspects; and (3) the instrument to get the data of initial abilility score prior to learning the developed learning product and of final ability score following learning the developed learning product.

The sheet of feasibility and instrument readability tests used the Likert scale. The instrument feasibility test used the following formula:

$$P = \frac{F}{N} x100\%$$ (Rinduwan, 2007:15)

Remarks:

P = percentage of assessment
F = the score obtained by the subjects of the research
N = Ideal score

The quantitative data analysis was calculated by using the following percentage formula:

$$P = \frac{(nx1) + (nx2) + (nx3) + (nx4)}{Nx4} x100\%$$

where, P = Percentage of answers
n = Number of options
N = Number of answers
1,2,3,4 = Weights given to options

(Sunu Priyawan, 2003:99)

1. Analysis of Pre-test and Post-test Completeness

In order to investigate the students' completeness to answer the pre-test and post-test, the following formula was used:

$$Individual\ Completeness = \frac{Number\ of\ correct\ answer}{Total\ number\ of\ questions} x100\%$$

2. Classical Completeness

The classical completeness was calculated by using the following formula:

$$Classical\ completeness = \frac{Number\ of\ students\ completing\ the\ learning}{Total\ number\ of\ students} x100\%$$

If the classical completeness is greater than or equal to 70%, the learning is classically regarded as completed one.

The descriptive statistical analysis technique was also employed to process the data of pre-test and post-test so that the effectiveness level of the obtained product development was known as a consequence to find out the improvement of the learning result on the material of the students. The descriptive statistical analysis used the following t-test formula:

$$t = \frac{\overline{D} - d_0}{sd\ /\ \sqrt{n}} \sim t\ (n-1) \quad \text{with} \quad D = X - Y$$ (Budiyono, 2009:151)

Remarks:

$\overline{D}$= mean of difference between pre-test and post-test

sd= Deviation standard

n = Subjects in the samples

4. Preliminary Research

The learning model developed in this research is predict, observe, explain, elaborate, write and evaluate (POE2WE) learning model, which is the development of the POE learning model, the TTW learning model, and the constructivist learning model. To materialize the development product of the Physics learning at Senior Secondary School with the POE2WE learning model, this research used the R2D2 model, which was applied through four focused measures: (1) defining, (2) designing, (3) developing, and (4) disseminating.

Library study is a phase to analyze indicators and basic competencies Core Competencies and Basic Competencies that are possible as references for the learning model development. It was done to support the selection of material to be developed. Based on the National Test analysis in 2012 from the software of the Ministry of National Education for Senior Secondary Schools in Ciamis regency, the competency which was still below the average was the one on the rectilinear motion. For details, see Annex 3.

The result of observation and questionnaire on the need analysis given to the teacher and students, shows that based on the questionnaire given to five teachers, 60% of the teaching and learning process instruments were produced by printing companies, 100% of the learning models were still conventional, 95% of the learning methods used the lecturing method and the rest 5% used the experimental ones, 100% of the learning materials were bought from publishing companies, 100% of the student work sheets were made by publishing companies, 60% of the 2013 curriculum did not use scientific methods, and 80% of the evaluations done by the teachers were merely cognitive.

The result of questionnaire on the need analysis to five students shows that 95% of the teachers taught monotonously, 95% of the instructional methods used lecturing method and the rest 5% used the experimental method, 100% of the students wanted other learning resources in addition to handouts and student work sheets, 100% of the students thought that the evaluations were merely cognitive, and 100% of the students wanted effective evaluations.

Other reflections on the implementation of Physics learning at Senior Secondary Schools all this time are as follows: (1) the instruments for practicum/experiment in the Physics learning activities are not readily available, which causes the learners difficult to prove the theories of the material instructed by the teacher; (2) the teacher assign the students with tasks merely focused on answering the questions in the instructional material, which causes the teaching and learning process becomes monotonous and boring; (3) the teacher rarely gives feedbacks so that the students are less motivated to learn independently and reluctant to express their own opinions/ideas; (4) the teaching and learning process is still teacher-centered; (5) the students are passive in the teaching and learning process, in which they are information receivers only, and they have not constructed on their own the knowledge that the learn; (6) the students tend to play their role as the objects rather than as the subjects of learning; and (7) the assessment is still merely oriented to learning product, not to learning process.

5. Experimentation of Learning Product

5.1 Experimentation of Syllabus and Lesson Plans

The results of the analysis of responses/evaluations on the syllabus and lesson plans are as follows:

(1) The syllabus and lesson plans are feasible to be applied as proven by the results of evaluation on the following learning technology components: (a) learning material identity is scored 3.80; (b) basic competencies and indicators are scored 3.50; (c) learning material, media, and resources are scored 3.50; (d) the learning activities of the students during the teaching and learning process are scored 4.00; and (f) the learning evaluation in the lesson plans is scored 3.88.

(2) Based on the data of responses/evaluations on the components of syllabus and lesson plans, it can be said overall that the syllabus and lesson plans are very precise, appropriate, suitable, and obvious to be used in the teaching and learning process with the Physics learning model at Senior Secondary School. Only few components need improvement: (1) the school identity does not occur; (2) the learning media use is not obvious; (3) the students are lack of role as the subjects of learning in the teaching and learning process.

5.2 Experimentation of Learning Material and Student Work Sheet

The results of the analysis on the responses/evaluations on the content of the Physics learning material are as follows:

(1) The contents of the learning materials are feasible to be used as proven by the results of the evaluations of the Physics learning contents by the experts on the following components: (a) the covers are scored 3.67; (b) the objectives are scored 4.00; (c) the learning materials are scored 3.44; (d) the exercises are scored 3.50; (e) the answer keys are scored 3.25; and (f) references are scored 3.00.

(2) Based on the responses/evaluations on the components of the learning materials, it can be said overall that the learning materials are very precise, appropriate, suitable, and obvious to be used for the Physics learning model development at Senior Secondary School. Only few components need improvement: (a) few symbols and pictures need to be changed; (b) the references of competency standards and basic competencies need to be included; and (c) the competency standard, basic competencies, and objectives should not be put together with the learning materials.

6. The Study of the Final Product of the *POE2WE* Learning Model for the Physics Learning at Senior Secondary School

The Physics learning model at Senior Secondary School at Senior Secondary School with the POE2WE learning model is one of the alternative models which can be used by Senior Secondary School. This learning model has been experimented, and the result of the experimentation fulfills the feasibility requirement to be implemented at Senior Secondary School. The model developed has been based on the fact that learning the Physics with the *POE2WE* learning model aims at developing thinking ability owned by the students through problem solving.

The development of the Physics learning model with the POE2WE learning model uses the following foundation that every learner will build new knowledge, by integrating the information that he or she obtains to his or her initial knowledge. In accordance with the constructivism, this learning model gives a probability of the availability of learning resource information through his or her peers and groups. The interactions of individuals in the groups have been proven to be significant for achieving the students' ability to solve problems.

Overall, the results of the research show that the development of the Physics learning model with the POE2WE learning model can be used and developed as a means of improving the quality of the teaching and learning process at Senior Secondary School. Therefore, the learning process equipped with the learning model and instruments (Syllabus, lesson plans, learning materials, student work sheets, evaluations, and model guidelines) can have a synergy with the Physics learning model with the POE2WE learning model especially for improvement of the teaching and learning process.

7. Display and Analysis of the Data Resulting from Field Test on the Development Product

7.1. The Effectiveness of Learning the Students' Results

7.1.1 Data of Pre-test and Post-test in the Field Experimentation

Table 1 displays the lowest, highest, and average scores in pre-test and post-test of the students of State Senior Secondary School 1 of Ciamis, State Senior Secondary School 2 of Ciamis, State Senior Secondary School 1 of Ciamis, and State Senior Secondary School of Baregbeg, Ciamis.

Table 1: The lowest highest, and average scores in pre-test and post-test

No.	Name of School	The lowest, highest and average scores of pre-test and post-test					
		Pre-test			Post-test		
		R	T	M	R	T	M
1.	State Senior Secondary School 1 of Ciamis	25	56	45	81	100	94
2.	State Senior Secondary School 2 of Ciamis	25	63	48	81	100	94
3.	State Senior Secondary School 3 of Ciamis	25	75	46	69	100	83
4.	State Senior Secondary School 1 of Baregbeg, Ciamis	25	63	51	81	100	89

Table 1 above shows that the lowest score of the pre-test, that is, 25 wwas obtained by all schools.The highest score in pre-test, that is, 75 is achieved by the students of State Senior Secondary School 3 of Ciamis whereas the highest average score in pre-test, that is, 51 is obtained by the students of State Senior Secondary School of Baregbeg, Ciamis. In addition, the the lowest score in post-test, that is, 69 is attempted by State Senior Secondary School 3 of Ciamis whereas the highest score in post-test, that is, 100 is gained by all of the schools. The highest average score ,that is, 94 is achieved by the students of State Senior Secondary School 1 of Ciamis and those of State Senior Secondary 2 of Ciamis.

The result of pre-test and post-test in the field test shows that the average score of post-test is better than that of pre-test of all the students of the sforementioned schools as displayed in Table 1.

7.1.2 The difference of pre-test and post-test in the field test in each school of the experimental group

In order to know how far the learning model experimented in each school can improve the learning achievement of the students, the data of the pre-test and post-test scores were analyzed by using the t test. Table 2 shows the result of t-test on the pre-test and post-test scores of the students of State Senior Secondary School 1 of Ciamis, State Senior Secondary School 2 of Ciamis, State Senior Secondary School 1 of Ciamis, and State Senior Secondary School of Baregbeg, Ciamis.

Table 2: The result of t-test on the pre-test and post-test scores of the experimental group

No.	The Schools of Experimental Group	The result of t-test on the pre-test and post-test scores	
		t- value	P
1.	State Senior Secondary School 1 of Ciamis	-23.081	0.000
2.	State Senior Secondary School 2 of Ciamis	-25.770	0.000
3.	State Senior Secondary School 3 of Ciamis	-12.716	0.000
4.	State Senior Secondary School 1 of Baregbeg, Ciamis	-29.183	0.000

Table 3 shows statistically the value of t test on the pre-test and post-test at State Senior Secondary School 1 of Ciamis is -23.081 ($p=0.000$); the value of t test on the pre-test and post-test at State Senior Secondary School 2 of Ciamis is -25.770 ($p=0.000$); the value of t-test on the pre-test and post-test at State Senior Secondary School 3 of Ciamis is -12.716 ($p=0.000$), and the value of t-test on the pre-test and post-test at State Senior Secondary School of Baregbeg, Ciamis is -29.183 ($p=0.000$). Based on the results of the data analysis, a conclusion can be drawn that there is a significant difference between the pre-test score and the post-test score of the learners of the experimental group ($p<0.05$). Therefore, the use of the Physics learning model at Senior Secondary School with the POE2WE learning model is proven to be effective and to influence the improvement of ability of the students

in Grade X of State Senior Secondary School 1 of Ciamis, State Senior Secondary School 2 of Ciamis, State Senior Secondary School 3 of Ciamis, and State Senior Secondary School of Baregbeg, Ciamis.

7.1.3 The score of t-test on the pre-test and post-test in each experimental group toward the control group.

Based on Table , the analysis of the results of t-test on the pre-test and post-test between the experimental group and the control group in each school shows the following: (1) the value of t-test on the pre-test of the students of State Senior Secondary School 1 of Ciamis and State Senior Secondary School of Cisaga is 1.159 (p = 0.251); (2) the value of t-test on the pres-test of the students of State Senior Secondary School 2 of Ciamis and State Senior Secondary School of Cisaga is 2.235 (p= 0.029); (3) the value of t-test on the pre-test of State Senior Secondary School 3 of Ciamis and State Senior Secondary School of Cisaga is 1.310 (p= 0.195); and (4) the value of t-test on the pre-test of the students of State Senior Secondary School of Baregbeg is 3.771 (p= 0.000).

Table 3
The result of pre-test and post-test of the experimental group and control group

The Schools of the Experimental Group	Pre-test		Post-test	
	t-value	P	t-value	p
Each school of the experimental group toward control group	1.159	0.251	12.159	0.000
	2.235	0.029	13.943	0.000
	1.310	0.195	5.289	0.000
	3.771	0.000	10.925	0.000
The experimental group integrated to control group	2.448	0.016	11.108	0.000

Table 3 above shows that there is not a significant difference in the result of pre-test between the students of the experimental group and those of the control group (p>0.05), meaning that the students of both the experimental group and the control group have the same level of initial ability. The results of the t-test on the final test of each school of the experimental group and the control group are as follows: (1) the value of t-test on the post-test of the students of State Senior Secondary School 1 of Ciamis and State Senior Secondary School of Cisaga is 12.159 (p= 0.000); (2) the value of t-test on the post-test of the students of State Senior Secondary School 2 of Ciamis and State Senior Secondary School of Cisaga is 13.943 (p= 0.000); (3) the value of t-test on the post-test of the students of State Senior Secondary School 3 of Ciamis and State Senior Secondary School of Cisaga is 5.289 (p= 0.000); and (4) the value of t-test on the post-test of the students of State Senior Secondary School 1 of Baregbeg, Ciamis and State Senior Secondary School of Cisaga is10.925 (p= 0.000).

Based on the result of the t-test on Table 3, a conclusion can be drawn there is not any difference of the result of post-test between the students of the environmental group and those of the control group (p>0.05). Thus, there is a significant difference between the use of the Physics learning model with the POE2WE learning model and that of the Physics learning model with the teacher-centered learning Model. The developed learning model is effectively used to improve the learning achievement in the Physics subject matter of the students of State Senior Secondary School 1 of Ciamis, State Senior Secondary School 2 of Ciamis, State Senior Secondary School 3 of Ciamis, and State Senior Secondary School of Baregbeg, Ciamis.

7.1.4 The score of t test in the pre-test and post-test of the experimental group and the control group integratedly

Table 3 displays the result of t test in the pre-test and post-test of the experimental group and the control group integratedly. The experimental group of the research include four schools namely: State Senior Secondary School 1 of Ciamis, State Senior Secondary School 2 of Ciamis, State Senior Secondary School 3 of Ciamis, and State Senior Secondary School of Baregbeg, whereas the control group is State Senior Secondary School of Cisaga, Ciamis.

The result of the t test in the Physics pre-test between the the experimental group and the control group integratedly shows that the value of t-test is -0.864 (p= 0.389), meaning that there is not any significant difference of initial ability in Physics between the experimental group and the control group in the pre-test on the Physics ability (p>0.05). Thus, there is not any significant difference of ability in Physics of the students in Grade X in Semester I between the group instructed with the learning model with the constructivist approach and the group instructed with the teacher-centered learning model. From the result of the analysis, a conclusion can be drawn that the learners either in the experimental group or in the control group have the same initial ability.

The result of the t test in the post-test between the experimental group and the control group integratedly shows that the value of t test is 2.448 (p= 0.016). Therefore, it can be concluded that based on the result of the post test, there is a significant difference in the Physics ability between the students of the experimental group and those of the control group ($p<0.05$), meaning that there is a significant difference of the result of the post-test between the students instructed with the POE2WE learning model and those instructed with the conventional learning model. Therefore, it can be concluded that the Physics learning model with the POE2WE learning model is effective to be used to improve the learning achievement in Physics subject matter of the students of Senior Secondary School.

8. Conclusion

Based on the results of the research, some conclusions are drawn as follows: 1) The development of Physics learning model at Senior Secondary School with the *POE2WE* learning model is done with the R2D2 development model which is done through four focused phases, namely: (a) defining, (b) designing, (c) developing, and (d) disseminating. 2) The results of tests on the learning model and learning instrument components show that the development product is feasible to be used according to the judgments of the following experts of learning design: (a) the subject matter experts conclude that the learning material and the student work sheet of this development product are feasible to be used or applied in the Physics learning of the students in Grade X in Semester 1 of Senior Secondary School; (b) the Physics teachers asses that the learning material and the student work sheet of the development product are feasible to be used; and (c) the subjects of group test value that the learning material components are very good and interesting to be learned. 3) Quantitatively, in the use of the Physics learning model to the students in Grade X in Semester I of Senior Secondary Schools in Ciamis regency, there is a significant difference based on the statistical tests of the initial t-test and the final t-test. ($p< 0.0000$). The response of the students to the learning process is positive as indicated by the results of the analysis that 63.34% of the learners have very positive attitudes and the rest 36.67% have positive attitudes toward the learning process. In addition, 50.83% of the students have very positive attitudes and the rest 49.17% have positive attitudes toward the Physics learning material. Finally, 72.50% of the students have very positive attitudes and the rest 27.50% have positive attitudes toward the teacher.

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