Effect size test of 7e learning cycle model: conceptual understanding and science process skills on senior high school students

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Abstract. This study aims to determine the effectiveness of the 7E Learning Cycle Model of conceptual understanding and science process skills students. The research method used a quasi-experiment with a non-equivalent control group design. The population in this study were students of class XI IPA Senior High School 9 Bandar Lampung. From the analysis of the hypothesis test showed that t-count obtained a result of 4.838 while t-table of 2.002 according to the provisions if the value of t-count> t-table then H₀ was rejected and H₁ was accepted. Based on these provisions, it means that there is an effect of the use of the Learning Cycle Type 7E model on the ability of students to understand the concepts. Analysis of science process skills shows that t-count is 2.074 while t-table is 2.002 and according to existing criteria, if the value of t-count>t-table then H₀ is rejected and H₁ is accepted, and its effectiveness is known by the effect test of the size which is getting a d value of 1.53 with a high category. The conclusion is the application of the 7E Learning Cycle Model is effective in improving conceptual understanding and science process skills.

1. Introduction

The information and communication technology is developing rapidly. One of the fields that are impacted significantly is the field of education [1]. Education that has quality will produce quality human resources that will be able to overcome life challenges and be proactive in helping to change the situation [2]. Reliable and competent power is expected to be able to utilize natural resources that are indeed abundant in Indonesia so that no more assistance is needed in processing Indonesia's wealth [3].

Industry 4.0 stimulates the advancement of science and technology [4]. Science education emphasizes providing direct experience to develop competencies so that students can develop and understand the natural environment scientifically [5]. The principle of learning science is discussing existing facts, conducting experiments to test hypotheses, and developing analytical skills [6]. In the learning process or the delivery of the material, the teacher can use various methods, learning methods, or learning models [7]. The main role of the teacher is completion, management, completion, and continuously. planned learning. And the teacher must be able to create pleasant and challenging conditions, with values, ethics, aesthetics, logic, and kinesthetic [8].

The level of success of teaching and learning is influenced by several prayer factors. The only model is learning that is used by teachers in teaching and learning activities [9]. Learning needed is
learning that not only repeats ideas but also learning that can facilitate students' ideas [10]. Then educators must also have learning strategies so that the learning process can run effectively. The function of the learning model is to create fun learning and not fulfill the requirements to spur students to think creatively.

Teacher competency about how he can guide and create the learning process to achieve the competencies to be achieved. Physics is the most basic science, as the basis of the basic principles of the universe. Physics is a science that is the basis for other sciences such as Astronomy, Biology, Chemistry, and Geology [11]. Learning physics to equip students using a series of theories and theoretical concepts [12].

Achieving a better understanding of the concept of physics, in terms of Scientific attitudes, requires a Model of Learning that seeks to instill[13]. Learning physics is not only supported by the knowledge of facts, memorization of formulas, but it needs to be complemented by understanding the correct concepts. To improve understanding of mathematical concepts students need to use interesting learning strategies or models [14]. Science process skills are important in teaching ways of reaching knowledge. The students need the process skills both when doing scientific investigations and during their learning process [15]. Science process skills as identifying a problem, formulating a hypothesis about the problem, making valid predictions, identifying and defining variables, designing an experiment to test the hypotheses, gathering and analyzing data and presenting rational findings that support the data [16]. Science process skills are known as procedural skills, experimental and investigating science habits of mind or scientific inquiry abilities [17].

The purpose of science education is to enable individuals to use scientific process skills; in other words, to be able to define the problems around them, to observe, to analyze, to hypothesize, to experiment, to conclude, to generalize, and to apply the information they have with the necessary skills [18]. The 7-E cycle learning model is a constructivist based learning model that pays attention to students' preconceptions as a background for new information [19]. The constructivist theory has the view that knowledge is constructed by the self by the student in his mind. Such knowledge is built by a person as a form of adaptation to the experience he gained from the environment [20].

Models type 7E Learning Cycle that change students' mindsets through investigations with material developed, build concepts, and apply or develop concepts in other conditions [6]. 7-E models that help transfer learning from what was previously known - sometimes the learning model must be changed to maintain value after new information, new insights and new knowledge are compiled [21]. Learning activities are more student-centered. By continuing exciting learning makes students more comfortable when the lesson takes place making students not feel bored and tense to receive learning [22]. It is hoped with models type 7E Learning cycle will motivate students to be even more enthusiastic in learning Physics, and they can improve their the conceptual understanding and science process skills

2. Research Method
The research method used quasi-experimental with nonequivalent control group design because this research using a pretest-posttest control group. This research was conducted at Senior High School 9 Bandar Lampung. The population was 245 congregations, with samples of class XI IPA 2 as Experiment class and XI IPA 1 class as a control class.

The sampling technique was done by purposive sampling assuming that members consider homogeneous. The instrument of this study used a plural choice test of 15 questions and an observation sheet to determine the understanding of concepts and science process skills. Before the question and observation sheet are used for research on understanding first in testing the validity, reliability, power difference, and level of difficulty. Analysis of data using Ms. Excel 2016 and SPSS 17 to answer normality, homogeneity, and hypothesis.

Learning using the 7E Learning Cycle Type on understanding the concepts and science process skills of students, then analyzing the data in this study using statistics by testing the value of the pretest and post-test and collecting observations. The test carried out consisted of tests of normality,
homogeneity, and statistical tests, the next data which can be used for hypothesis testing using Effect Size.

3. Result and Discussion

3.1. Description of Concept Understanding Data

Understanding Concept Tests is carried out at the beginning and last meeting of the learning process. The data is presented in table form.

| Class      | Average Pretest | Average Posttest |
|------------|-----------------|------------------|
| Control    | 35.6            | 80.4             |
| Experiment | 37.3            | 89.6             |

According to the table above actually shows that the value of pretest and posttest control more low more than experimental classes. To analyze the score, student learning outcomes using normalized scores, N-Gain is obtained from verification of the posttest score with the score pretest divided by the maximum score minus the score pretest. The results of the calculation N-Gain will be used to test the effect size.

| Class      | N-Gain | Category |
|------------|--------|----------|
| Control    | 0.69   | Medium   |
| Experiment | 0.83   | High     |

3.2. Description of Science Process Skills Data

Observations are made by making direct observations of the preparation of ongoing learning and experimental activities. Observations are carried out to study whether or not the indicators of the science learning process have been realized when the learning is running. The observation data sheet is as follows.

| Class      | Meeting 1 (%) | Meeting 2 (%) | Average | Category |
|------------|--------------|---------------|---------|----------|
| Control    | 67.83        | 70.58         | 69.21   | Good     |
| Experiment | 69.25        | 81.75         | 75.50   | Good     |

3.3. Analysis of Prerequisite Testing

The testing of prerequisites is carried out for the data obtained to be normally distributed and homogeneous.

3.3.1. Normality Test

Tests used to study normally distributed data or not in this study, namely using Kolmogorov-Smirnov, show normally distributed data. Based on the results of the posttest normality test with a significant level of 0.05. If $L_{\text{calculate}} < L_{\text{table}}$ then the data is normally distributed.
Table 4. Normality Test Results Post-test Pre-test Experiment Class And Control Class

| Data   | Experiment |        | Control |        |
|--------|------------|--------|---------|--------|
|        | Postest    | Pretest| Postest | Pretest|
| Total (N) | 35        | 35     | 34      | 34     |
| $\alpha$  | 0,05      | 0,05   | 0,05    | 0,05   |
| Sig      | 0,089     | 0,254  | 0,164   | 0,105  |
| Conclusion | Normal  | Normal | Normal  | Normal |

Table 5. Normality Test Results of Science Process Skills

| Data   | Science Process Skills |
|--------|------------------------|
| Total (N) | Experiment | Control |
|         | 10          | 10      |
| $\alpha$ | 0,05        | 0,05    |
| Sig     | 0,119       | 0,692   |
| Conclusion | Normal  | Normal |

3.3.2. Homogeneity test
The homogeneity test is done as a second prerequisite in determining the hypothesis test to be used. The results of the posttest homogeneity of the control class and experimental class used the Homogeneity of Variances test. It can be denied that $H_0$ is accepted by $F_{count}>F_{table}$ which means it should have the same variant. After knowing the data from the same population.

Table 6. Homogeneity Test Results

| Data   | Statistical |
|--------|-------------|
|        | Homogeneity Test of Variances (Sig $>$ 0,05) |
|        | Pretest    | Posttest |
| Experiment |             |          |
| Control   | 0,150      | 0,110    |
| Conclusion | Homogeneous Variance |
3.3.3. The Result of Hypothesis Testing

Hypothesis Testing using t-Test on the Application of Ms. Excel 2016.

| Class     | t-table | t-count | Conclusion     |
|-----------|---------|---------|----------------|
| Control   | 2.002   | 4.838   | There is Effect|
| Experiment|         |         |                |

| Class     | t-table | t-count | Conclusion     |
|-----------|---------|---------|----------------|
| Control   | 2.002   | 2.074   | There is Effect|
| Experiment|         |         |                |

From the table above estimated as a result of the hypothesis test shows the value of $T_{count}$ is greater than the value of $T_{table}$. Accepting the hypothesis $H_0$ accepted. Thus, it can be understood that there are differences between concepts and skills between experimental classes who learn to use a 7E Learning Cycle with a control class that learns using the model Discovery Learning.

3.4. The Result of Test Effect Size

From the testing, it obtained by the value of the effect size that is 1.53 which is included in the high category ($d = 1.53 > 0.8$). Thus it can be concluded that is learning model is the Type 7E Learning Cycle effective in increasing concept understanding. Using the 7E Type Learning Cycle learning model is proven to make students have a good understanding of concepts and science process skills. This can be seen from the average value of the experimental class and the control class.

By going through several phases in the research process, to find out how much improvement and influence of the 7E Type Learning Cycle learning model in the experimental class and the control class can be seen from the results of the hypothesis test that obtained $T_{count}$ results of 4.838 and $T_{table}$ of 2.002, thus the hypothesis was accepted and with using the effect size test shows the results $d = (0.687 < 0.8)$ of these results it can be said that the 7E Type Learning Cycle learning model influences the ability of the science process and students' understanding of the concept of the material.

The 7E Type Learning Cycle learning model, in addition to improving the understanding of concepts and the ability of the science process, can also attract student learning interest. This is important in the learning process due to the success of the 7E Type Learning Cycle learning model in improving students' cognitive values.

4. Conclusion

Learning Cycle type 7E against conceptual understanding and science process skills has increased. This is evidenced by the average value of posttest learners experiment class higher than a grade from the control class and the results of observations using the observation sheet show the science process skills of students are increasing. The results of the test N-Gain show the difference between the scores pretest and post-test in both the experimental class and the control class.

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