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The Development of Sea-Wave Power Plant Model as Maritime-Based Science Instructional Media for Junior High School Students in Coastal-Areas

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Abstract : : In order for science learning to be interesting and beneficial for students, science instructions must be oriented to the student's daily environment. One way to link science instruction with the surrounding environment is by showing the application of scientific concepts to the appropriate technology. For students who live and study in coastal areas, the application of the concept of science should be linked to the sea that they observe every day. In this study a set of science learning media has been developed in the form of sea-wave power plant model. This model is designed so that it can visualize the process of using sea waves to produce electrical energy in the small scale. Expert assessment shows that the model of sea-wave power plant is declared valid so, it is suitable to be used as an instructional media for junior high school in science learning.

Keywords: Science instructional media, ocean wave power plant model, expert validity

1. Introduction

According to Schafersman (1994), science is a method of investigating nature, a way of knowing about nature that discovers reliable knowledge about it. In other words, science is a method of discovering reliable knowledge about nature. Therefore, science learning should be oriented towards investigating natural phenomena. According to Taber (2011) the experience gained from observing an object or event in the student learning environment is then interpreted so that meaning is built. The original meaning in the form of subsequent views into understanding and so on becomes new knowledge. According to Jean Piaget, children have an innate nature of curiosity and they will continue to try to understand the world around them, that curiosity motivates them to actively construct understanding through representations in their minds that are related to their daily experiences (Arends 2007).

Although a scientific approach instructions are highly recommended by the government, this method is still not optimally implemented by the teacher. Hazrulrizawati Abd. Hamid (2007) and Sumintono, et al. (2011) have identified that scientific instructions with experimental method is rarely implemented by teachers. They find that one of the obstacles is that teachers tend to pursue learning content (especially cognitive domains), lack of time for experimental methods, and lack of equipment and materials in the laboratory.

To make learning more meaningful and beneficial to students, learning should be oriented to the context of the student's daily life. Learning science will be meaningful for students if in learning the learner finds new things and after learning students can explain existing natural phenomena based on scientific concepts that have been obtained in class. Meanwhile, science learning will be useful for students if students can explain the application of scientific concepts in technology products and design or make simple technology products or solve scientific problems that surround students. In order for learning to be in the context of student life, contextual learning is seen as very important in science teaching.

According to Bern and Erickson (2001), contextual learning and teaching are defined as innovative teaching concepts that help students associate content learned with the context of life in which the content is used. According to Davtyan (2014), contextual learning activities can not only be carried out in classrooms, but also in laboratories, and other learning environments.

In order to make science learning more contextual, the researchers tried to design and develop contextual science instructional media based on coastal areas. One of the media that has been built is a model of sea wave power plants. Therefore, this study aims to design, develop, and validate the model of sea wave power plant as a maritime-based contextual science instructional media for junior high school students

2. Methodology

The development of maritime-based contextual science instructional media in this study uses the ADDIE development model. The ADDIE development model chart was adapted from Greaney & Ellis (2005) and Branch (2009), as shown in Figure 1.

In this study two stages of the ADDIE model were carried out. This is because the initial stage or phase of analysis has been carried out and has been reported in previous publications. Meanwhile, the implementation and evaluation phase has not been done by researchers, yet. The results of the analysis phase indicate that this maritime-based instructional media is needed for learning science in coastal areas because the cognitive abilities and scientific process skills of students in the region are still low (Zulirfan, et al., 2018). The phases that will be reported in this article are the design phase and the development phase.

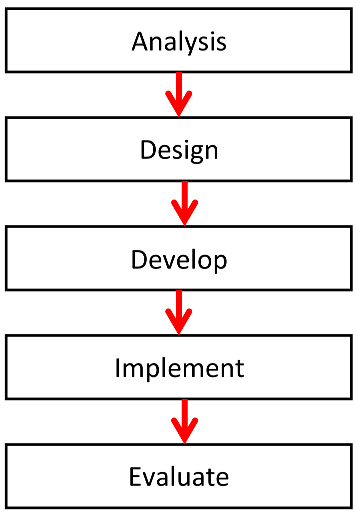

Figure 1. Flow chart of ADDIE Model

Based on needs analysis and curriculum analysis, the researchers designed contextual science learning media in the form of sea-wave power plant models. Then the model is made base-on to the design. The model that has been built is then tested for its function. After the model functions properly, the model will be assessed by science education experts.

3. Result and Discussion

The instructional media design in the form of a sea-wave power plant model is shown in Figure 2. According to the Figure 2, it can be seen that the media to be developed should be transparent so that students can easily observe the process of using sea-wave energy. Besides that, students can also see directly the energy conversion process from one form to another.

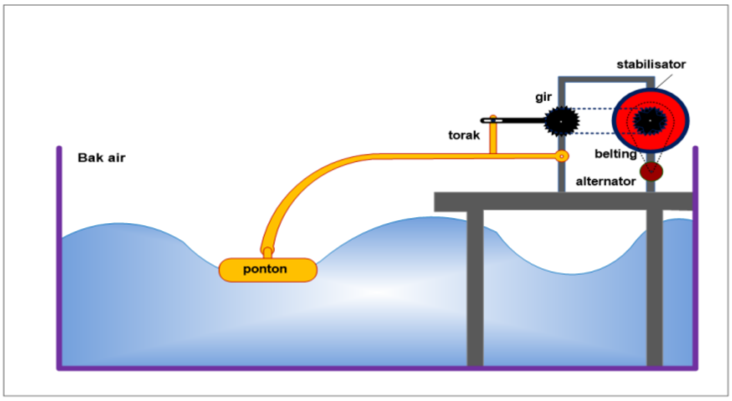

Figure 2. The Design of Sea-Wave Power Plant Model

Figure 2 also shows that Sea-Wave Power Plant Model consists of several important parts, namely:

1. A container made of transparent material (acrylic) which functions as a place for sea water.
2. Alternator device. The stand is made of acrylic. Alternator functions as a modifier of mechanical energy into electricity. Alternator consists of a system of conversion of wave energy into kinetic energy.
3. Buoy system, function to get the wave swing so that it can rotate the dynamo. Buoys made of bottles that fit the lever made of acrylic.
4. The wave generator lever serves to make a disturbance to the water so that it forms a wave.
5. The output system is in the form of LED lights.

After design phase, then the media entered the development stage. Development begins with building a container of water. Containers are made of acrylic so the container wall becomes transparent. Alternator is selected to fit the float of the buoy. Wave generators are needed to produce water waves in the tank representing the actual ocean waves. Figure 3 shows a model of sea-wave power plat that has been developed.

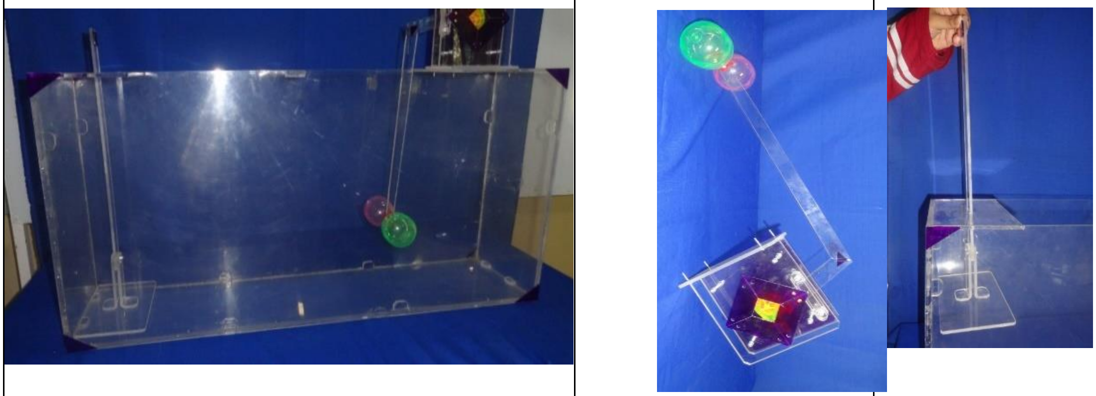

Figure 3. Model of Sea-Wave Power Plant (left) with buoy system (middle) and wave-raising system (right)

Some of the difficulties that we have encountered in developing this media properly are:

- Find the appropriate size of the container so that it can form sufficient waves to oscillate the buoy. This trial to get a suitable container size causes a lot of material to be wasted and adds to the worker's work.
- Get the appropriate float. This is because the float and its lever must be able to follow the wave pattern.
- Get the appropriate alternator or energy conversion system.

After the model is developed and functioning, the model is then validated by 3 scientific education experts. Experts were asked to assess and provide recommendations for improvements to the model that had been built as a science instructional media for junior high school students in the coastal area. Expert validation results are shown in Table 1.

Table 1. Expert Judgement for Sea-Wave Power Plant Model

No	Aspect	Items number	Mean score	Decision
1	Suitable to student characteristics	3	3.78	Valid
2	Ease of use	3	3.33	Valid
3	Persuasive and Security	2	3.84	Valid
4	Contextual and Constructive	2	3.84	Valid
5	Technology Integration	2	3.67	Valid
6	Equipment functions technically	3	3.67	Valid
Experts validity index			3.69	Valid

Table 1 shows that the three experts gave an average mean score for each aspect of assessment between 3.33 to 3.84 from a maximum scale of 4. This shows that the model has met the feasibility of all aspects. Experts state that this model is in accordance with the characteristics of junior high school students, the model is easy to demonstrate, and attract attention and harmless.

Experts also state that the model is in accordance with the context of students' daily lives and can help students in constructing their science knowledge. Zulirfan, et al. (2018) asserted that

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the process of science teaching should be contextual, meaning that scientific activities are directed to observe the natural phenomena around it. Experts also agree that the model can show the integration of scientific concepts with technology and most importantly the model has functioned technically. In general, the Sea-Wave Power Plant Model that was developed in this study was declared valid by experts with a validity index of 3.69. These results provide recommendations to researchers to conduct a limited trial to students in coastal areas directly to find out their response.

4. Conclusion

Maritime-based contextual science instruction media for junior high school students has been successfully built in this study. This instructional media is in the form of a Sea-Wave Power Plant Model. This instructional media has undergone a process of validation of science education experts. The expert validity index for this media is 3.69 from a 4.0 scale. This figure states that the Model of the Sea-Wave Power Plant is declared feasible as a science instructional media for junior high school students in coastal areas.

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