Wave energy concept mastery relate on creative thinking skills of the pre-service physics teachers in environmental physics lectures

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Abstract. This research is a survey that aims to wave energy concept mastery relate on creative thinking skills of Pre-Service Physics Teachers in a university in Bima Town-West Nusa Tenggara. This survey involved 23 of seventh semester Physics education students who have taken the Environmental Physics Lectures. Data collected through an instrument in essay form that integrated with indicators of creative thinking skills. Data analysis was done by using descriptive quantitative analysis techniques and ANOVA test using SPSS 20. Based on the results of data analysis, it was concluded the mastery of wave energy concept of Pre-Service Physics Teachers was still low, where the average value was 44.78. Besides that, 78% of Pre-Service Physics Teachers’ creative thinking skills can be categorized on low categorized. In addition, based on the ANOVA test there was a difference the mastery of wave energy concept in Pre-Service Physics Teachers who have low and middle category of creative thinking skills. The map of wave energy concept mastery and levels of creative thinking skills will be used as references in developing environmental physics lectures about wave energy and creative thinking skills for Pre-Service Physics Teachers.

1. Introduction

The world's demand for electrical energy sources in the last 10 years is increasing at a rate of nearly 25% per year [1]. This increase is driven by rising demand for electrical energy, willingness to use clean technology, fossil fuel prices, transmission line costs and rising costs to boost energy supply guarantees [2, 3]. Wave energy offers an environmentally friendly renewable energy source and has been a major concern in many researches in recent years [4, 5].

Currently, the availability of energy sources in Indonesia is unable to fulfill the increasing demand for electricity [6, 7]. The occurrence of temporary termination and the sharing of electrical energy in rotation is the impact of the limited electrical energy that can be supplied by PLN. It caused the rate of increase of new energy sources and the procurement of power plants is not proportional to the increase in electricity consumption [8, 9]. Therefore, for the long term need to be introduced and taught the concept of wave energy and promote research and development in the field about wave energy to the younger generation so
as to provide early understanding on the young generation of wave energy and other renewable energy. The goal is to prepare a knowledgeable and responsible workforce that can contribute to the advancement of science and technology about renewable energy [4, 10].

Environmental Physics is one of the lectures that can bridge the delivery of the wave energy concept to pre-service teachers. Through the environmental physics lectures certainly provides a broad opportunity for students to explore all matters relating to the influence and utilization of the environment in the field of physics. One of things can be explored is the utilization of marine environment as a source of energy especially about wave energy. To master the wave energy concept, students must be understood about fundamental physics materials are like mechanic fluid, energy conversion and electricity [11]. In addition to providing an understanding of the concept to the students, of course it is also necessary to be trained thinking skills, in order pre-service teachers continue to develop their a sense of curiosity [12].

In process of physics learning occur the process of thinking, one way that students can do when faced with a problem in physics learning is to think creatively. Creative thinking is very important for students to help solve the problems often encountered in the learning process [13, 14, 15]. Therefore, the ability to think creatively is needed by students in learning related to the physics materials, because by thinking creative students will develop a sense of curiosity and sensitivity in digging and seeking information about problems encountered in the learning process [3]. The sensitivity of creative thinking can be measured by indicators that have been determined by experts, one of which according to Guilford [16] who mentions five indicators of creative thinking, namely: (1) problem sensitivity that is the ability to detect, recognize and understand and responds to a statement, situation or problems; (2) fluency is the ability to generate many ideas; (3) flexibility is the ability to propose a variety of solutions or approaches to problems; (4) originality is the ability to spark the gags in the original, non-cliches, and rarely given by most people; and (5) elaboration is the ability to add a situation or problem so that it becomes complete, and elaborate in detail, in which there are tables, graphs, drawings, models and words.

2. Methods
This research is a survey that aims to describe wave energy concept mastery relate to creative thinking skills of pre-service physics teachers in a university in Bima Town-West Nusa Tenggara. This survey involved 23 students of seventh semester Physics education pre-service physics teachers who have taken the Environmental Physics Lecture. Data collected through the instrument in essay form that integrated with indicators to measure creative thinking skills. Data analysis was done by using descriptive quantitative analysis techniques and anova test using SPSS 20 to find differences of wave energy concept mastery on level of creative thinking skills of pre-service physics teachers.

3. Results and discussion
Based on the data was obtained from the measurement of concept mastery and levels of creative thinking skills (Guilford framework) of pre-service physics teachers using essay test on the wave energy concept and then analyzed through descriptive statistic shown that the mastery of the wave energy concept and creative thinking skills of pre-service physics teachers were still in the low category, as shown by figure 1 and figure 1.
Based on figure 1, it can be seen that the levels of mastery of wave energy concept in pre-service physics teachers was still low, where the average value in low of creative thinking skills group was 42.95 and middle group was 57.00 but average value classically was 44.78. It is caused by lecturers only explain the concept of wave energy generally and then given the task to pre-service physics teachers to make papers then collected and not to be discussed or presented. Whereas the concept of wave energy is an abstract concept so that in learning the concept was required a good way like animation media, demonstration or experiment that can help students to master the concept of wave energy [17,18].

While based on figure 2, it can be seen that as many as 78% of the 23 pre-service physics teachers who have low creative thinking skills in fluency and elaboration indicators. It was only 22% of students who have creative thinking skills with middle category and none have high creative thinking skills. The numbers of pre-service physics teachers who have low creative thinking skills on the fluency indicators were caused by
the lack of understanding of the basic concept of wave energy owned by the pre-service physics teachers so that they were unable to generate their ideas [16]. Basic concept is very needed to solve physics problem [19]. And the other hand, the low level of creative thinking skills in elaboration indicators were caused by the unable the pre-service physics teachers to specify their ideas and unable to interpret the graphs in question [16, 20]. Data interpretation skills should be had by students to be used in problem solving in learning process [21].

Besides that, the other things were found on Figure 2 that as many as 74% pre-service physics teachers who have low category creative thinking skills in originality and flexibility indicators, 26% of pre-service physics teachers have creative thinking skills in middle category and none in high category. The low level of creative thinking on the indicator of originality was caused by the average of pre-service physics teachers’ answers tended to be the same and not dare to present the alternative answers in accordance with the presented problems. It can be seen from some of the pre-service physics teachers’ answers that early were corrected answers but they replaced with the wrong answers that are similar with their friends. Confidence and braveness to present the alternative answers are very needed to develop creative thinking skills [16]. While the low of creative thinking skills on flexibility indicator caused by the solution proposed by the pre-service physics teachers only based on a concept in text book and did not dare to relate the facts or evidence that exist with the concept that was known, so the answers were too short and did not provide information completely. In science learning included physics need scientific facts or evidences to interpret the particular occurrences [22, 23].

In addition based on figure 2, it is found that as many as 87% of pre-service physics teachers who have low creative thinking skills on problem sensitivity indicator, only 13% of pre-service physics teachers have creative thinking skills in medium category and none have high creative thinking skills on problem sensitivity. It was caused by most pre-service physics teachers did not understand the presented problems so that they were wrong in interpreting the presented problems and caused their answers or solutions were not accurate. Problem sensitivity is ability to detect, recognize and understand a situation or problems [16, 20].

The level of creative thinking skills certainly relate to the mastery of the wave energy concept in pre-service physics teachers. It was shown by analysis result in table 1 where pre-service physics teachers who have low creative thinking skills obtained low score in wave energy concept. Otherwise, pre-service physics teachers who have creative thinking skills in the middle category got higher score. This is in accordance with the research that was launched by [24] stating that the level of creative thinking skills of students greatly affects the achievement of learning outcomes. To clarify whether or not the effect of pre-service physics teachers’ creative thinking skill level on the concept of wave energy can be seen in table 1.

| Dependent Variable: Wave Energy Concept Mastery | Source         | Type III Sum of Squares | df | Mean Square | F      | Sig.  |
|-----------------------------------------------|----------------|-------------------------|----|-------------|--------|-------|
| Corrected Model                               | 514.963a       | 1                       | 514.963 | 14.714 | .001   |
| Intercept                                     | 26060.876      | 1                       | 26060.876 | 744.647 | .000   |
| Creative Thinking                             | 514.963        | 1                       | 514.963 | 14.714 | .001   |
| Error                                         | 734.950        | 21                      | 34.998   |              |        |
| Total                                         | 47376.000      | 23                      |              |              |        |
| Corrected Total                               | 1249.913       | 22                      |              |              |        |
Based on table 1 above, the value of $F_{ratio} = 14,714$ with significant numbers = 0.001 where the significant number is smaller than the significant value (0.05) and $F_{ratio} = 14,714$ is greater than $F_{table} = 4.32$. It shows that there is a difference of value between pre-service physics teachers who have low creative thinking skills with who have middle creative thinking skills in environmental physics lectures. This is similarly expressed in research conducted by [25, 26] which revealed that students who have high creative thinking skills earn high learning results as well.

4. Conclusion

Based on the discussion it can be concluded that the mastery of wave energy concept in pre-service physics teachers was very small with an average value of 44.78. As many as 78% of pre-service physics teachers have low creative thinking skills, only 12% in the middle level and none have high creative thinking skills. However, there was a difference the mastery of wave energy concept in Pre-Service Physics Teachers who have low and middle category of creative thinking skills.

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