Improvement of High Order Thinking Skill of Physics Student To Prepare Human Resources In Order To Faced of Global Competition In ASEAN Economic Community

A. Halim1*, Ngadimin1, Soewarno1, Sabaruddin2, and Susanna1

1Department of Physics Education, Training Teacher and Education Faculty, Syiah Kuala University, Aceh-Indonesia.
2Department of Physics Education, Training Teacher and Tarbiyah Faculty, National University of Islamic, Ar-Raniry, Aceh-Indonesia.

*E-mail: abdul.halim@unsyiah.ac.id

Abstract. One of effort to produce graduates of Secondary Education who have critical, creative and innovative thinking skills, as the main capital to face the global competition in the ASEAN Economic Community, through this research will be applied method of Problem Solving (PS) as one of method to improve the student’s High Order Thinking Skills (HOTS). Research using quasi-experimental method, the pretest-posttest control group design and the research sample used as many as 91 students of class XI (control and experiment groups) at Madrasah Aliyah (MAN) School Rukoh Darussalam. Data analysis using descriptive statistics to calculate the N-Gain normalized. The results of data analysis showed that after treatment there was an increase of high order thinking skills, both for classroom experiments (N-Gain = 0.84) or the control group (N-Gain = 0.71). That is, because the learning process is based on the method of Problem Solving (PS) in the experimental group more related to indicators of HOTS. For example the indicator of analysis (C4) is particularly relevant to the first step in the method of PS. During learning activities, which is based on the PS method, students are trained to analyze the problems and also to recall these problems by using their own language. Inferensial of the results of the study are expected to teachers of science and non-science to select and apply methods or models of learning that can improve the human resources, so they have ability to face the global competition in ASEAN economic community.

1. Introduction
Peoples who live in countries in Southeast Asia to form a regional organization or association, known as ASEAN (Association of South East Asian Nations) in 1961, called the declaration Bangkok on August 8, 1967 [1]. At first organization consisting of five countries (Malaysia, Indonesia, Thailand, Singapore, and the Philippines) activities focused on issues of security and peace in Southeast Asia, but in 1997 the issue of developing into economic sectors and social life. The next strategic steps undertaken by the association of the countries in Southeast Asia are forming the ASEAN Community in 2015 [2,3,4].

The first pillar of the ASEAN Economic Community in 2015 aims to establish a system of free and open economy, mainly related to the flow of goods, services, investment, skilled labor and capital flows in 2015. While the second pillar of the ASEAN Security Community aims to maintain security and
prevent; the growth of terrorism, drug trafficking, human trafficking (trafficking), arms trade, and poaching (illegal fishing) [5,6]. The third pillar is the ASEAN Socio-Cultural Community activities had been drafted roadmap ASEAN Socio-cultural Community, made up of six work program that should be realized by all ASEAN countries, namely; human resources development, welfare and protection of the public, justice and righteousness in society, ensure environmental sustainability, restricting the development of GAP and building the ASEAN identity [2,4,7,8,9].

To realize the ASEAN Socio-Cultural Community in 2015 was good, need to be supported by one of the human resource development is good and this is one aspect of education that supports the success of the ASEAN Community by 2015. Recognizing the importance of these aspects to be developed, then in 1995, has been formed higher education network in Southeast Asia, known as ASEAN University Network (AUN) [10,11,12]. The implications of roadmap ASEAN Socio-cultural Community on the implementation of the education system in the Study of Higher Education, especially the implementation of the system of learning in any field of science is necessary to design a model of learning that can improve thinking skills, critical, creative, and innovative in every alumnus [2,11,12,13,14].

The ability of thinking is always evolving and can be studied, because of the higher order thinking skill is one of the stages of thinking that can not be separated from everyday life. The higher order thinking skill is the ability to connect, manipulate and transform knowledge and experience that is already owned to think critically and creatively in an effort to determine the decision, and solve problems in new situations [15,16]. This result is expected to be a valuable contribution to develop teaching methods that are capable of producing human resources as problem solvers not the problem maker [10,11,16,17].

The world of education is looking for an effective way of learning physics, especially in learning one of the steps that are effective in teaching physics is to realize higher-order thinking skills to students. One of the goals of the subject of physics is to develop the experience to be able to formulate the problem, propose and test hypotheses through experiments, designing and assembling experiment instrument, collecting, processing, and interpreting experimental data and publishing the results orally and in writing [18]. Component of the world is the shifting from traditional dominant teaching for low-level cognitive skills, leading to a high level of cognitive or thinking skills [11].

According to Costa [19] the basic thinking skills include qualifications, classification, relationship variables, transformation, and the causual relationship, whereas complex thinking skill includes problem solving, decision making, critical thinking and creative thinking. According Soemarmo in Izzati [20], creative thinking and problem solving include the type of higher order thinking. Gegne in Ida [21] said points out the problem solving activities in the learning process can train thinking skills, because this learning process allows generating a new way of solving problems. Problem solving is a fundamental part of learning physics, solving the problem is how to obtain a better knowledge and more quickly, the students learn how to correctly apply the knowledge that they have gained and it helps them to see in a more detail when they solve problems. Model of problem solving can take place when a person exposed to an issue in which there are a number of possible answers. Efforts to find a possible answer is a problem solving process. The process itself, can take place through a discussion, or a discovery through data collection, either obtained from experiments or the data from the field.

Bloom's Taxonomy is considered to be the basic for higher order thinking and these thoughts are based on that some kind of learning requires cognitive processes which is more than others, but it has more general benefits. In Bloom's Taxonomy as an example, the ability to involve the analysis, evaluation and creating are considered a higher order thinking Pohl in Lewy et.al [22].

Ideas of Stein and Tory Lane quoted by Tory Thomson in Lewy et.al [22] define higher order thinking is the use of complex, non-algorithmic thinking to solve a task in the which there is not a predictable, well-ehearsed approach or pathway explicitly suggested by the task, the task instruction, or a worked out example. The problem solving model that researchers used in this study is problem solving according to Polya. Goerge Polya reveals problem solving that is in order to determine a way out of a difficult and full of obstacles to reach the goal [14,23].
The understanding the physics of matter requires thinking and reasoning in order to solve the problem of physics. The mastery of science (physics) materials is required basic thinking skills [24] and also complex (high) thinking skills, including critical thinking [14,19]. Improving the quality of the learning process through learning model of problem solving is expected to increase interaction, attitudes and thinking skills, and cognitive processes. Therefore, the learning model that is implemented is problem-solving learning model. The purpose of this study was to determine skills higher order thinking, based on the background of the problem. The research problems is how is students’ higher order thinking in static fluid material after getting the learning model of problem solving?

2. Research Method
This study used a quasi-experimental methods involving two classes of experimental classes and control classes. Quasi-experimental method was chosen because researchers could not create a new group of participants selected at random as a pure experimental whose group is consisted of randomly selected participants. Experimental design used in this research is the design of a pretest-posttest control group design [25]. The study design is described as follows:

| Class   | Name | Pre-test | Treatments | Post-test |
|---------|------|----------|------------|-----------|
| Experiment | A    | O1       | X1         | O3        |
| Control  | B    | O2       | X2         | O4        |

The test that is developed to measure students higher order thinking skills is in the form of essays and students' mastery of the concepts of physics-based is static fluid material multiple choice. Then the researcher implemented learning using learning strategies in problem solving Polya model in experimental class, and conventional learning strategies in the control class. After the study was completed, a final test was to identify an increase in higher order thinking skills.

After researchers processed the data collection, the next step was the analysis of data. The data that was analyzed was the quantitative data of test resulted of higher order thinking skills of students. The data was analyzed with a customized the research problem that has been formulated. Data analysis was performed with the help of Microsoft office excel.

This research was conducted in MAN Rukoh Banda Aceh. While the subject of this research is a class XI student of 91 students, which is spread on three parallel classes. From this population, drawn randomly class XI-IA3 which would serve as an experimental class and class XI-IA2 as the control class. Technique sampling was conducted by using purposive sampling that is sampling based on certain considerations or specific purposes [26]. Samples were selected based on the results of interviews and recommendations from teachers who taught in the schools based on students with cooperative characteristics in accepting learning using the new method.

3. Result and Discussion
Analyzed data in this research is score N-gain (normalized gain) which is gained from pre-test score and post-test score in control and experiment class. Score N-Gain data which is used for analyzing the improvement of higher order thinking skill, experiment and control class.

| Table 2. Pretest Result, Post-test and N-Gain of Higher Order Thinking Skill (HOTS) in Experiment Class and Control Class |
|---------------------------------------------------------------------------------------------------------------------|
| Ideal score (100)                                                                                                   |
| Variables | Pre test | Post test | N-gain | Pre test | Post test | N-gain |
| Experiment class |                                                  |
| Control class |                                                  |
The result of the research about pre student higher order thinking skill is shown with score analysis of student higher order thinking skill pre-test score. Pre-test in this research is conducted to assess pre higher order thinking skill of the student. Pre-test is conducted in both classes, experiment class which is taught by using problem solving model and control class which is taught by using conventional learning model. Data pre-test, post-test and $N$-gain entirely is shown in table 2.

Table 2 shows entirely mean and standard deviation score of pre-test, post-test, and gain which is normalized higher order thinking skill in experiment and control class entirely. The tabulation data result of higher order thinking skill of student in experiment and control class, the more obvious improvement in each indicator of students’ higher order thinking skill on fluid statics material are shown in figure 1.

| Indicator | $\mu$ | $\sigma$ |
|-----------|-------|---------|
| Analyzing (C4) | 35.19 | 6.08 |
| Evaluating (C5) | 89.04 | 5.83 |
| Creating (C6) | 0.84 | 0.08 |
| N-Gain | 38.70 | 5.65 |
| | 82.04 | 6.39 |
| | 0.71 | 0.09 |

Figure 1 shows student’s higher order thinking skill in experiment class is higher in each indicator than control class. Students’ higher order thinking skill in analyzing indicator is in high category with 0.85. It is because analyzing indicator is easier for student to understand than evaluating and creating indicator in physics subject. It is in accordance with the learning principal which requires student to build their self-concept from the material they have learned. The using of Polya problem solving model enables students train themselves to think about the existence around them with demonstration help, as the result, it improves students’ high level thinking skill on static fluid material.

Pre-test, post-test and gain score data of experiment and control class are identified come from homogeneous variants, it is continued by testing post-test average difference by using dependent t-test. The average difference test is conducted to measure whether students’ higher order thinking skill who use Polya problem solving model is better than when use conventional approach on static fluid material. Later on, research hypothesis is tested. Tested hypothesis are:

3.1. Hypothesis
Hypothesis ($H_0$): There is no significant difference of improvement students’ higher order thinking skill on static fluid between class which uses Polya problem solving model and class which uses conventional learning model.
Hypothesis (H₀): There is significant difference of improvement students’ higher order thinking skill on static fluid between class which uses problem solving model and class which uses conventional learning model.

After the score of t_count is gained, the next step is t_count is compared with t_table with sample n₁ ≠ n₂, and homogeneous variant (σ₁² = σ₂²), so it can be used the formula t-test pooled variant, with degree of freedom is (d_k) = n₁ + n₂ – 2. Testing criteria for accepting and rejecting hypothesis as followed:

- Rejecting H₀, and Accepting H₁, if : t_count > t_table
- Accepting H₀ and Rejecting H₁, if : t_count ≤ t_table

With significance level α = 0.05.

Result of average difference test Gain-normalized students’ higher order thinking skill can be read on the calculation summary which is shown on table 3.

Table 3. Average difference test N-gain of students’ higher order thinking skill on static fluid material in control and experiment class.

| Data source | t_table (0.05) | t_count | df | Decision |
|-------------|---------------|---------|----|---------|
| N-Gain      | 2.01          | 5.32    | 51 | accepting H₁ |

Table 3 shows that score t_count (5.32) and score t_table in df = 51 with degree of confidence is 95% gained about 2.01. It shows that t_count > t_table. The conclusion shows that there is significant difference of improvement students’ higher order thinking skill on fluid statics material between class which uses Polya problem solving model and class which uses conventional learning model.

According to description of research result above, students who learn by using Polya problem solving model significantly be able to improve thinking skill than students who learn by using conventional learning model. This review is based on the result of t-test which is gained t_count > t_table (5.32 > 2.01) with confidence level is 95%, that means research result is significant. it means there is significant difference of student cognition skill on static fluid between group who learns by using Polya problem solving model and group who learns by using conventional learning model in student grade XI MAN 3 Banda Aceh.

Polya problem solving model can be used to stimulate high level thinking skill in situation which has problem oriented. In this learning model, teacher has role to provide the problem, ask the question, and facilitate the investigation and dialogue. This model cannot be implemented without teacher’s role in developing class to be opened in exchanging ideas [27]. In addition, problem solving learning is conducted by enabling teacher to provide the authentic problem and meaningful for student. This learning requires student to investigate authentically to figure out the real solution. They have to analyze and define the problem, develop hypothesis, predict, collect and analyze the information, if it is needed, they have to conduct experiment, as well as make inference.

According to explanation above, it can be concluded that problem solving learning model significantly may improve students’ higher order thinking skill. This result study is supported by [28] who add that problem solving by using real problem can be the context for the student to think critically. In addition [16,29,30] supports that learning which requires student to be active is the important requirement in growing up the thinking skill as well as independent life. The improvement of students’ higher order thinking skill can occur because in problem solving model, student is not only taught to be able to solve the physics problem cognitive type, but also solve mathematics problems.

According to description of study result data, student group who learns by using problem solving learning model significantly can improve student’s mastery of concept than the student who learns by using conventional learning model. This review is based on the result of t-test which is gained t_count > t_table (2.92 > 2.01) with confidence level is 95%, so that, study result is significant. it means there is significant difference about student’s mastery of concept on static fluid material between student who
learns by using problem solving model and student who learns by using conventional learning model in student grade XI MAN 3 Banda Aceh. The result of study is supported by [14,16,31]. According to result of the study, it can be known that learning program by using problem solving model can improve mastery of concept and problem solving skill.

Theoretically, problem solving learning model can improve students’ mastery of concept, because it requires student to understand the problem which is formed matrix in daily life. Problem solving model also can help student in solving the problem systematically, and improve students’ creativity, especially in problem solving. It requires much time to solve mathematics problem. This model is very good as cognitivism which encourages stimulus response relationship in teacher and student. According to constructivism theory, knowledge is not the collection fact of the reality which is learned, but, knowledge is the individual cognitive construction toward object, experience, as well as environment. Therefore, in learning, it must be created the environment which presents and stimulates brains development of student [32,33,34]. So, problem solving model is suitable with constructivism theory which involves the role of student to construct their own knowledge with improving learning result.

The implementation of problem solving model in the class still has the shortcoming, those are, some topic are difficult to be implemented because of inadequate of laboratory instrument, it makes student difficult to see, observe and conclude the concept. In addition, it needs longer time than any other learning approach, as the last, it is also makes student bored with matrix application is formed as the daily problem which is hard to be solved.

4. Conclusion
According to result of study, the average of N-gain for students’ higher order thinking skill is gained 0.84 in experiment class, and 0.71 in control class. The result of analysis showed that t-test for students’ higher order thinking skill shows \( t_{\text{count}} (5.32) > t_{\text{table}} (2.01) \), it can be concluded that there is significant difference of students’ higher order cognition skill on static fluid material between class who learns by using problem solving model and the class who learns by using conventional learning model.

To face global competition in the ASEAN economic community require higher-level thinking skills for all fields of science. Therefore, based on the results of this study suggested similar studies can proceed to other fields. So that the people of Indonesia to compete with other countries in the ASEAN region.

Acknowledgment
To all those who have contributed to this research activity, we thank you. Especially to the manager of the postgraduate study program of science education that has helped facilitate the implementation of this research.

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