

RESEARCH ARTICLE | NOVEMBER 07 2019

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AIP Conf. Proc. 2169, 020014 (2019)

<https://doi.org/10.1063/1.5132649>



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Renewable Energy Props Development

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Abstract. Against the background of the findings in the field that renewable energy props are still very limited in availability and use. In line with this, the purpose of this study is to develop renewable energy teaching aids for high school students. The research methodology used is research development and literature review. The development model used in this study is Borg and Gall. The instrument used in this study was a questionnaire. Validation is carried out by material and media experts. The validity results are calculated using the Product Moment formula, while the reliability is calculated by the KR-20 formula. Props that have been successfully developed in the form of miniature houses with solar-based electricity and mechanical energy on the roof. This trainer is equipped with a charge to store electrical energy, lights, fans and bells as an output indicator. Make it easy for students to change the angle of light coming or falling objects making it easier for students to take data to compare the electrical energy produced at different angles and heights of falling objects.

INTRODUCTION

The government led by the Ministry of Energy and Mineral Resources is aggressively encouraging the use of renewable energy through various policies in this regard. The Ministry of Education as part of the government has accommodated the inclusion of basic competencies regarding renewable energy in the 2013 curriculum.

Renewable energy is energy that is produced from natural sources such as the sun, wind, and water and can be produced again and again. Resources will always be available and do not harm the environment. Renewable energy comes from natural elements that are available on earth in large quantities, for example: the sun, wind, rivers, plants. Renewable energy is the cleanest energy source available on the planet. Renewable energy sources can be utilized to overcome the problem of electrification limitations. These sources can be used as alternatives to electricity dependency on PLN supplies [1].

Learning about renewable energy is the first step to achieving energy security in the future. With the integration of renewable energy materials in physics subjects in the 2013 curriculum, it is hoped that Indonesia, which is rich in renewable energy sources, can escape the dependence on fossil energy sources.

One of the obstacles faced in learning physics, is the process of learning physics is often confronted with an abstract material. Physics lessons still seem difficult to understand because some material has abstract concepts and sometimes students do not easily relate to everyday events in human life [2].

One of the learning efforts that can provide more concrete experiences is learning assisted by science teaching aids. Even though it is simple in physical appearance, it can support the working principles and concepts of science taught so that it can help students understand concepts [3]. The use of science aids is expected to make it easier for students to understand the concepts contained in science material and can learn something abstract to be concrete or real [4].

Renewable energy learning is ideally based on practicum with learning media that illustrates the implementation of renewable energy in everyday life. But in the initial observation, there are still several obstacles to practice

renewable energy materials by observing equipment in the laboratory and interviews with students and some physics teachers in several high schools in Jakarta. Problems found by researchers include:

1. Unavailability of renewable energy learning media in laboratories in some schools.
2. Media Learning existing renewable energy does not significantly apply the utilization of renewable energy sources for household needs so learners have difficulty understanding the use of renewable energy in daily life.



FIGURE 1. Pudak Scientific Renewable Energy Kit

Based on the results of the initial observation, it is deemed necessary an effort to develop renewable energy learning media that can significantly apply the utilization of renewable energy sources for household needs and seek New innovations to maximize the ability of learners. Using the media appropriately and varied will lead to the spirit of learning of learners and encourage learners to improve their thought creations so that the learning outcomes will increase.

Research Purpose

The purpose of this research resulted in learning media as a renewable energy props in the form of miniature houses by utilizing solar and mechanical energy as a power source.

METHODS

The research methods used were Research and Development (R & D) according to Walter R. Borg, Meredith D. Gall, and Joyce P. Gall with modifications. Development Research (R & D) is a process used to validate educational products. The steps in the process constitute a research and development cycle consisting of: a study of previous research results related to the validity of components on the product to be developed, developing products Based on the findings, do the field trials in accordance with the background in which the product will be used, and review and revise the product based on the results of the field trials [5].

The following are the steps to research the development of renewable energy AIDS:

Phase I Preliminary Studies Research

1. Observation (necessity analysis and preliminary study)

This stage is done to conduct field studies, literature, and identify problems that arise in learning so that the development of renewable energy AIDS is needed. Data collection is conducted through surveys, reviewing literature, and previous research results.

Phase II Product Development

2. Planning development model of renewable energy props

At this stage, the initial design set of renewable energy props to solve the problems found at the previous research stage. The things that are done, among others, set the design of the model props, identifying the activities undertaken at each stage of the research and testing the feasibility of model design of renewable energy props in

the limited coverage area. The feasibility test for model design of renewable energy AIDS is carried out by asking media experts for consideration, and material through discussion.

Props that will be developed is a miniature house that uses renewable energy sources as an alternative source of electricity. The renewable energy source used is solar energy by utilizing solar cells as the sun's light energy converter into electricity and mechanical energy by utilizing a piezoelectric transducer as a mechanical energy converter into Electric.

Props are developed in such a way that can describe the process of "Energy Harvesting", ranging from the conversion of energy sources to electricity, the storage of electrical energy generated, to its use for the needs of such as lighting, bells and fans.

3. Early product development model of renewable energy props

At this stage built the initial form of a model of renewable energy props, and drafted devices (the manual of the use of renewable energy props and data collection instruments) needed to gather all information during the use of Renewable energy aids in learning.

Prior to the next stage, the teaching aids will be tested by physicist learning and physicist, to determine the validity of the theoretics.

Stage III field Trial and revision

4. Preliminary product test of renewable energy props model

At this stage, the initial product from the previous step was tested to a small group of 10 randomly selected learners and validations by experts (learning and expert media experts). These preliminary product trials are intended to identify obstacles that may be encountered in the operation of props by learners. The device used to collect data at this stage is a questionnaire. The Data obtained is then analyzed and evaluated to improve the props model. The valuation scale used is the Likert scale, which consists of five categories:

Very good	(score 5)
Good	(score 4)
Moderate	(score 3)
Not good	(score 2)
Very not good	(score 1)

Final assessment is calculated based on each item's acquisition score:

$$\% \text{ Interpretation Score} = \frac{\sum \text{Score Acquisition}}{\sum \text{Maximum Score}} \times 100\%$$

0-20%	: Very not good
21%-40%	: Not good
41%-60%	: Moderate
61%-80%	: Good
80%-100%	: Very good

5. Early product improvement of renewable energy tools model

At this stage, improvements were made based on the results of the initial product test of the model of renewable energy props by analyzing the deficiencies found in trials and inputs for improvement of both the advisers and the specialist and media experts.

6. Early product improvement of renewable energy tools model

At this stage, the original product model of the revised props based on the previous stage was tested back to a large group of 20 randomly selected learners (without re-participating 10 learners Involved in previous stages) and validation by experts (Learning media experts and material experts).

7. Repair product model of renewable energy tools

At this stage, a revision is carried out based on the results of a large group test by repaying the input from experts and mentor lecturers. This is done especially if new constraints are found after large or unidentified group trials during planning.

8. Product field trials of renewable energy tools model

After the test and revision in the previous stages, implementation model of renewable energy props is done in a larger area that involves a class where used in learning the basic competencies "understanding Limited energy resources and their impact on life ". At this stage, data collection is done through polls with learners as respondents.

9. Final improvement of renewable energy tools model

At this stage, before the model of renewable Energy props published a wider user, re-done the revision to correct the shortcomings that may be encountered in the previous stage so that the implementation of the model This renewable energy props are becoming better. Expected after this stage, the model is completely free of flaws and deserves to be implemented on learning.

10. Dissemination and publication of renewable energy tools

At this stage, the results of development research of renewable energy aids are socialized through scientific forum, for example national Seminar on Physics (SNF) 2019.

RESULTS AND DISCUSSION

Renewable energy props that have been developed successfully in this Pelitian in the form of miniature houses with electricity derived from renewable energy. The characteristics of this research development results are as follows:

1. Miniature House of the embossed acrylic material with dimensions 40 cm × 35 cm × 37 cm can be disassembled pairs to train motoric students.
2. Miniature Elektrification House implements the utilization of renewable energy, through the use of solar cells (solar radiation energy) and piezoelectric cells (mechanical energy) on the roof of the house.
3. The electrical energy obtained from the solar cells is stored in the electric storage device in the form of three pieces of lithium Ion 3.7 V batteries that are composed in series.
4. Electrical energy that is designed from the piezoelectric cells is stored in the electrical storage device in the form of 1 mF capacitor that can be arranged in parallel (maximum 10 pieces).
5. Output on miniature house in the form of lighting with four LED lights, fan, buzzer, and USB slots for HP charger.
6. The angle on the roof equipped with solar cells can be changed to determine the effectiveness of electrical energy that can be produced by the angle of coming light on the surface of solar cells.
7. Angles on the roof equipped with piezoelectric cells can be altered to determine the effectiveness of electrical energy that can be produced by collision angles against the piezoelectric surface of the cell.
8. The battery voltage, solar cell, and capacitor on the piezoelectric cells are measured digitally on a device controller.

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8. The battery voltage, solar cell, and capacitor on the piezoelectric cell are measured digitally on a device controller.

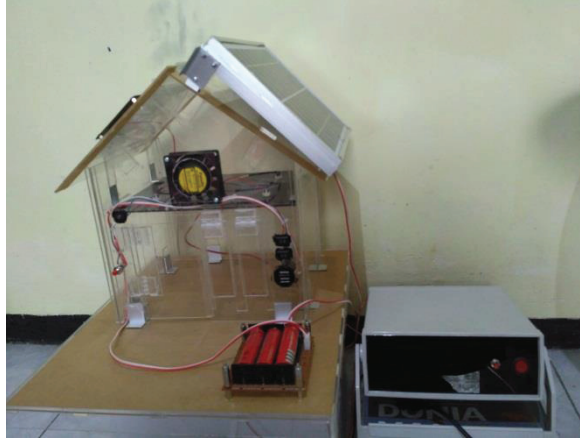


FIG 2. Renewable Energy Props Research results

The average validation results by teachers, media experts lecturers and material expert lecturers show that the learning media results are very good. The media aspect has an average value of 90.00 while the material aspect has an average value of 93.06. The results of validation by Guru have an average of 93.14 values.

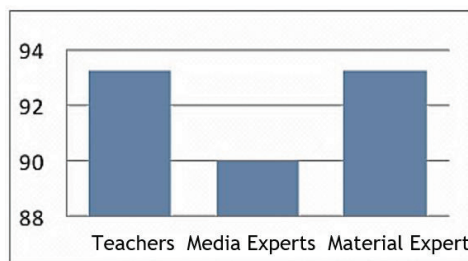


FIG 3. Graphic Props Validation Results

CONCLUSION

According to the outcome and discussed above, then it can be concluded that:

The development of renewable energy props can be used as a physics learning media in schools. A renewable energy props development results in a simple process of energy utilization in the sphere of electricity use in daily life.

ACKNOWLEDGMENT

The research is fully funded by personal researcher. We are grateful to our colleagues from the State University of Jakarta and the Kartika VIII-1 Senior high school Jakarta who are very helpful and greatly assisted the research.

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